MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

STATE FOREST LAND MANAGEMENT PLAN

FINAL ENVIRONMENTAL IMPACT STATEMENT

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EXECUTIVE SUMMARY

THE PROPOSED PLAN

The Trust Land Management Division of the Montana Department of Natural Resources and Conservation proposes to implement a State Forest Land Management Plan (Plan) to provide field personnel with consistent policy, direction, and guidance for the management of state forested lands. The Plan will apply to the forested lands portion of the total 5.2 million acres of school trust lands administered by DNRC. The forested land portion totals 662,000 acres.

The Department also proposes to adopt a list of types of actions that qualify for categorical exclusion from the preparation of an Environmental Assessment or Environmental Impact Statement, unless extraordinary circumstances occur.

SCOPE OF THE EIS

This is a programmatic plan. Several alternatives were developed as philosophies and approaches to the management of state forested lands. The selected alternative will provide policies and guidelines for managing state-owned forest lands.

The Plan will not address site-specific issues nor make specific land use allocations. It will contain the general philosophies and management standards that will provide the framework for our project-level decisions. We do not guarantee any projection of outputs, products, or services from implementation of the selected alternative, although we have created plausible scenarios (presented as ranges) as a basis for predicting environmental effects.

In accordance with MEPA rules (ARM 26.2.652(5)), the Director of DNRC will select a final alternative fifteen days after the FEIS has been transmitted to the Governor, the Environmental Quality Council and the public. The selected alternative will be made available to all interested parties in the form of a document called a Record of Decision (ROD). In addition to the required elements per MEPA (ARM 26.2.658), the ROD will include all of the elements of the selected alternative necessary for implementation (i.e., philosophy statements and resource management standards). The ROD will, in essence, become known as *the State Forest Land Management Plan.*

The selected alternative will provide a guiding framework for proposing and analyzing site-specific projects. The resulting Plan and this FEIS will be useful reference documents that will make site-specific decisions more efficient by helping us remain consistent with our overall management philosophy, and by saving needless repetition of the reasoning behind policy decisions that have already been made. However, neither the EIS nor the Plan will substitute for public involvement and proper analysis and documentation in future project-specific decisions.

SUMMARY OF CHANGES BETWEEN DEIS AND FEIS

Please note that recently the State Legislature instituted a reorganization of several state departments. As of July 1, 1995, the Department of State Lands (DSL) was merged with the Department of Natural Resources and Conservation (DNRC). In addition, the Forest Management Bureau was transferred to the new Trust Land Management Division. The FEIS has been amended to reflect these changes.

On June 19, 1995, we released the State Forest Land Management Plan Draft Environmental Impact Statement (DEIS) to the public for review. The comment period lasted for 45 days and closed on August 4, 1995. One hundred seventy-four comments were received. In addition, testimony was recorded at public hearings held in Billings, Bozeman, Kalispell and Missoula. A summary of the public comments and our responses are in Appendix RSP of this Final Environmental Impact Statement (FEIS).

After careful evaluation of the public comments and staff concerns an additional alternative, named Omega, was developed for consideration. Alternative Omega is a hybrid of the previously identified preferred alternatives in the DEIS: Beta, Delta and Epsilon.

This FEIS contains the original content of the DEIS, with modifications based on new information and response to comments. Several issues were identified by the public which precipitated changes, including categorical exclusions, road management and the resource management standards (RMS). We have dropped three categorical exclusions from further consideration in this Plan: timber harvest, timber stand improvement and prescribed fire. The road management standards were amended to clarify policy on road closures under each alternative. Additions and amendments were also made to other resource management standards. For instance, the Fisheries RMS were expanded to include an explanation of Recommendation #17 of the Flathead Basin Forest Practices and Fisheries Cooperative Program for the protection of bull trout and westslope cutthroat trout, as well as the Immediate Actions developed by the Governor's Bull Trout Restoration Team. The Sensitive Species and Threatened and Endangered Species RMS were modified to further clarify our policy in these areas.

Other changes, clarifications and corrections have been made to the text, including the incorporation of the Omega alternative into existing narrative, tables and figures.

LEGAL AND ADMINISTRATIVE FRAMEWORK

LEGAL

Federal lands, called trust lands, were granted to the state when Montana was admitted into the Union. Montana's Constitution requires that trust lands be managed to provide revenue to support schools. The courts have consistently upheld this requirement.

However, trust land managers have some discretion in meeting the broad trust management goal. That discretion is necessary because managers are required to not only satisfy trust principles, but also to comply with other constitutional requirements and state and federal statutes. Specifically, Montana's Constitution allows that it is within the discretion of trust land managers tomanage for long-term income, even at the expense of immediate or short-term returns.

ADMINISTRATIVE

State trust lands are legally assigned to one of four "highest and best use" categories: Forest, Grazing, Agricultural, or Other. The "Other" category includes such things as administrative sites and would not be affected by the proposed Plan. The Forest Management Bureau of the Trust Land Management Division directs the management of classified Forest lands and has assumed lead responsibility for the State Forest Land Management Plan. By agreement with the Agriculture and Grazing Management Bureau, the Forest Management Bureau is also responsible for those portions of Grazing and Agricultural lands on which forestry expertise is appropriate. The proposed Plan would address only responsibilities of the Forest Management Bureau.

Several other government agencies and landowners could be affected by implementation of the proposed Plan. For example, the Montana Department of Fish, Wildlife and Parks (MDFWP) is responsible for managing fish and wildlife populations within the state and consequently must collaborate with DNRC's management. Large private industrial forest landowners could also be affected by the proposed Plan. There could be changes in the state's policy regarding granting rights-of-way, managing cumulative environmental impacts, and otherwise coordinating with adjoining landowners. The timber industry could be affected by changes in the timber supply from state lands.

ISSUES THAT WILL AFFECT THE SELECTION OF A FINAL ALTERNATIVE

We identified two major sets of issues that will affect selection of an alternative: (1) those raised by our own employees, and (2) those raised by the public and other agencies. The issues raised by our employees can be found in the Project Record. They include questions about Department management framework and policies, resource management and allocation, resource valuation, marketing, managing across ownerships, and categorical exclusions. Many of these questions will be answered by the Plan, while others will be answered outside the Plan, during implementation training and elsewhere.

ISSUES RAISED BY THE PUBLIC AND OTHER AGENCIES

The following thirteen issues emerged from responses to a public mailing and were affirmed by a series of public meetings.

1. ACCESS: Public concerns include the public's right to use state forest lands, the need to maintain or develop rights-of-way across private and federal ownerships, and the importance of developing permanent, legal access to all state tracts.

2. ROAD MANAGEMENT AND MAINTENANCE: The extent of forest road development has generated considerable public discussion. Road development may affect wildlife security and adversely impact water quality. However, roads are viewed by some as an asset to forest management, protection, and recreational access.

3. COORDINATION AND COOPERATION: There is general agreement that increased coordination and cooperation among adjacent landowners would be beneficial and efficient. Activities on state lands are not always compatible with adjacent landowners' management. Effects of adjacent landowners' activities may impose constraints on management activities on state lands.

4. WILDLIFE: There is increasing public sentiment to recognize the importance of wildlife values. Big game hunting contributes an increasing percentage of the state's economic base. Non-game species are an integral part of forest ecosystems. Many people place a very high value on preserving wildlife habitat, while others believe that wildlife values may be enhanced, or at least maintained, through proper management and other commodity uses.

5. WATERSHED MANAGEMENT: Many people believe that forest practices should be conducted in a manner that protects water quality. However, there is disagreement over what practices constitute an adequate level of protection.

6. WEED MANAGEMENT: The spread of noxious weeds has become an important statewide issue. DNRC must comply with weed management laws. Some people believe DNRC should share the cost of weed control and suggest that a variety of uses could share the cost of control. Others are concerned about the potential effects of using chemicals to control weeds.

7. GRAZING: Livestock grazing is a traditional use of state land that is becoming controversial. Forest grazing can impact water quality, riparian habitat, and understory vegetation. Some people believe that DNRC should manage livestock grazing more closely.

Others believe that grazing is a valuable revenue-producing use with which other less productive uses should not interfere.

8. TIMBER MANAGEMENT: There are strong sentiments both for increasing and for reducing the amount of timber to be harvested from state lands. Some argue that harvesting timber at the maximum sustainable level would optimize trust revenue. Others believe that reducing timber harvests would benefit ecosystem health and provide higher quality timber for future harvest when timber values are higher.

9. CLEARCUTTING: There is strong sentiment for minimizing or eliminating the use of clearcutting. However, some people believe clearcutting, appropriately used, is a beneficial and cost-efficient silvicultural tool.

10. ECOSYSTEM INTEGRITY: There is public concern regarding the impact of timber harvests on overall ecosystem health. Some people believe protection of old-growth forests and maintenance of natural forest characteristics should be a priority. Others believe old-growth forests are biologically unhealthy and that individual dead or dying trees should be harvested to use the resource before it is wasted.

11. TRUST MANAGEMENT POLICY: Some people believe environmental protection measures should not interfere with trust revenue production. Others believe that environmental protection must come before trust income.

12. PUBLIC INVOLVEMENT AND PLANNING: Some people believe that a sincere and aggressive public involvement effort would prevent domination by special interest and political pressures. Others believe that excessive public involvement may lead to unwise or political decisions that are contrary to DNRC's management goals and trust responsibilities.

13. RECREATIONAL OPPORTUNITIES: There is broad public interest in maintaining a variety of recreational opportunities on state land, but disagreement about the amounts and types of fees to be charged and the extent and types of activities that should be promoted.

THE ALTERNATIVES

We originally developed six alternatives through a process of internal discussion, public discussion, development of preliminary concepts, and a rigorous screening process. After release of the DEIS, a seventh alternative, Omega, was developed based on public comments and input from our staff. The narratives below explain the core concepts of each alternative. Each approach represents differing beliefs and assumptions as to the best way to meet the trust mandate.

ALPHA

This is the way we do things now, and it is the path we would continue to follow in the absence of major changes in legislative or policy direction. We would provide income to the trust by marketing a sustainable harvest of forest products while allowing other revenue-generating uses, such as grazing and cabin-site leasing, in response to applications initiated by the public.

We would meet legal and/or generally accepted standards of environmental protection. Existing standards and guidelines, and all other current plans, would remain in effect. Standards and guidelines would be modified or expanded when conditions warranted such action.

Each land office would have an annual timber sale target. Proposals for dominant land uses other than timber management would normally be initiated by the public or other agencies. We would respond to special use proposals as we had time, but our highest priorities would be activities that supported the timber program.

This allocation of time would result in the continuation of timber management as our dominant land use, with other uses developed primarily in response to outside demand.

BETA

Under Beta, we assume that intensive management would promote healthy and productive ecosystems while yielding greater long-term income than natural processes alone would produce. We would promote an ecologically diverse, resilient, and productive forest. Managing for diversity of stand structures would provide a sustainable yield of timber and other outputs whose cumulative value would exceed that from timber alone.

Timber harvest would play the dual role of directly generating revenue, as in the past, while also serving as our primary tool for producing the desired range of stand structures and patterns. We would also use other measures to enhance environmental quality. Because diverse wildlife habitat would be supported by managing for a variety of forest conditions, we would de-emphasize standards for individual species.

Each land office would have annual goals which would include a timber sale target as well as goals for marketing other uses. Many of these goals would include the use of timber harvest as a tool. For example, forests dominated by immature second-growth timber might be thinned to produce small logs and pulpwood, reducing stand stress levels and hastening development of old-growth features and high-value forest products. In areas with considerable old-growth, some stands might be managed on long rotations to perpetuate old-growth, while others might be managed on shorter rotations to produce high yields of timber.

Our goals would be to pursue income opportunities from old-growth and other distinctive features without using timber harvest. These activities could include fee-based wildlife viewing, environmentally-friendly recreation developments, conservation easements and leases, and educational programs.

GAMMA

An underlying assumption of Gamma is that growing population and a fixed land base will cause the value of forested lands to be driven high enough that a diverse array of small annual yields from natural ecosystems will produce the greatest possible long-term average trust income. Current uncertainty in the politics of natural resource allocation makes it smarter for us to preserve the widest and richest possible array of future options, rather than maximize revenue in the short run and risk significantly limiting future options.

Under Gamma, our program direction would emphasize restoring and maintaining natural ecosystems under the assumption that we can do little to improve on nature's ability to sustain a productive and healthy ecosystem. We would expect relatively small marketable yields each year, but would expect the quality and diversity of marketable opportunities to grow rather than diminish with passing time.

In most cases, the dominant land uses would be activities that maintained or enhanced undeveloped forest conditions. Program goals might include a target income from dispersed recreation fees or leases, development of fee-access wildlife observation blinds, or timber harvest on some number of acres to simulate the effects of wildfire where fire protection had altered natural conditions.

We would emphasize activities that did not substantially change the appearance or function of the naturally occurring forest, such as hiking and wildlife watching and campgrounds that affected only small areas while serving as a base for other activities. We would use timber harvest as a tool to approximate naturally occurring events such as fires, or to rehabilitate areas that had been altered in the past and were in poor condition. Low-impact harvesting could be used as an income source when it was clearly compatible with natural succession.

On lands that are already developed or surrounded by development to the point that restoration of natural conditions would be impractical, the dominant use would be that which best supported this philosophy.

DELTA

Under this alternative, we assume that the greatest long-term average return would come from competitively marketing our resources, focusing on flexibility, creativity, and attention to financial rate of return. Forest land management would be strongly influenced by market conditions.

We would inventory potential money-making opportunities and use financial analysis as the first indicator for initiation and timing of projects. Our decisions would balance our response to changing market conditions with maintaining technical adaptability, so that we would not abruptly drop one activity to begin another. However, we would be strongly influenced by market conditions such as cycles in demand and price for commodities or unique recreational demands. Dominant land uses could shift with changing market trends, but we would not normally make disruptive changes in response to temporary market variations. This approach would emphasize a high degree of flexibility in choosing dominant land uses.

From our inventory of potential money-making opportunities, we would list those that could be marketed and which would not have clearly unacceptable environmental impacts. Opportunities under Delta might include exclusive timber management rights for a specified term on certain blocks of our ownership; development rights on a parcel of waterfront land with high recreation potential; leasing an entire drainage with substantial low-elevation old-growth to a coalition of environmental groups; or a land exchange program designed to increase the average income-producing value of our holdings.

Lands identified for high recreation and wildlife values could be marketed by several different methods: (1) competitive bidding, (2) soliciting Requests For Proposal, (3) issuing licenses that set fees as a percentage of gross profit, or (4) leasing general recreation rights based on outside requests. We would attempt to provide resident and non-resident recreational opportunities, realizing that the highest revenue potential probably would come from developments that would attract non-residents. Other recreational opportunities on non-leased or non-licensed sites would remain available to the general public at a minimal fee.

If a particular tract did not appear to have any potential that could be readily marketed by DNRC, it could become a candidate for exchange or simply be held for the future with little or no current management. We would also conduct an active land exchange program to consolidate our holdings into blocks if we could manage them more efficiently than scattered parcels.

We would meet the minimum acceptable standards of environmental protection. In cases where the standards allowed discretion, we would accept some adverse environmental effects in order to earn larger long-term monetary returns to the school trust. In cases of uncertain environmental impacts, we would take some risk in favor of earning greater monetary return.

EPSILON

Under this program, we assume that the relative market value of timber, the existence of a manufacturing and marketing infrastructure, and our own technical expertise and long experience give us a natural advantage that makes timber management the best way to maximize long-term average trust income. Consequently, we would formalize timber marketing as our primary business. Our main program goal would be to offer the harvest level and mix of sales most appropriate for current market conditions and long-term sustainable yield.

Other revenue-generating activities such as grazing and cabin-site leasing could be allowed in response to applications initiated by the public, as long as they did not substantially interfere with our timber marketing program. If a proposal came to us we would, as time permitted, consider its environmental impacts and revenue potential, as compared to timber harvest on the same lands. If the proposal clearly offered better long-term prospects than timber management on those lands, we would grant approval.

Lands that were not suitable for profitable timber management would either be managed for the next most profitable use that did not conflict with present or future timber harvest, be considered for exchange, or be held for the future with only minimal management.

We would meet the minimum acceptable standards of environmental protection. In cases where the standards allowed discretion, we would accept some adverse environmental effects in order to earn larger long-term monetary returns to the school trust. In cases of uncertain environmental impacts, we would take some risk in favor of earning greater monetary return.

ZETA

Under this program, we assume that changing social values, an increasing demand for quality outdoor experiences, and our status as a large forest land manager put us in a unique position to maximize long-term average trust revenue by specializing in marketing outdoor recreation and wildlife-related opportunities. Our program direction would emphasize wildlife and recreation management first and other activities only to the degree that they did not conflict with, or would enhance, these primary resource values.

We would inventory opportunities for making money through emphasizing recreation and/or wildlife management. Under this strategy, we would concentrate our efforts on initiating and actively marketing proposals that would provide income from wildlife and recreation management.

Lands identified for high recreation and wildlife values could be marketed by several methods: (1) competitive bidding; (2) soliciting Requests For Proposal; (3) issuing licenses setting fees as a percentage of gross profit; or (4) leasing recreation rights based on outside requests. We would attempt to provide resident and non-resident recreational opportunities, realizing that the highest revenue potential may come from developments that would attract non-residents. Other recreational opportunities on non-leased or non-licensed sites would remain available to the general public at a minimal fee.

Proposals from outside the agency could displace wildlife/recreation use, but their revenue potential and environmental impacts would have to be more favorable than those expected from recreation or wildlife management.

Lands that did not have marketable wildlife or recreation potential could be managed for the next most profitable use as long as doing so would not diminish wildlife or recreation opportunities for the future. Management for other uses would be handled in ways that maintained or enhanced future wildlife/recreation potential. For example, grazing leases could pay special attention to protecting riparian areas, prairie dog communities, or access roads.
We would exceed minimum environmental protection standards only when doing so would enhance wildlife and recreation economic values.

OMEGA

The Omega alternative was developed using Beta as a philosophical base and then combining elements of Beta, Delta and Epsilon. Specific issues of concern were addressed, including, managing threatened, endangered and sensitive species; implementing a management plan on scattered versus blocked state ownership; meeting landscape-level analysis objectives in a cost-effective manner; managing timber resources, including old-growth; and pursuing non-timber income opportunities.

Under this program, we assume that the best way to produce long-term income for the trust is to manage intensively for healthy and biologically diverse forests. Our understanding is that a diverse forest is a stable forest that will produce the most reliable and highest long-term revenue stream. Healthy and biologically diverse forests would provide for sustained income from both timber and a variety of other potential uses. They would also help maintain stable trust income in the face of uncertainty regarding future resource values.

We would take a 'coarse filter' approach to biodiversity by favoring an appropriate mix of stand structures and compositions on state lands. This approach supports diverse wildlife habitats. Because we cannot assure that the coarse filter approach will adequately address the full range of biodiversity, we would also employ a 'fine filter' approach for threatened, endangered and sensitive species.

In the foreseeable future, timber management would continue to be our primary source of revenue and primary tool for achieving biodiversity objectives. By promoting biodiversity, we would be protecting the future income-generating capacity of the land by maintaining or restoring healthy and productive ecosystems.

Prescribed fire will play a larger role in Omega than in any of the other alternatives. Restoration of historical forest conditions to the landscape requires that prescribed burning be among the management tools available. For centuries, fire was the predominant disturbance agent on the landscape. The last several decades have seen timber harvest replace fire as the primary disturbance agent in our forests. This has caused shifts in species compositions and the representation of various forest cover types.

Within this alternative, fire may be prescribed as an underburn treatment in some types of stands, or as a post-harvest treatment in other types. We would continue to suppress wildfire, however. The Biological Diversity Strategies for Forest Type Groups attachment (see Appendix RMS) would serve as a guideline describing situations where we may use prescribed fire.

We would pursue other income opportunities as guided by changing markets for new and traditional uses. These uses may replace timber production when their revenue exceeds long-term timber production revenue potential. Where we pursue non-timber uses, we may not comply with the biodiversity elements of this alterative. However, because we expect these other income opportunities to occur on a minor amount of the forest acreage, these uses would not compromise the overall fundamental premise of managing for biodiversity.

SUMMARY OF RESOURCE MANAGEMENT STANDARDS

We have drafted Resource Management Standards (RMS) to be applied under each alternative. RMS were developed for Biodiversity, Silviculture, Road Management, Watershed, Fisheries, Threatened & Endangered Species, Sensitive Species, Big Game, Grazing on Classified Forest Lands and Weed Management. These standards, summarized here, take into account the alternatives' different management emphases. This summary presents the major differences between RMS as they would be applied under each alternative. The complete RMS can be found in Appendix RMS.

BIODIVERSITY RESOURCE MANAGEMENT STANDARDS

Alpha

- DNRC would normally use management practices that sustain site productivity and reduce the risk of losses due to damaging agents, which may help promote certain elements of biodiversity, but promoting biodiversity itself would not be a primary goal.
- On projects where elements of biodiversity are identified as issues, DNRC would evaluate these elements at a landscape level. These evaluations must consider all ownerships and identify opportunities to mitigate impacts while meeting project objectives.
- Where landscape evaluations identify opportunities to mitigate biodiversity impacts, DNRC may incorporate such measures into management activities if there is a known connection to long-term timber productivity, or if it would prevent significant environmental impacts.
- DNRC would not initiate cooperative ecosystem management planning with adjoining landowners, but may participate if initiated by others as long as it would promote long-term trust revenue opportunities.
- Interim old-growth standards for Stillwater, Coal Creek, and Swan River State Forests would no longer be in force upon Plan adoption.

Beta

- DNRC would promote biodiversity by favoring a variety of stand structures and patterns on state lands, thus maintaining representation of habitats for native plant and animal species.
- When land management activities are being considered, DNRC would evaluate the distribution and arrangement of stand structures at a landscape level. These evaluations would consider all ownerships and identify opportunities to promote a desirable distribution of stand structures and patterns.
- DNRC would use information from landscape evaluations to design management activities so that they will maintain or promote a favorable distribution of stand conditions. Timber harvests will be designed to promote the long-term diversity and balanced representation of forest conditions across the landscape.
- DNRC would make reasonable attempts to develop cooperative ecosystem management planning with adjoining landowners.
- We would seek to maintain and restore old-growth in at least half the amounts expected to occur on state lands with natural processes in similar types of forest.
- We would not maintain additional old-growth to compensate for its loss on adjoining ownerships, unless agreed upon in cooperative ecosystem management plans.

Gamma

- DNRC would promote biodiversity with management activities that maintain and restore natural ecological characteristics.
- When land management activities are being considered, DNRC would prepare landscape-level biodiversity plans for specific actions that would promote natural ecological characteristics that promote biodiversity.
- All management activities would be consistent with actions identified in the landscape-level biodiversity plans.
- DNRC would attempt to develop cooperative ecosystem management planning with adjoining landowners.
- DNRC would seek to maintain old-growth in amounts consistent with natural processes in similar forest types. Old-growth conditions would be developed or maintained on enough additional acres to provide for replacement of existing old-growth over time.

Delta and Epsilon

- DNRC would normally use management practices that would sustain site productivity and reduce the risk of losses due to damaging agents. Some of these practices might help promote certain elements of biodiversity; however, promoting biodiversity itself would not be a primary goal except where it provided direct trust income.
- On projects where elements of biodiversity are identified as issues, DNRC would evaluate these elements at a landscape level. These evaluations must consider all ownerships and identify opportunities to mitigate impacts while meeting project objectives.
- Where landscape evaluations identify opportunities to mitigate biodiversity impacts, DNRC may incorporate such measures if there is a known connection to trust revenue opportunities, or if trust revenue would not be diminished.
- In situations where cumulative impacts to biodiversity would limit DNRC's income-producing capability, DNRC would make reasonable attempts to develop cooperative ecosystem management plans with adjoining landowners, with the objective of promoting biodiversity at a landscape level while equitably maintaining or promoting long-term trust revenue opportunities.
- Old-growth would not be specifically protected from harvest unless the trust were compensated or protection was agreed upon as part of a cooperative ecosystem management plan.

Zeta

- DNRC would promote biodiversity where it supports income opportunities based on wildlife and recreation. Promoting biodiversity would also be a primary goal where it provides direct income by means such as conservation easements or leases, wildlife viewing areas, or nature trail development.
- On projects where elements of biodiversity are identified as issues, DNRC would evaluate these elements at an appropriate spatial scale. These evaluations would consider all ownerships and identify opportunities to mitigate impacts while meeting project objectives.
- DNRC may incorporate measures to mitigate biodiversity issues if they appear to promote or directly provide trust revenue opportunities.
- In situations where cumulative impacts to biodiversity would limit DNRC's income-producing opportunities,

we would make reasonable attempts to develop cooperative ecosystem management planning with major adjoining landowners, with the objectives of promoting biodiversity at a landscape level and equitably maintaining or promoting long-term trust revenue opportunities.

- Within an appropriate ecosystem analysis area, DNRC would seek to maintain or restore old-growth forest in amounts of at least half the average proportion that would be expected to occur with natural processes in similar forest types. Old-growth conditions would be developed or maintained on enough additional acres to provide for replacement of existing old-growth over time.
- We would not maintain additional old-growth to compensate for its loss on adjoining ownerships, unless agreed upon in cooperative ecosystem management plans.

Omega

- DNRC would promote biodiversity by taking a 'coarse filter' approach, thereby favoring an appropriate mix of stand structures and compositions on state lands. Appropriate stand structures and compositions would be based on ecological characteristics.
- The coarse filter approach supports diverse wildlife habitat by managing for a variety of forest structures and compositions, instead of focusing on habitat needs for individual, selected species. DNRC would also employ a 'fine filter' approach for T&E and sensitive species focusing on single species' habitats.
- Within areas of large, blocked ownership, DNRC would manage for a desired future condition characterized by the proportion and distribution of forest types and structures historically present on the landscape. The typical analysis area would be a third-order drainage with the focus on maintaining or restoring forest conditions that would have naturally been present given topographic, edaphic and climatic characteristics of the area. Where our ownership contains forest structures made rare on adjacent lands due to others' management activities, we would not necessarily maintain those structures in amounts sufficient to compensate for their loss when assessed over the broader landscape. However, if our ownership contained rare or unique habitat elements occurring naturally (e.g., bog, patches of a rare plant), we would manage so as to retain those elements.
- On areas of smaller and/or scattered ownership, DNRC would not frequently be in a position to provide for appropriate representation of forest conditions across the broader landscape level. DNRC activities would still be based on restoring a semblance of historic conditions within state ownership. Where our ownership contained forest structures made rare on adjacent lands due to others' management activities, we would not necessarily maintain those structures in amounts sufficient to compensate for their loss when assessed over the broader landscape. However, if our ownership contains rare or unique habitat elements occurring naturally (e.g, bog, patches of a rare plant), we would manage so as to retain those elements.

- Within an appropriate ecosystem analysis area, DNRC would seek to maintain or restore old-growth forest in amounts of at least half the average proportion that would be expected to occur with natural processes on similar sites.
- DNRC would maintain sufficient replacement old-growth to meet this goal given that old-growth does not live forever. However, DNRC would not maintain additional old-growth to compensate for loss of old-growth on adjoining ownerships.

SILVICULTURE RESOURCE MANAGEMENT STANDARDS

Alpha, Beta, Delta, Zeta and Omega

- All prescribed silvicultural treatments would maintain the long-term productivity of the soil and site to ensure long-term capability to produce trust revenue and maintain soil hydrologic function.
- Management regimes would be designed to realize the productive capability of the site to provide desired products and benefits and minimize the risk of losses to biotic or abiotic agents.
- The long-term quality of the genetic base would be maintained or improved.
- Diversity of ages, species, and structure would be maintained within or between stands in order to maintain a complex and stable ecosystem.
- Silvicultural prescriptions would be prepared for all planned treatments.
- A financial evaluation would be done for all proposed silvicultural treatments.
- All treatments would have to produce a net return higher than the net return for no action.
- All silvicultural treatment regimes would meet other RMS and comply with all appropriate statutes and regulations.

Gamma

- All prescribed silvicultural treatments would maintain the long-term productivity of the soil and site to ensure long-term capability to produce trust revenue and maintain soil hydrologic function.
- Management regimes would be designed to realize the productive capability of the site to provide desired products and benefits and minimize the risk of losses to biotic or abiotic agents.
- The long-term quality of the genetic base would be maintained or improved.
- Diversity of ages, species, and structure would be maintained within or between stands in order to maintain a complex and stable ecosystem.
- Silvicultural prescriptions would be prepared for all planned treatments.
- A financial evaluation would be done for all proposed silvicultural treatments.
- All treatments except those done specifically for ecosystem rehabilitation must produce a net return higher than the net return for no action.
- All silvicultural treatment regimes would meet other RMS and comply with all appropriate statutes and regulations.

Epsilon

- All prescribed silvicultural treatments would maintain the long-term productivity of the soil and site to ensure long-term capability to produce trust revenue and maintain soil hydrologic function.
- Management regimes would be designed to realize the productive capability of the site to provide desired products and benefits and minimize the risk of losses to biotic or abiotic agents.
- All regeneration harvest units would be reforested to prescribed stocking levels as rapidly as site conditions allow.

- The long-term quality of the genetic base would be maintained or improved.
- Diversity of ages, species, and structure would be maintained within or between stands in order to maintain a complex and stable ecosystem.
- Silvicultural prescriptions would be prepared for all planned treatments.
- A financial evaluation would be done for all proposed silvicultural treatments.
- All treatments must produce net return higher than net return for no action.
- All silvicultural treatment regimes would meet other RMS and comply with all appropriate statutes and regulations.

ROAD MANAGEMENT RESOURCE MANAGEMENT STANDARDS

Alpha

- Location, design, construction, and maintenance of all roads would be consistent with BMPs, SMZ rules, Watershed RMS, other State Land Resource Standards, and the conditions of all appropriate permits.
- Transportation planning would be conducted in the early stages of project-level planning.
- The transportation system would be planned to minimize road miles while best meeting current and future management needs.
- Outside SMZs, we would build new roads if use of existing roads would produce more undesirable impacts than new construction. Inside SMZs, we would refer to the Watershed RMS.
- We would locate and design roads to minimize maintenance needs.
- Maintenance would be adequate to ensure continued road use and resource protection.
- DNRC would determine road density at the Unit or Land Office level to meet Threatened and Endangered Species, Big Game, Sensitive Species and Biodiversity RMS, as well as road surface protection and other resource needs.
- In the Swan River State Forest, road closures would be planned in accordance with the 1994 Swan Valley Grizzly Bear Conservation Agreement.

Beta

- Location, design, construction, and maintenance of all roads would be consistent with BMPs, SMZ rules, Watershed RMS, other State Land Resource Standards, and the conditions of all appropriate permits.
- Transportation planning would be conducted as a part of comprehensive landscape-level planning.
- The transportation system would be planned to minimize road miles while best meeting current and future management needs. We would evaluate and use alternative transportation systems that do not require roads whenever possible.
- Outside SMZs, we would build new roads if use of existing roads would produce more undesirable impacts than new construction. Inside SMZs, we would refer to the Watershed RMS.
- We would locate and design roads to minimize maintenance needs.
- Maintenance would be scheduled and funded to ensure continued road use and resource protection. Drainage structures and other resource protection measures would be maintained on restricted as well as open roads.
- DNRC would plan road density to meet landscape level ecosystem plans and

other RMS. DNRC would determine road density to meet Threatened and Endangered Species, Big Game, Sensitive Species and Biodiversity RMS, as well as road surface protection and other resource needs.

- On roads which are deemed non-essential to near-term future management plans, DNRC would emphasize revegetation and slash obstruction, to minimize maintenance costs, erosion and enhance road closure and effectiveness while leaving the capital investment intact.
- In the Swan River State Forest, road closures would be planned in accordance with the 1994 Swan Valley Grizzly Bear Conservation Agreement.

Gamma

- Location, design, construction, and maintenance of all roads would be consistent with BMPs, SMZ rules, Watershed RMS, other State Land Resource Standards, and the conditions of all appropriate permits.
- Transportation planning would be conducted as a part of comprehensive landscape-level ecosystem planning.
- The transportation system would be planned to reduce current road miles, obliterate and rehabilitate unnecessary roads, and develop a more balanced transportation system that would meet current and future management needs.
- Outside SMZs, we would build new roads if use of existing roads would produce more undesirable impacts than new construction. Inside SMZs, we would refer to the Watershed RMS.
- We would locate and design roads to limit the amount of required maintenance.
- Maintenance would be scheduled and funded to ensure continued road use and resource protection. Drainage structures and other resource protection measures would be maintained on restricted as well as open roads.
- DNRC would plan road density to minimize open roads on state land. Only those roads that could be regularly maintained and that provide planned public or permanent administrative access would remain open. Threatened and Endangered Species, Big Game, Sensitive Species, and Biodiversity RMS, as well as road surface protection and other resource needs, would be used to determine which system roads should remain open.
- In the Swan River State Forest, road closures would be planned in accordance with the 1994 Swan Valley Grizzly Bear Conservation Agreement.

Delta

- Location, design, construction, and maintenance of all roads would be consistent with BMPs, SMZ rules, Watershed RMS, other State Land Resource Standards, and the conditions of all appropriate permits.
- Transportation planning would be conducted to provide for efficient access for the variety of uses proposed for each tract.
- The transportation system would be planned to minimize road miles while best meeting current and future management needs.
- Outside SMZs, we would build new roads if use of existing roads would produce more undesirable impacts than new construction. Inside SMZs, we would refer to the Watershed RMS.
- We would locate and design roads to minimize maintenance needs.
- Maintenance would be scheduled and funded to ensure continued road use

and resource protection. Drainage structures and other resource protection measures would be maintained on restricted as well as open roads.

- DNRC would determine road density to meet Threatened and Endangered Species, Big Game, Sensitive Species, and Biodiversity RMS, as well as road surface protection and other resource needs.
- In the Swan River State Forest, road closures would be planned in accordance with the 1994 Swan Valley Grizzly Bear Conservation Agreement.

Epsilon

- Location, design, construction, and maintenance of all roads would be consistent with BMPs, SMZ rules, Watershed RMS, other State Land Resource Standards, and the conditions of all appropriate permits.
- Transportation planning would be conducted in the early stages of project-level planning.
- The transportation system would be planned to minimize road miles while best meeting current and future management needs.
- Outside SMZs, we would build new roads if use of existing roads would produce more undesirable impacts than new construction. Inside SMZs, we would refer to the Watershed RMS.
- We would locate and design roads to minimize maintenance needs.
- Maintenance would be scheduled and funded to ensure continued road use and resource protection. Drainage structures and other resource protection measures would be maintained on restricted as well as open roads.
- We would plan road density to meet timber harvesting schedules. DNRC would determine maximum allowable road densities to meet Threatened and Endangered Species, Big Game, Sensitive Species, and Biodiversity RMS, as well as road surface and other resource needs.
- In the Swan River State Forest, road closures would be planned in accordance with the 1994 Swan Valley Grizzly Bear Conservation Agreement.
- The choice of roads to be opened and closed would be adjusted to facilitate timber harvesting plans.

Zeta

- Location, design, construction, and maintenance of all roads would be consistent with BMPs, SMZ rules, Watershed RMS, other State Land Resource Standards, and the conditions of all appropriate permits.
- Transportation planning would be conducted in connection with wildlife and recreational value inventories.
- The transportation system would be planned to minimize road miles, close and rehabilitate unnecessary roads, and develop a more balanced transportation system that focuses on access for recreation and wildlife management needs and objectives.
- Outside SMZs, we would build new roads if use of existing roads would produce more undesirable impacts than new construction. Inside SMZs, we would refer to the Watershed RMS.
- We would locate and design roads to minimize maintenance needs.
- We would also locate and design roads and other transportation systems to take advantage of scenic views, to properly approach wildlife areas, and to provide recreational opportunities.
- Maintenance would be scheduled and

funded to ensure continued road use and resource protection. Drainage structures and other resource protection measures would be maintained on restricted as well as open roads.

- DNRC would determine road densities to meet Threatened & Endangered Species, Big Game, Sensitive Species, and Biodiversity RMS, as well as recreational plans, road surface protection and other resource needs.
- In the Swan River State Forest, road closures would be planned in accordance with the 1994 Swan Valley Grizzly Bear Conservation Agreement.

Omega

- DNRC will only build necessary roads, that is, those needed for current and near-term management objectives, as consistent with the other resource management standards.
- We would evaluate and use alternative transportation systems that do not require roads whenever possible.
- Location, design, construction, and maintenance of all roads would be consistent with BMPs, SMZ rules, Watershed RMS, other State Land Resource Standards, and the conditions of all appropriate permits.
- Transportation planning would be conducted as a part of comprehensive landscape-level planning.
- Outside SMZs, we would build new roads if use of existing roads would produce more undesirable impacts than new construction. Inside SMZs, we would refer to the Watershed RMS.
- We would locate and design roads to minimize maintenance needs.
- Maintenance would be scheduled and funded to ensure continued road use and resource protection. Drainage structures and other resource protection measures would be maintained on restricted as well as open roads.
- DNRC would plan road density to meet landscape level ecosystem plans and other RMS. DNRC would determine road density to meet Threatened and Endangered Species, Big Game, Sensitive Species and Biodiversity RMS, as well as road surface protection and other resource needs.
- On roads which are deemed non-essential to near-term future management plans, DNRC would emphasize obliteration through revegetation and slash obstruction. This would minimize maintenance costs, erosion, enhance road closure and effectiveness while leaving the capital investment intact.
- In the Swan River State Forest, road closures would be planned in accordance with the 1994 Swan Valley Grizzly Bear Conservation Agreement.

WATERSHED RESOURCE MANAGEMENT STANDARDS

Alpha

- We would manage watersheds, soil resources, and bodies of water to maintain high water quality meeting or exceeding state water quality standards, and to protect designated beneficial uses.
- Forest management practices would incorporate BMPs into project design and implementation.
- Projects involving substantial vegetation removal or ground disturbance would require an assessment of cumulative watershed effects to ensure that the project will not increase impacts beyond the physical limits imposed by the stream ecosystem for supporting its most restrictive beneficial use.

- Threshold values for cumulative watershed effects would be set at a level to ensure protection of beneficial water uses with a low to moderate degree of risk.
- DNRC would cooperate with other landowners to manage cumulative watershed effects within prescribed thresholds.
- We would manage Streamside Management Zones (SMZs), riparian areas and wetlands in a manner that complies with appropriate laws and regulations and protects and maintains water quality and beneficial uses.
- SMZ width would depend on erosion potential, level of disturbance proposed, and beneficial uses of the stream. Maximum 100 foot wide SMZ in all but exceptional cases of steep slopes, erosive soils, and sensitive streams.
- Trees would be retained in the SMZ as prescribed in the SMZ rules.
- a 25 foot wide SMZ would be maintained around isolated wetlands greater than one-half acre.
- Existing roads in SMZs would be used if the potential water quality impacts are adequately mitigated.
- We would rehabilitate or mitigate the adverse effects of fire, flood, and other natural or management-related events as funds were available.

Beta

- We would manage watersheds, soil resources, and bodies of water to maintain high water quality meeting or exceeding state water quality standards, and to protect designated beneficial uses.
- An inventory and analysis of watershed impacts would be conducted on state-owned forest land as funding allowed, sufficient to identify causes of watershed degradation and set priorities for watershed restoration. We would emphasize mitigation to provide greater opportunities to produce trust income while maintaining beneficial uses.
- Forest management practices would incorporate BMPs into project design and implementation.
- Projects involving substantial vegetation removal or ground disturbance would require an assessment of cumulative watershed effects to ensure that the project will not increase impacts beyond the physical limits imposed by the stream ecosystem for supporting its most restrictive beneficial use.
- Threshold values for cumulative watershed effects would be set at a low to moderate degree of risk.
- DNRC would cooperate with other landowners to manage cumulative watershed effects within prescribed thresholds.
- We would manage SMZs, riparian areas and wetlands in a manner that complies with appropriate laws and regulations and protects and maintains water quality and beneficial uses.
- SMZ width would be dependent on erosion potential, level of disturbance proposed, and beneficial uses of the stream. Maximum 200 foot SMZ.
- Trees would be retained in the SMZ as prescribed in the SMZ rules.
- a 50 foot SMZ would be maintained around isolated wetlands greater than one-quarter acre.
- Existing roads in SMZs would be used if potential impacts are adequately mitigated.
- We would rehabilitate or mitigate the adverse effects of fire, flood, and other natural or management-related events as funds were available.

- For development activities, we would ensure that adequate reclamation plans and bonds are included in the approved plans of operation.
- We would locate fire management bases, camps, helibases, staging areas, and other centers for incident activities outside of the SMZ.
- We would use fire suppression methods that would result in the least soil disturbance possible in the SMZ.

Gamma

- We would manage watersheds, soil resources, and bodies of water to maintain high water quality meeting or exceeding state water quality standards, and to protect designated beneficial uses.
- An inventory and analysis of watershed impacts would be conducted on state-owned forest land as funding allowed, sufficient to identify causes of watershed degradation and set priorities for watershed restoration. We would emphasize an aggressive program of mitigation to remedy water quality impacts caused by past activities, using restoration methods that promote long-term ecological integrity of the restored ecosystem.
- Forest management practices would incorporate BMPs into project design and implementation.
- Projects involving substantial vegetation removal or ground disturbance would require an assessment of cumulative watershed effects to ensure that the project will not increase impacts beyond the physical limits imposed by the stream ecosystem for supporting its most restrictive beneficial use.
- Threshold values for cumulative watershed effects would be set at a low degree of risk.
- SMZ width would be dependent on type of waterbody.
- Fish-bearing streams would have an SMZ 300 feet of horizontal distance in width on each side.
- Permanently flowing non-fish-bearing streams would have a 150-foot wide SMZ.
- Lakes would have a 300-foot wide SMZ.
- Seasonally flowing or intermittent streams would have a 100-foot wide SMZ.
- Trees would be retained in the SMZ as prescribed in the SMZ rules.
- a 100 foot wide SMZ would be maintained around isolated wetlands greater than one-quarter acre.
- We would abandon and rehabilitate existing roads in SMZs where possible. Where there were no reasonable alternative routes, we would apply the most effective mitigation measures possible.
- We would rehabilitate or mitigate the adverse effects of fire, flood, and other natural or management-related events as funds were available.
- For development activities, we would ensure that adequate reclamation plans and bonds are included in the approved plans of operation.
- We would locate fire management bases, camps, helibases, staging areas, and other centers for incident activities outside of the SMZ.
- We would use fire suppression methods that would result in the least soil disturbance possible in the SMZ.

Delta and Epsilon

- We would manage watersheds, soil resources, and water bodies to maintain high water quality meeting or exceeding state water quality standards, and to protect designated beneficial uses.

- An inventory and analysis of watershed impacts would be conducted on state-owned forest land as funding allowed, sufficient to identify causes of watershed degradation and set priorities for watershed restoration. We would emphasize mitigation to provide greater opportunities to produce trust income.
- Forest management practices would incorporate BMPs into project design and implementation.
- Projects involving substantial vegetation removal or ground disturbance would require an assessment of cumulative watershed effects to ensure that the project will not increase impacts beyond the physical limits imposed by the stream ecosystem for supporting its most restrictive beneficial use.
- Threshold values for cumulative watershed effects would be set at a moderate to high degree of risk.
- DNRC would cooperate with other landowners to manage cumulative watershed effects within prescribed thresholds. DNRC would mitigate for other owners' current and past activities, as well as our own, only to the extent necessary to comply with requirements for water protection.
- SMZs, riparian areas, and wetlands would be managed to comply with appropriate laws and regulations and protect and maintain water quality for beneficial uses.
- SMZ width would be set according to SMZ rules, except in sensitive locations.
- Trees would be retained in the SMZ as prescribed in the SMZ rules.
- We would retain a 25-foot wide SMZ around isolated wetlands greater than one-half acre.
- Existing roads in SMZs would be used if potential impacts are adequately mitigated.
- We would rehabilitate or mitigate the adverse effects of fire, flood, and other natural or management-related events as funds were available.
- For development activities, we would ensure that adequate reclamation plans and bonds are included in the approved plans of operation.
- We would locate fire management bases, camps, helibases, staging areas, and other centers for incident activities outside of the SMZ.
- We would use fire suppression methods that would result in the least soil disturbance possible in the SMZ.

Zeta

- We would manage watersheds, soil resources, and bodies of water to maintain high water quality meeting or exceeding state water quality standards, and to protect designated beneficial uses.
- An inventory and analysis of watershed impacts would be conducted on state-owned forest land as funding allowed, sufficient to identify causes of watershed degradation and set priorities for watershed restoration. We would emphasize an aggressive program of mitigation to remedy water quality impacts caused by past activities. Rehabilitation efforts that enhance fisheries or recreation would be given priority.
- Forest management practices would incorporate BMPs into project design and implementation.
- Projects involving substantial vegetation removal or ground disturbance would require an assessment of cumulative watershed effects to ensure that the project will not increase impacts beyond the physical limits imposed by the

stream ecosystem for supporting its most restrictive beneficial use.

- Threshold values for cumulative effects would be set at a low to moderate degree of risk.
- DNRC would cooperate with other landowners to manage cumulative watershed effects within prescribed thresholds.
- SMZ width would be dependent on erosion potential, level of disturbance proposed, and beneficial uses of stream. Maximum 200-foot SMZ.
- Trees would be retained in the SMZ as prescribed in the SMZ rules.
- We would maintain a 50-foot SMZ around isolated wetlands greater than one-quarter acre.
- Existing roads in SMZs would be used if potential impacts are adequately mitigated.
- We would rehabilitate or mitigate the adverse effects of fire, flood, and other natural or management-related events as funds were available.
- For development activities, we would ensure that adequate reclamation plans and bonds are included in the approved plans of operation.
- We would locate fire management bases, camps, helibases, staging areas, and other centers for incident activities outside of the SMZ.
- We would use fire suppression methods that would result in the least soil disturbance possible in the SMZ.

Omega

- We would manage watersheds, soil resources, and bodies of water to maintain high water quality meeting or exceeding state water quality standards, and to protect designated beneficial uses.
- An inventory and analysis of watershed impacts would be conducted on state-owned forest land as funding allowed, sufficient to identify causes of watershed degradation and set priorities for watershed restoration. We would emphasize mitigation to provide greater opportunities to produce trust income while maintaining beneficial uses.
- Forest management practices would incorporate BMPs into project design and implementation.
- Projects involving substantial vegetation removal or ground disturbance would require an assessment of cumulative watershed effects to ensure that the project will not increase impacts beyond the physical limits imposed by the stream ecosystem for supporting its most restrictive beneficial use.
- Threshold values for cumulative watershed effects would be set at a low to moderate degree of risk. On the Stillwater, Coal Creek and Swan River State Forests, we would establish thresholds at a level to ensure protection of beneficial water uses with a low degree of risk.
- DNRC would cooperate with other landowners to manage cumulative watershed effects within prescribed thresholds. DNRC would continue to participate in cooperative monitoring efforts, such as the Flathead Basin Commission's Monitoring Plan.
- We would manage SMZs, riparian areas, and wetlands in a manner that complies with appropriate laws and regulations and protects and maintains water quality and beneficial uses.
- SMZ width would be dependent on erosion potential, level of disturbance proposed, and beneficial uses of the stream. Maximum 200-foot SMZ.
- Trees would be retained in the SMZ as prescribed in the SMZ rules.

- A 50-foot equipment restriction would be maintained around isolated wetlands greater than one-quarter acre.
- Existing roads in SMZs would be used if potential impacts are adequately mitigated.
- We would rehabilitate or mitigate the adverse effects of fire, flood, and other natural or management-related events as funds were available.
- For development activities, we would ensure that adequate reclamation plans and bonds are included in the approved plans of operation.
- We would locate fire management bases, camps, helibases, staging areas, and other centers for incident activities outside of the SMZ.
- We would use fire suppression methods that would result in the least soil disturbance possible in the SMZ.
- DNRC will develop a monitoring strategy to assess watershed impacts of land use activities and the effectiveness of mitigation measures.
- If monitoring indicated watershed impacts from management or other activities, problems would be corrected. The information collected would be used to identify the need for mitigation measures and modification of future activities to avoid similar impacts.
- Upon request, monitoring data will be made available to the public. DNRC will compile the results of monitoring into a report for the Land Board by October 2000 and every five years thereafter.

FISHERIES RESOURCE MANAGEMENT STANDARDS

Alpha

- DNRC would coordinate with MDFWP in design and implementation of projects that may affect the fisheries resource.
- Activities in the Flathead Basin would be designed to protect bull trout and west slope cutthroat trout habitat.
- We would minimize impacts to fisheries by implementing RMS and Best Management Practices (BMPs), and complying with the Streamside Management Zone Law and other laws and regulations.
- We would implement immediate actions as interim measures to conserve bull trout habitat, as recommended by the Governor's Bull Trout Restoration Team.

Beta, Gamma, Zeta and Omega

- DNRC would coordinate with MDFWP in design and implementation of projects that may affect the fisheries resource.
- Activities in the Flathead Basin would be designed to protect bull trout and west slope cutthroat trout habitat.
- We would manage activities outside the Flathead basin to sustain and enhance bull trout, west slope cutthroat, Yellowstone cutthroat, and all other designated "sensitive" species, and Species of Special Concern.
- We would minimize impacts to fisheries by implementing RMS and BMPs, and complying with the Streamside Management Zone Law and other laws and regulations.
- We would construct, reconstruct, and maintain road crossing structures on fish-bearing streams to provide for fish passage.
- Silvicultural treatments adjacent to fish-bearing streams would prescribe for steady entry of pool-forming trees into the stream system.
- Fisheries designated as "sensitive" or containing Species of Special Concern would be managed so as to comply with

additional, and possibly more restrictive, direction specified in the Sensitive Species RMS.

- We would cooperate with other agencies to prevent stocking of non-native fish, over-fishing and poaching.
- We would implement immediate actions as interim measures to conserve bull trout habitat, as recommended by the Governor's Bull Trout Restoration Team.

Delta and Epsilon

- DNRC would coordinate with MDFWP in design and implementation of projects that may affect the fisheries resource.
- Activities in the Flathead Basin would be designed to protect bull trout and west slope cutthroat trout habitat.
- We would minimize impacts to fisheries by implementing RMS and BMPs, and complying with the Streamside Management Zone Law and other laws and regulations.
- We would construct and maintain road crossing structures on fish-bearing streams to provide for fish passage.
- Fisheries designated as "sensitive" or containing Species of Special Concern would be managed so as to comply with additional, and possibly more restrictive, direction specified in the Sensitive Species RMS.
- We would implement immediate actions as interim measures to conserve bull trout habitat, as recommended by the Governor's Bull Trout Restoration Team.

THREATENED AND ENDANGERED SPECIES RESOURCE MANAGEMENT STANDARDS

Alpha

- DNRC would implement its 1988 grizzly bear management standards and guidelines for the west side of the Northern Continental divide, or updates of those standards.
- DNRC would participate on interagency working groups to develop guidelines and implement recovery plans for grizzly bear, bald eagle and wolf (there are no working groups for Peregrine falcons).
- We might modify activities to promote recovery of T&E plant and animal species, when consistent with producing revenue through sustained harvest of forest products. We would comply with Section 9 of the Endangered Species Act, which prohibits any action that may be considered a "taking," but would not unilaterally promote recovery.
- In the Swan River State Forest, DNRC would adhere to the set of management guidelines contained in the 1994 Swan Valley Grizzly Bear Conservation Agreement.

Beta

- DNRC would implement federal and working group standards, or DNRC standards of equivalent conservation effect, for grizzly bear management.
- DNRC would participate on interagency working groups to develop guidelines and implement recovery plans for grizzly bear, bald eagle and wolf (there are no working groups for Peregrine falcons).
- DNRC would promote recovery of threatened and endangered plant and animal species.
- In the Swan River State Forest, DNRC would adhere to the set of management guidelines contained in the 1994 Swan Valley Grizzly Bear Conservation Agreement.

Gamma

- DNRC would promote recovery of grizzly bears on state lands. We would adopt and implement federal and working group standards and guidelines for grizzly bear management on state lands in each designated recovery area.
- DNRC would participate on interagency working groups to develop guidelines and implement recovery plans for grizzly bear, bald eagle and wolf (there are no working groups for Peregrine falcons).
- We would promote recovery of all threatened and endangered plant and animal species.
- In the Swan River State Forest, DNRC would adhere to the set of management guidelines contained in the 1994 Swan Valley Grizzly Bear Conservation Agreement.

Delta and Epsilon

- DNRC would no longer implement the 1988 DNRC interim grizzly bear management standards and guidelines for the west side of the Northern Continental Divide.
- DNRC would review information from interagency working groups established to develop guidelines and implement recovery plans for T&E plant and animal species.
- DNRC would comply with Section 9 of the Endangered Species Act, which prohibits actions that may be considered a "taking."
- DNRC would not routinely implement federal and working group guidelines to promote recovery of threatened and endangered species.
- In the Swan River State Forest, DNRC would adhere to the set of management guidelines contained in the 1994 Swan Valley Grizzly Bear Conservation Agreement.

Zeta

- DNRC would either adopt and implement federal and working group standards and guidelines for grizzly bear management or develop its own standards, to the extent that doing so would not conflict with trust management policy.
- We would participate on interagency working groups to develop guidelines and implement recovery plans for grizzly bear, bald eagle and wolf (there are no working groups for Peregrine falcons).
- DNRC might modify activities to promote recovery of T&E plant and animal species when doing so is consistent with producing trust revenue. We would comply with Section 9 of the Endangered Species Act, which prohibits any actions that may be considered a "taking," but we would not unilaterally promote recovery.
- In the Swan River State Forest, DNRC would adhere to the set of management guidelines contained in the 1994 Swan Valley Grizzly Bear Conservation Agreement.

Omega

- DNRC would participate in recovery efforts of T&E plant and animal species and would confer with the U.S. Fish and Wildlife Service (USFWS) to develop habitat mitigation measures. These measures might differ from federal management guidelines as DNRC plays a subsidiary role to federal agencies in species recovery.

- We would participate on interagency working groups to develop guidelines and implement recovery plans for grizzly bear, bald eagle and wolf (there are no working groups for Peregrine falcons).
- In the Swan River State Forest, DNRC would adhere to the set of management guidelines contained in the 1994 Swan Valley Grizzly Bear Conservation Agreement.

SENSITIVE SPECIES RESOURCE MANAGEMENT STANDARDS

Alpha, Delta, Epsilon, and Zeta

- DNRC would consider sensitive species in project planning through the MEPA process. Sensitive species and their habitats identified in the project area would be given consideration during project planning in an attempt to mitigate potential adverse impacts.
- Measures to protect sensitive species would be implemented if they could be reconciled with other management goals.
- Where management of sensitive species is deemed compatible with other management goals, we would maintain important site characteristics so long as this would not substantially reduce trust revenue.
- Field surveys by qualified professionals might be required in project areas where sensitive plant species could be impacted by project actions.

Beta and Gamma

- DNRC would manage to support and where appropriate enhance populations of sensitive species on state land.
- Sensitive species and their habitats identified in the project area would be conserved.
- Appropriate measures would be taken to ensure adequate conditions to support these species or contribute to their habitats.
- Field surveys by qualified specialists would be required to determine the presence and location of sensitive plant species. Existing site conditions that could affect the continued maintenance of local populations would be documented.

Omega

- DNRC would manage so as to generally support populations of sensitive species on state land.
- For sensitive plant species, important sites and/or site characteristics would be protected.
- For sensitive animal species, DNRC would provide habitat characteristics recognized as suitable for individuals to survive and reproduce in situations where land ownership patterns and the underlying biological and geographical conditions allow for them.
- Periodic field surveys by qualified specialists would be conducted to assess how well management actions have provided for site conditions needed to support sensitive plant species.

BIG GAME RESOURCE MANAGEMENT STANDARDS

Alpha

- DNRC would manage big game habitats as a potential source of income to the school trust. To accomplish this, DNRC would keep winter ranges and all other seasonally important big game habitats in a condition capable of supporting big game populations, unless such measures were not compatible with annual program objectives.

- We would implement the elk and white-tailed deer winter range standards and guidelines drafted in November 1989.
- DNRC would consult with MDFWP to determine if seasonally important big game habitat exists within each proposed project area and, if so, to determine which habitat values might be affected by the proposed action.
- More detailed analysis would be necessary if MDFWP determines that a proposed action might conflict with management of big game habitat. When big game needs are not compatible with other management objectives, conflicts would be addressed on a case-by-case basis.

Beta and Gamma

- DNRC would promote a diversity of stand structures and landscape patterns and rely on them to provide good habitat for native wildlife populations.
- Big game habitat needs would be a secondary consideration in management decisions. However, measures to mitigate potential impacts would be implemented if they were consistent with overall management objectives, and with the Biodiversity RMS.
- The current elk and white-tailed deer management standards and guidelines drafted in November 1989 would no longer be adopted as Department policy.
- DNRC would consult with MDFWP to determine which big game habitat values are most likely to be affected by proposed management actions.

Delta

- DNRC would manage aggressively to produce revenue from available forest resources.
- On some lands, management of big game species would represent the best way to maximize trust income. Habitat manipulations would be designed to maintain or improve current and future revenue opportunities from fee-based hunting, wildlife viewing, conservation leases or easements to interested parties.
- Big game habitat needs would be given low priority in situations where revenue potential is greater from management of other resources. Mitigation measures would be implemented to ensure that big game species and their essential habitats are likely to remain in each third-order watershed following any proposed DNRC action.
- The current elk and white-tailed deer management standards and guidelines drafted in November 1989 would no longer be adopted as Department policy.
- DNRC would consult with MDFWP to determine which big game habitat values are most likely to be affected by proposed management actions.

Epsilon

- DNRC would manage forest lands to produce trust income through a sustained annual timber sale level, while attempting to incorporate big game habitat needs consistent with primary timber management objectives.
- DNRC would keep winter ranges and other seasonal ranges in a condition capable of supporting big game populations, unless this is not compatible with timber harvest objectives.
- DNRC would implement the elk and white-tailed deer management standards and guidelines drafted in November 1989 where they are compatible with timber management goals.

- DNRC would consult with the MDFWP to determine if seasonally important big game habitat exists within each proposed project area and, if so, to determine which habitat values might be affected by the proposed action.
- DNRC would consult with MDFWP to determine if important big game habitat exists within each proposed timber sale. Mitigation measures would be implemented to ensure that big game species and their essential habitats are likely to remain in each third-order watershed following any proposed DNRC action.

Zeta

- DNRC would emphasize revenue production from recreational development and wildlife management.
- Big game habitat needs would be secondary where revenue potential from management of other resources is clearly higher. When managing other resources, wildlife mitigation measures would be designed to maintain at least 50-60 percent of the potential wildlife habitat value.
- The current elk and white-tailed deer management standards and guidelines drafted in November 1989 would no longer be adopted as Department policy.
- DNRC would consult with MDFWP to determine how best to enhance big game and other wildlife habitat values in situations where big game management is a priority. In areas managed for other resources, consultations with wildlife biologists would be used to develop appropriate mitigation measures.

Omega

- DNRC would promote a diversity of stand structures and landscape patterns, and rely on them to provide good habitat for native wildlife populations.
- To the extent possible, DNRC would manage to provide for big game habitat. Measures to mitigate potential impacts would be implemented if they were consistent with overall management objectives, and with the Biodiversity RMS.
- The current elk and white-tailed deer management standards and guidelines drafted in November 1989 would no longer be adopted as Department policy.
- DNRC would consult with MDFWP to determine which big game habitat values are most likely to be affected by proposed management actions and would cooperate with MDFWP to limit detrimental impacts to big game.

CLASSIFIED FOREST LAND GRAZING RESOURCE MANAGEMENT STANDARDS

Alpha

- Grazing licenses would indicate the number of Animal Unit Months (AUMs) and grazing period of use. Grazing leases would specify AUMs only.
- Lessees and licensees would have primary responsibility for developing and maintaining rangeland improvements, and for maintaining or improving range condition.
- Stocking rates would be estimated by visual assessment of existing vegetative plant species composition.
- Riparian management concerns would be considered only in isolated instances, primarily in conjunction with mixed ownership allotments.

Beta and Omega

- Grazing licenses and leases would specify AUMs, kinds of livestock, and period of use. Lease/license stipulations would be set at the time of renewal.
- Lessees and licensees would have primary responsibility for developing and maintaining rangeland improvements and for maintaining or improving range condition.
- DNRC would support rangeland improvements through technical and financial assistance as workload and budget allow.
- Stocking rates would be estimated by visual assessment of existing vegetative plant species composition.
- Livestock management practices would be designed to prevent damage to streambanks that results in non-point source pollution.
- Mineral, protein, and other supplements would be placed to maximize animal distribution away from riparian areas. Holding facilities would be placed outside of riparian areas.
- Continuous, season-long grazing would be authorized, with the level of forage utilization not to exceed 60 percent and healthy riparian function maintained.

Gamma

- Grazing licenses and leases would specify AUMs, kinds of livestock, and period of use. Lease/license stipulations would be set at the time of renewal.
- Lessees and licensees would have primary responsibility for developing and maintaining rangeland improvements and for maintaining or improving range condition.
- DNRC would support rangeland improvements through technical and financial assistance as workload and budget allow.
- Stocking rates would be estimated by visual assessment of existing vegetative plant species composition.
- Livestock management practices would be designed to prevent damage to streambanks that results in non-point source pollution.
- Mineral, protein, and other supplements would be placed to maximize animal distribution away from riparian areas. Holding facilities would be placed outside of riparian areas.
- Continuous season-long grazing would not be allowed.

Delta and Epsilon

- Grazing licenses and leases would specify AUMs and period of use. Lease/license stipulations would be set at the time of renewal.
- Lessees and licensees would have primary responsibility for developing and maintaining rangeland improvements and for maintaining or improving range condition.
- DNRC would support rangeland improvements through technical assistance as workload and budget allow.
- Stocking rates would be estimated by visual assessment of existing vegetative plant species composition.
- Livestock management practices would be designed to prevent damage to streambanks that results in non-point source pollution.
- Mineral, protein, and other supplements would be placed to maximize animal distribution away from riparian areas. Holding facilities would be placed outside of riparian areas.
- Season-long grazing would be authorized when it has been demonstrated to be

consistent with achieving properly functioning range condition, including healthy riparian areas.

Zeta

- Grazing licenses and leases would specify AUMs, kinds of livestock, and grazing period of use. Lease/license stipulations would be set at the time of renewal.
- Lessees and licensees would have primary responsibility for developing and maintaining rangeland improvements and for maintaining or improving range condition.
- DNRC would support rangeland improvements through technical and financial assistance as workload and budget allow.
- Stocking rates would be estimated by visual assessment of existing vegetative plant species composition.
- Livestock management practices would be designed to prevent damage to streambanks that results in non-point source pollution.
- Mineral, protein, and other supplements would be placed to maximize animal distribution away from riparian areas. Holding facilities would be placed outside of riparian areas.
- Season-long grazing would be authorized with the level of forage utilization not to exceed 30 percent.

NOXIOUS WEEDS RESOURCE MANAGEMENT STANDARDS

Alpha

- Forested state lands would be managed to prevent or control the spread of noxious weeds. We would comply with weed management laws, through revegetation plans and agreements with county weed boards.
- DNRC would submit revegetation plans to county weed boards for their review of land-disturbing projects such as road construction.
- DNRC would cooperate with weed districts for control projects across ownerships.
- We would promote the prevention of weed spread by requiring measures such as cleaning heavy equipment, prompt revegetation of roads, and reducing ground disturbance.
- Stipulations and control measures to prevent the spread of weeds would be included in timber sale contracts.
- Herbicide treatments would be limited to areas where they offer the most cost-effective means of control and funds are available. New outbreaks would have first priority for control. Management of large areas of infestation may be limited to perimeter containment.
- On unleased/unlicensed state lands, DNRC would be responsible for weed control.
- A lessee or licensee of state land would be responsible for weed control on the leased/licensed land at his cost, and must comply with the Montana County Weed Management Act.
- All right-of-way agreements would require the permittee to control weed problems along the right-of-way.
- A portion of recreational access fees would be used, as available, for weed control on sites where weeds are introduced by recreation use.

Beta, Zeta and Omega

- Forested state lands would be managed to prevent or control the spread of noxious weeds. We would comply with weed management laws by inventorying noxious weed occurrences, developing management plans, and allocating funds for weed control projects.

- DNRC would submit revegetation plans to county weed boards for their review of land-disturbing projects such as road construction. We would promptly revegetate with site-adapted grasses that emphasize native species.
- DNRC would cooperate with weed districts for control projects across ownerships.
- We would use an integrated pest management approach.
- We would promote the prevention of weed spread by requiring measures such as use of weed-free equipment, prompt revegetation of roads, and reducing ground disturbance.
- Stipulations and control measures to prevent the spread of weeds would be included in timber sale contracts. Where stipulated, weed control efforts would continue for two years following land disturbance.
- Herbicide treatments would be limited to areas where they offer the most cost-effective means of control and where biological and mechanical control measures are ineffective. New outbreaks and locations where native plant communities are threatened would have first priority for control. Management of large areas of infestation may be limited to perimeter containment.
- On unleased/unlicensed state lands, DNRC would be responsible for weed control.
- A lessee or licensee of state land would be responsible for weed control on the leased/licensed land at his cost, and must comply with the Montana County Weed Management Act.
- All right-of-way agreements would require the permittee to control weed problems along the right-of-way.
- A portion of recreational access fees would be used, as available, for weed control on sites where weeds are introduced by recreation use.

<u>Gamma</u>

- Forested state lands would be managed to prevent or control the spread of noxious weeds. We would comply with weed management law by inventorying noxious weed occurrences, developing management plans, and allocating funds for weed control projects.
- DNRC would submit revegetation plans to county weed boards for their review of land-disturbing projects such as road construction. We would promptly revegetate with site-adapted grasses that emphasize native species.
- DNRC would cooperate with weed districts for control projects across ownerships.
- We would use an integrated pest management approach.
- We would promote the prevention of weed spread by requiring road construction and harvest equipment to be cleaned prior to moving equipment into a project area.
- Stipulations and control measures to prevent the spread of weeds would be included in timber sale contracts. On weed-free areas, contractors would be responsible for weed control for two years following land disturbance.
- Herbicide treatments would be very limited, to areas where they offer the most cost-effective means of control and native plant communities are threatened. Herbicide treatments would focus on narrow, site-specific applications.
- On unleased/unlicensed state lands, DNRC would be responsible for weed control.

- A lessee or licensee of state land would be responsible for weed control on the leased/licensed land at his cost, and must comply with the Montana County Weed Management Act.
- All right-of-way agreements would require the permittee to control weed problems along the right-of-way. Vehicle restrictions to reduce the spread of weeds would be integrated into road management plans and right-of-ways.
- A portion of recreational access fees would be used, as available, for weed control on sites where weeds are introduced by recreation use. If recreation use funds are not available, DNRC would supplement weed control.

Delta

- Forested state lands would be managed to prevent or control the spread of noxious weeds and improve the economic return from those lands. We would comply with weed management laws, through revegetation plans and agreements with county weed boards.
- DNRC would submit revegetation plans to county weed boards for their review of land-disturbing projects such as road construction.
- DNRC would cooperate with weed districts for control projects across ownerships.
- We would promote the prevention of weed spread by requiring road construction and harvest equipment to be cleaned prior to moving equipment into a project area.
- Stipulations and control measures to limit the spread of weeds would be attached to timber sale contracts.
- Herbicide treatments would be limited to areas where they offer the most cost-effective means of control, and where biological and mechanical control measures are less effective, and where reduced weeds and improved forage would increase income potential. New outbreaks would have first priority for control. Management of large areas of infestation may be limited to perimeter containment.
- On unleased/unlicensed state lands, DNRC would be responsible for weed control.
- A lessee or licensee of state land would be responsible for weed control on the leased/licensed land at his cost, and must comply with the Montana County Weed Management Act.
- All right-of-way agreements would require the permittee to control weed problems along the right-of-way.
- A portion of recreational access fees would be used, as available, for weed control on sites where weeds are introduced by recreation use.

Epsilon

- Forested state lands would be managed to prevent or control the spread of noxious weeds. We would comply with weed management laws, through revegetation plans and agreements with county weed boards.
- DNRC would submit revegetation plans to county weed boards for their review of land-disturbing projects such as road construction.
- DNRC would cooperate with weed districts for control projects across ownerships.
- We would promote the prevention of weed spread by requiring road construction and harvest equipment to be cleaned prior to moving equipment into a project area.
- Stipulations and control measures to limit the spread of weeds would be attached to timber sale contracts.
- Herbicide treatments would be limited to areas where they offer the most cost-effective means of control, and where biological and mechanical control

measures are less effective. New outbreaks would have first priority for control. Management of large areas of infestation may be limited to perimeter containment.

- On unleased/unlicensed state lands, DNRC would be responsible for weed control.
- A lessee or licensee of state land would be responsible for weed control on the leased/licensed land at his cost, and must comply with the Montana County Weed Management Act.
- All right-of-way agreements would require the permittee to control weed problems along the right-of-way.
- A portion of recreational access fees would be used, as available, for weed control on sites where weeds are introduced by recreation use.

SUMMARY OF ALTERNATIVES

The following table summarizes how each alternative would respond to issues raised by concerned citizens.

SUMMARY OF ALTERNATIVES BY ISSUE

ISSUE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
1) PUBLIC'S RIGHT TO USE STATE LANDS Some people believe the public should have unrestricted recreational use of state lands, at no cost. Others believe that unrestricted recreational use will adversely affect lease values. The 1991 Legislature passed HB 778 authorizing general recreational use of legally accessible state lands with the purchase of a $5.00 Recreational Use License (RUL). Rules allow other recreational uses on unleased tracts, and on leased tracts with the permission of the lessee. Some people believe a fee should be charged for other recreational uses, beyond those currently defined as "general recreation."	General recreational use (currently defined as including non-commercial and non-concentrated hunting, fishing and other activities determined by the Land Board to be compatible with the use of state lands; general recreation use does not include the use of streams and rivers by the public under the stream access law provided in Title 23, Chapter 2, Part 3) would be allowed on legally accessible lands with the purchase of a Recreational Use License. Other recreational uses would be allowed free of charge on unleased lands and with the permission of the lessee on leased tracts.	General recreational use (currently defined as including non-commercial and non-concentrated hunting, fishing and other activities determined by the Land Board to be compatible with the use of state lands; general recreation use does not include the use of streams and rivers by the public under the stream access law provided in Title 23, Chapter 2, Part 3) would be allowed on legally accessible lands with the purchase of a Recreational Use License.	General recreational use (currently defined as including non-commercial and non-concentrated hunting, fishing and other activities determined by the Land Board to be compatible with the use of state lands; general recreation use does not include the use of streams and rivers by the public under the stream access law provided in Title 23, Chapter 2, Part 3) would be allowed on legally accessible lands with the purchase of a Recreational Use License.	General recreational use (currently defined as including non-commercial and non-concentrated hunting, fishing and other activities determined by the Land Board to be compatible with the use of state lands; general recreation use does not include the use of streams and rivers by the public under the stream access law provided in Title 23, Chapter 2, Part 3) would be allowed on legally accessible lands with the purchase of a Recreational Use License. Some high-valued recreational tracts would be leased for recreational uses. Public use may be restricted on those tracts. Other accessible tracts would be available for uses defined as General Recreation.	General recreational use (currently defined as including non-commercial and non-concentrated hunting, fishing and other activities determined by the Land Board to be compatible with the use of state lands; general recreation use does not include the use of streams and rivers by the public under the stream access law provided in Title 23, Chapter 2, Part 3) would be allowed on legally accessible lands with the purchase of a Recreational Use License. Other recreational uses would be allowed free of charge on unleased lands and with the permission of the lessee on leased tracts.	General recreational use (currently defined as including non-commercial and non-concentrated hunting, fishing and other activities determined by the Land Board to be compatible with the use of state lands; general recreation use does not include the use of streams and rivers by the public under the stream access law provided in Title 23, Chapter 2, Part 3) would be allowed on most legally accessible lands with the purchase of a Recreational Use License. Some high-valued recreational tracts would be leased for recreational uses. Public use may be restricted on those tracts. Other accessible tracts would be available for uses defined as General Recreation.	General recreation use (currently defined as including non-commercial and non-concentrated hunting, fishing and other activities determined by the Land Board to be compatible with the use of state lands; general recreation use does not include the use of streams and rivers by the public under the stream access law provided in Title 23, Chapter 2, Part 3) would be allowed on legally accessible lands with the purchase of a Recreational Use License.

ISSUE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
1B) RIGHT-OF-WAY ACROSS STATE FOREST LANDS There is general concern that the public's right to use federal lands is being eroded by restrictions imposed by surrounding land owners. Many people believe that public access across state lands to adjacent federal lands should be developed as opportunities exist. Some people also believe that access across state lands to private lands should be developed.	Proposals for rights-of-way would be considered subject to management constraints, workload and environmental review. Compatibility with our timber management program would be an important factor in approval of right-of-way requests.	Proposals for rights-of-way would be considered subject to management constraints, workload and environmental review. Compatibility with our management goals would be an important factor in approval of right-of-way requests.	Proposals for rights-of-way would be considered subject to management constraints, workload and environmental review. Maintenance of the natural ecosystem would be a primary consideration in approval of right-of-way requests.	Proposals for rights-of-way would be considered subject to management constraints, workload and environmental review. Opportunities for marketing state resources would be an important factor in approval of right-of-way requests.	Proposals for rights-of-way would be considered subject to management constraints, workload and environmental review. Compatibility with our timber management program would be an important factor in approval of right-of-way requests.	Proposals for rights-of-way would be considered subject to management constraints, economic considerations, workload and environmental review. Opportunities for generating revenue from recreation or wildlife management would be an important factor in approval of right-of-way requests.	Proposals for rights-of-way would be considered subject to management constraints, workload and environmental review. Compatibility with our management goals would be an important factor in approval of right-of-way requests.
1C) ACQUIRING ACCESS TO STATE LAND Concern has been expressed that the lack of legal access to many state tracts limits our ability to manage those tracts. Some people believe we should place a high priority on securing permanent access to all state tracts.	Access would be secured to state lands when specific projects were proposed (primarily timber sales). When possible, we would obtain permanent access to state lands.	Access would be secured to state lands when specific projects were proposed. When possible, we would obtain permanent access to state lands.	Access would be secured to state lands when specific projects were proposed. When possible, we would obtain permanent access to state lands.	We would actively pursue permanent right-of-way to all tracts that have long term management potential. Acquisition priorities would be based on expected monetary return.	We would actively pursue permanent right-of-way to all tracts that have long term timber management potential.	We would actively pursue permanent right-of-way to all state tracts with significant opportunities to generate revenue from recreation or wildlife management.	Access would be secured to state lands when specific projects were proposed. When possible, we would obtain permanent access to state lands.

ISSUE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
2) ROAD MANAGEMENT AND MAINTENANCE The extent of forest road development has generated considerable public discussion. Road development may affect wildlife security and adversely impact water quality. Some people view road systems as an asset to forest development, protection, and recreation access. They believe roads should remain open to motor vehicle use. Others believe that the environmental costs of road development outweigh the benefits and advocate a minimum amount of forest development.	Roads would be built as needed to support land management activities (primarily timber sales). Roads would be considered a permanent investment and would generally not be obliterated unless doing so would mitigate impacts that could otherwise limit management opportunities. We would consider seasonal and year-long closures, subject to management concerns, maintenance costs, use levels, and adjacent ownership needs. We would limit road maintenance to critical needs, and require users to perform maintenance or pay maintenance fees.	We would actively seek ways to minimize the amount of new roads needed to support management activities. We would promote cooperative road management planning among adjacent land owners as one way to minimize roads. We would consider obliterating roads that were not primary access routes. We would close most roads following use in order to minimize open road mileage, unless they provided planned public access or regular administrative access. We would begin to develop an active road maintenance program and require road users to do maintenance or pay maintenance fees.	We would actively seek ways to minimize the amount of roads needed. We would promote cooperative road management planning among adjacent land owners as one way to minimize roads. We would emphasize obliterating roads that were not primary access routes. All roads would be closed to vehicle use unless continued use was consistent with recreational needs and ecosystem integrity. Some closed roads would be developed for cross country skiing, mountain biking or hiking. We would begin to develop an active road maintenance program and require road users to do maintenance or pay maintenance fees.	Roads would be built as needed to support land management activities. Roads would be considered a permanent investment and would generally not be obliterated unless doing so would mitigate forest impacts that could otherwise limit management opportunities. We would consider seasonal and year-long closures, subject to management concerns, maintenance costs, use levels, and adjacent ownership needs. We would begin to develop an active road maintenance program and require road users to do maintenance or pay maintenance fees.	Roads would be built as needed to support timber management activities. Roads would be considered a permanent investment and would generally not be obliterated unless doing so would mitigate impacts that could otherwise limit management opportunities. Roads would not be built for other uses unless they were paid for by the proposed use and would not limit timber management. We would consider seasonal and year-long closures, subject to management concerns, maintenance costs, use levels, and adjacent ownership needs. We would begin to develop an active road maintenance program and require road users to do maintenance or pay maintenance fees.	We would build roads primarily to enhance or promote profitable recreation and wildlife management opportunities. However, we would actively seek ways to minimize roads through cooperative road planning. We would use selective road closures to maximize recreational opportunities while protecting wildlife and water quality. Closed roads could be used for recreational activities such as hiking, skiing and snowmobiling. We would begin to develop an active road maintenance program and require road users to do maintenance or pay maintenance fees.	We would only build necessary roads, that is, those needed for current and near-term management objectives, as consistent with the other resource management standards. We would promote cooperative road management planning among adjacent land owners as one way to minimize roads. We would consider obliterating roads that were not primary access routes. We would close most new roads following use in order to minimize open road mileage, unless they provided planned public access or regular administrative access. We would continue to develop an active road maintenance program and require road users to do maintenance or pay maintenance fees.

ISSUE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
3A) ADMINISTRATIVE COORDINATION There is general agreement that increased coordination and cooperation among adjacent landowners would be beneficial and efficient. Many people believe that DNRC should take an active role in management cooperatives such as road construction, road maintenance, weed control and fire suppression. Some people also believe DNRC should develop an active land exchange program to consolidate state lands to improve efficiency.	We would maintain our current level of cooperation with other land owners. Land exchanges would receive a low priority when allocating personnel and funds.	In addition to our current level of cooperation with other land owners, we would also attempt cooperative ecosystem management planning. We would favor land exchanges that improved our flexibility to manage for a variety of trust revenue opportunities.	In addition to our current level of cooperation with other land owners, we would also attempt cooperative ecosystem management planning. We would favor land exchanges that improved trust revenue opportunities from restoration or maintenance of natural conditions.	In addition to our current level of cooperation with other land owners, we would encourage joint marketing agreements to share development costs and increase resource values. We would favor land exchanges that led to revenue generating opportunities.	In addition to our current level of cooperation with other land owners, we would encourage joint marketing agreements to share development costs and increase resource values. We would favor land exchanges that consolidated our timber lands.	In addition to our current level of cooperation with other land owners, we would encourage joint marketing agreements to share development costs and increase resource values. We would favor land exchanges that improved our opportunities for recreational and wildlife leases.	In addition to our current level of cooperation with other land owners, we would attempt cooperative ecosystem management planning. We would be actively involved in community-based planning efforts where appropriate. We would favor land exchanges that improved our flexibility to manage for a variety of trust revenue opportunities.

ISSUE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
3B) CUMULATIVE ENVIRONMENTAL EFFECTS							
Controversy develops when the cumulative effects of activities on intermingled ownerships may need mitigation measures. Conflicts occur over which landowner should modify its activities. Some people want DNRC to mitigate for the activities of other landowners. Other people think DNRC should conduct sound management on its own ownership and not mitigate for the activities of surrounding landowners.	We would evaluate cumulative effects and in most cases mitigate for the activities of others.	We would evaluate cumulative effects and in most cases mitigate for the activities of others. However, in some cases we may accept significant individual resource impacts if the activity would result in greater overall ecosystem integrity. We would pursue ecosystem management, and other agreements with adjoining land owners to achieve mutual landscape goals.	We would evaluate cumulative effects of proposed actions and mitigate for all past, present and reasonably foreseeable future actions by all land owners in the area. We would pursue ecosystem management, and other agreements with adjoining land owners to achieve mutual landscape goals.	We would evaluate cumulative effects and pursue cooperative agreements to share the responsibility of mitigation among landowners. If cooperators would not agree to limit their activities DNRC would: 1) Mitigate the activities of others for resources that have legal protection such as T&E species or water quality. 2) In other cases, we would conduct our proportional share of the mitigation based on land ownership in the project area.	We would evaluate cumulative effects and pursue cooperative agreements to share the responsibility of mitigation among landowners. If cooperators would not agree to limit their activities DNRC would: 1) Mitigate the activities of others for resources that have legal protection such as T&E species or water quality. 2) In other cases, we would conduct our proportional share of the mitigation based on land ownership in the project area.	We would evaluate cumulative effects and pursue cooperative agreements to share the responsibility of mitigation among landowners. If cooperators would not agree to limit their activities DNRC would: 1) Mitigate the activities of others for resources that have legal protection such as T&E species or water quality. 2) In other cases, we would conduct our proportional share of the mitigation based on land ownership in the project area.	We would evaluate cumulative effects and pursue cooperative agreements to share the responsibility of mitigation among landowners. In some cases we may accept significant individual resource impacts if the activity would result in greater overall ecosystem integrity and greater long-term revenue potential. (e.g., wildlife security may be reduced to promote natural vegetation conditions) We would pursue ecosystem management, and other agreements with adjoining land owners to achieve mutual landscape goals.

ISSUE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
3C) CONFLICTING LAND USES Activities on state lands are not always compatible with adjacent landowners' management, particularly with the increase in residential development on private land. Adjacent land management may impose constraints on the land management activities of state land. Some people believe DNRC should take an active role to resolve these conflicts; some believe that DNRC should not conduct activities that would limit the property rights of adjacent landowners; and others believe DNRC should not modify its activities to accommodate adjacent landowners.	Generally, we would modify our proposed actions to minimize conflicts with uses on adjoining non-state lands. We would coordinate activities with adjacent landowners on a case-by-case basis. When conflicts did occur, we would consider covenants or conservation licenses as a way to compensate the trust while also accommodating adjoining land owners.	Generally, we would modify our proposed actions to minimize conflicts with uses on adjoining non-state lands. We would coordinate activities with adjacent landowners on a case-by-case basis. When conflicts did occur, we would consider covenants or conservation licenses as a way to compensate the trust while also accommodating adjoining land owners.	Generally, we would modify our proposed actions to minimize conflicts with uses on adjoining non-state lands. When conflicts did occur, we would consider covenants or conservation easements as a way to compensate the trust while also accommodating adjoining land owners. We would discourage adjoining land owners from activities that diminished natural conditions on state lands.	We would only adjust our management activities to make them compatible with adjacent land uses when doing so was in the best long-term interests of the trust. We would allow conflicting land uses when the resulting income potential was great. Covenants or conservation licenses would be considered when trust compensation was comparable to that from other marketable uses of the land in question.	We would consider adjusting our timber management activities so they are compatible with adjacent lands when doing so was in the best interests of the trust. We would allow conflicting land uses when the resulting income potential was great. Covenants or conservation licenses to compensate the trust would be considered when trust compensation was comparable to that from other marketable uses of the land in question.	We would only adjust our management activities to make them compatible with adjacent land uses when doing so was in the best interests of the trust. When conflicts did occur, we would consider recreation leases, covenants or conservation licenses as long as the trust was adequately compensated, and overall recreation and wildlife income opportunities were not diminished.	We would consider adjusting our management activities so they are compatible with adjacent lands, when doing so is consistent with the general philosophy of the alternative. We would coordinate activities with adjacent landowners case-by-case. When conflicts did occur, we would consider covenants or conservation licenses as long as the trust was adequately compensated. These covenants or licenses may not fully comply with the biodiversity elements of this alternative. However, because we expect these opportunities to occur on a minor amount of forest acreage, these uses would not compromise the overall fundamental premise of managing for biodiversity.

ISSUE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
4) WILDLIFE There is increasing public sentiment to recognize the importance of wildlife values. Big game hunting contributes an increasing percentage of the state's economic base. Non-game species are an integral part of forest ecosystems. Many people place a very high priority on preserving wildlife habitat, and believe that commodity production degrades habitat quality. Others believe that wildlife values may be enhanced, or at least maintained, through proper management and other commodity uses.	When considering projects, our primary wildlife emphasis would be on protection of big game habitat. When big game needs were not compatible with other management objectives, conflicts would be addressed on a case-by-case basis. We would adopt federal T&E species standards, or develop our own guidelines, to support recovery of threatened and endangered species to the extent that doing so would not conflict with our overriding trust management policy. Habitat for non-game species would only be emphasized when it became an issue on a specific project. Nominal income would be generated from wildlife management through outfitting, hunting or fishing.	When considering projects, we would manage wildlife habitats by promoting a diversity of stand structures and patterns. We would rely on this to provide good habitat for native wildlife populations. Big game habitat would be de-emphasized. We would adopt federal T&E species standards, or develop our own standards of equivalent conservation effect through consultation with U.S. Fish and Wildlife Service, to promote recovery of threatened and endangered species. Non-game species would be protected by promoting a diversity of forest conditions. Income to the trust from wildlife would be generated from outfitting, hunting, and fishing.	We would manage wildlife habitats by promoting natural ecosystem characteristics. We would emphasize habitat for plant and wildlife species such as interior forest dwelling or old-growth-dependent species that are better indicators of overall forest health than big game species. Habitat for T&E species would be managed in ways that would most likely result in species recovery. Income to the trust from wildlife would be generated from outfitting, hunting, fishing, and licensing of non-consumptive wildlife activities such as bird watching or wildlife viewing areas.	Wildlife and its habitat would be considered a resource with income potential. Management activities would be modified to provide an appropriate level of protection to wildlife habitat based on the site-specific potential for income production. Habitat for T&E species would be managed to standards that avoided violation of the Endangered Species Act. Management for non-game species would be limited to those species or sites that represent opportunities to provide income. Income to the trust from wildlife could be generated from exclusive hunting leases, general hunting and fishing, or leases and licenses protecting wildlife values.	Wildlife habitat would be considered secondary to timber management. The level of wildlife habitat protection would be reduced if protection measures would substantially detract from timber management objectives. Habitat for T&E species would be managed to standards that avoided violations of the Endangered Species Act. Nominal income to the trust would be generated from wildlife management through outfitting, and hunting or fishing.	Wildlife and its habitat would be a primary income producing resource. On suitable lands, we would design habitat manipulations to improve income opportunities. We would adopt federal T&E species standards, or develop our own guidelines, to support recovery of threatened and endangered species to the extent that doing so would not conflict with our overriding trust management policy. Non-game species would be managed to maintain viable populations and to provide a variety of recreational opportunities. Income could be generated from activities such as exclusive hunting leases or fish pond development, as well as from general recreation uses.	When considering projects, we would manage wildlife habitats by promoting a diversity of stand structures and patterns. We would rely on this to provide good habitat for native wildlife populations. To the extent possible, we would manage to provide for big game habitat We would participate in recovery efforts of T&E plant and animal species by developing and implementing habitat mitigation measures. Non-game species would be supported by promoting a diversity of forest conditions. Income to the trust from wildlife would be generated from outfitting, general hunting and fishing, or leases and licenses to protect wildlife values.

ISSUE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
5) WATERSHED MANAGEMENT Forest lands generally have high values as watersheds. Timber harvests, livestock grazing, road construction and other land-disturbing activities can impact these values. Many people believe that forest practices should be conducted in a manner that protects water quality. However, there is disagreement over what practices constitute an adequate level of protection. Some people believe that management practices in riparian areas should have more stringent requirements.	We would rely on Forestry Best Management Practices, State Water Quality laws, the SMZ law and our own RMS to provide watershed protection. BMPs would be minimum standards. Effectiveness & implementation of BMPs would be monitored through contract administration and on-site evaluation. Mitigation of cumulative watershed effects would be emphasized, and appropriate constraints would be applied to our activities.	We would rely on Forestry Best Management Practices, State Water Quality laws, the SMZ law and our own RMS to provide watershed protection. BMPs would be minimum standards. Effectiveness & implementation of BMPs would be monitored through contract administration and on-site evaluation. We would pursue an aggressive program of water quality rehabilitation to mitigate the effects of past activities. Mitigation of cumulative watershed effects would be emphasized and appropriate constraints would be applied to our activities. RMS would give special emphasis to protection of riparian zones.	We would adopt a standard of no net impact to sensitive watersheds and important fisheries. In most cases our practices would exceed BMPs, Water Quality laws and SMZ regulations. Effectiveness & implementation of BMPs would be monitored through contract administration and on-site evaluation. We would pursue an aggressive program of water quality rehabilitation to mitigate the effects of past activities. Mitigation of cumulative watershed effects would be emphasized, and appropriate constraints would be applied to our activities. RMS would give special emphasis to protection of riparian zones.	We would rely on Forestry Best Management Practices, State Water Quality laws, the SMZ law and our own RMS to provide watershed protection. BMPs would be minimum standards. Effectiveness and implementation of BMPs would be monitored through contract administration and on-site sale evaluation. Mitigation of cumulative watershed effects would be emphasized, and appropriate constraints would be applied to our activities. We would do watershed rehabilitation if it would increase income opportunities.	We would rely on Forestry Best Management Practices, State Water Quality laws, the SMZ law and our own RMS to provide watershed protection. BMPs would be minimum standards. Effectiveness and implementation of BMPs would be monitored through contract administration and on-site sale evaluation. Mitigation of cumulative watershed effects would be emphasized, and appropriate constraints would be applied to our activities. We would do watershed rehabilitation if it would increase timber opportunities.	We would rely on Forestry Best Management Practices, State Water Quality laws, the SMZ law and our own RMS to provide watershed protection. BMPs would be minimum standards. Effectiveness and implementation of BMPs would be monitored through contract administration and on-site sale evaluation. We would pursue an aggressive water quality and fisheries rehabilitation program to mitigate the effects of past activities in watersheds with high fisheries values. Mitigation of cumulative watershed effects would be emphasized, and appropriate constraints would be applied to our activities.	We would rely on Forestry Best Management Practices, State Water Quality laws, the SMZ law and our own RMS to provide watershed protection. Our operations would meet or exceed BMPs. Effectiveness and implementation of BMPs would be monitored through contract administration and on-site evaluation. We would emphasize mitigation of existing water quality impacts in order to minimize the effects of past activities. Mitigation of cumulative watershed effects would be emphasized and appropriate constraints would be placed on our activities. RMS would give special emphasis to the protection of riparian zones.

ISSUE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
6) WEED MANAGEMENT The spread of noxious weeds has become an important issue statewide. Weeds established on state lands can spread to other ownerships. Livestock use, recreational activities and logging can distribute weeds. DNRC must comply with weed management laws. Some people believe DNRC should share the cost of weed control and suggest that a variety of uses could share the cost of control. There is some concern regarding the use of chemicals to control weeds.	We would comply with weed management laws through agreements with county weed boards. Stipulations to limit weed distribution would be included in all contracts. A portion of recreational fees and forest improvement fees would be used for weed control. Users would be responsible for weed control related to their leased or licensed use. Herbicide spraying would be used as a weed control measure when appropriate.	We would take a more active approach to weed control than in the past. Stipulations to limit weed distribution would be included in all contracts. A portion of recreational fees and forest improvement fees would be used for weed control. Users would be responsible for weed control related to their leased or licensed use. Herbicide spraying would be used as an interim practice, but long range emphasis would be on integrated pest management.	We would take a more active approach to weed control than in the past. Restrictions or mitigations would be placed on most activities to prevent or control noxious weeds. A portion of fees from most uses would be dedicated to weed control programs. Users would be responsible for weed control related to their leased or licensed use. Natural and biological weed control measures would be favored. Herbicides would be used only for spot spraying of new infestations.	We would take a more active approach to weed control than in the past. Stipulations to limit weed distribution would be included in contracts. A portion of fees from most uses would be dedicated to weed control programs. Users would be responsible for weed control related to their leased or licensed use. Herbicide spraying would be used for weed control when it was the most cost effective method for protecting marketable values. However, it would be part of an integrated pest management program.	We would comply with weed management laws through agreements with the County Weed Boards. Stipulations to limit weed distribution would be included in timber sale agreements. A portion of fees from most uses would be dedicated to weed control programs. Users would be responsible for weed control related to their leased or licensed use. Herbicide spraying would be used for weed control when it was the most cost effective method for protecting marketable values. However, it would be part of an integrated pest management program.	We would comply with weed management laws through agreements with the County Weed Boards. Stipulations to limit weed distribution would be included in contracts. A portion of fees from most uses would be dedicated to weed control programs. Users would be responsible for weed control related to their leased or licensed use. Herbicide spraying would be used for weed control when its net effect was to enhance income potential from recreation and wildlife management. Our overall emphasis would be on integrated pest management.	We would take a more active approach to weed control than in the past. Stipulations for weed prevention would be included in all timber sale contracts. A portion of recreation fees and forest improvement fees would be used for weed control. We would emphasize an integrated pest management approach to weed control per HB 395. This approach would be implemented using one or a combination of weed treatments, including biological, herbicide and cultural treatments, based on overall effectiveness and cost considerations.

ISSUE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
7) GRAZING Livestock grazing is a traditional use that is becoming controversial. Forest grazing can impact water quality, riparian habitat and understory vegetation. Some people believe that livestock grazing should be more closely managed by DNRC. Others believe that livestock grazing is a historic and valuable revenue-producing use with which other less productive uses should not interfere. Some forested state lands are classified as principally valuable for grazing.	Lessees on forested classified grazing lands would be responsible for management, type of livestock, season of use, and animal distribution. They would be required to develop and maintain improvements. Grazing licenses, on classified forest lands, would specify AUMs, and season of use. Licenses could be modified to accommodate timber management activities. Carrying capacities would be based on potential forage production. Lease and license administration and monitoring would have low priority. We would not routinely monitor the watershed effects from livestock grazing.	Grazing leases and licenses would be more closely monitored to evaluate impacts to forest ecosystems. The condition of riparian areas would serve as a primary indicator of management impacts. Restrictions would be placed on grazing practices to promote a diverse ecosystem and protect watersheds. Lessees/licensees would be required to develop and maintain improvements. Grazing leases/licenses on classified forest lands would specify animal type, AUMs, and season of use. Leases/ licenses could be modified to accommodate other management activities.	Grazing of rangeland areas intermingled with forest would only be allowed when not damaging to plant communities, water quality and riparian zones. The condition of riparian zones would be used as a primary indicator of management impacts. Some grazing licenses could be suspended to allow range recovery and forest regeneration. Lessees/licensees would be required to develop and maintain improvements. Grazing leases/licenses on classified forest lands would specify animal type, AUMs, and season of use. Leases/ licenses could be modified to accommodate other management activities.	Livestock grazing would be promoted on sites where it was a primary income source, and suspended or restricted in areas where it would adversely affect higher income uses. The condition of riparian zones would be used as a primary indicator of management impacts. Grazing leases/licenses on classified forest lands would specify animal type, AUMs, and season of use. Leases/ licenses could be modified to accommodate other management activities.	Grazing use would be secondary to timber management. Where compatible, grazing and timber would both be managed. Grazing could be suspended/restricted in areas where it impacted timber production (i.e. regeneration sites). Riparian areas would be managed more intensely due to watershed concerns and the potential to limit timber management. The condition of riparian zones would be used as a primary indicator of management impacts. Grazing leases/ licenses on classified forest lands would specify animal type, AUMs, season of use. Leases/ licenses could be changedd to accommodate timber activities.	Forested rangeland would be managed more intensively so as to enhance wildlife and recreation income generating opportunities. Grazing leases and licenses on classified forest lands would specify animal type, AUMs, and season of use. Contracts could be modified and grazing practices could be restricted to promote wildlife values and recreational opportunities. Lessees and licensees would be required to develop and maintain improvements. The condition of riparian zones would be used as a primary indicator of management impacts.	Grazing leases and licenses would be more closely monitored to evaluate impacts to forest ecosystems. The condition of riparian areas would serve as a primary indicator of management impacts. Restrictions would be placed on grazing practices to promote a diverse ecosystem and protect watersheds. Lessees/licensees would be required to develop and maintain improvements. Grazing leases/licenses on classified forest lands would specify animal type, AUMs, and season of use. Leases/licenses could be modified to accommodate other management activities.

ISSUE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
8) TIMBER MANAGEMENT There are strong sentiments both for increasing and for reducing the amount of timber to be harvested from state lands. Some argue that harvesting timber at the maximum sustainable level would optimize trust revenue. They believe a steady, sustainable timber harvest from state lands is healthy for the forest. Others believe that reducing timber harvests would benefit ecosystem health, other resources and provide higher quality timber for future harvest when real timber values are much higher.	We would try to offer a steady and sustainable supply of timber from forested state lands. Constraints to our annual harvest would result from T&E species requirements, SMZs, watershed concerns and cumulative effects considerations. Salvage of dead and dying material would be pursued as market conditions and staffing allowed.	Timber would be managed both for income and as a tool to promote biological diversity. We would try to offer a steady and sustainable supply of timber from forested state lands. Salvage of dead and dying material would occur where economically feasible, only after sufficient material was retained to maintain biological diversity.	Timber harvest may be used as a tool to help restore and maintain ecosystem integrity, but we would not attempt to offer a steady timber harvest target each year. The concept of sustained yield would be modified to include ecosystem components such as fungi, rots, dead downed debris, micro-organisms and fauna. Sustainability of ecological features, processes, plant and animal species, and overall environmental quality would be emphasized, rather than a sustained supply of timber.	Timber harvest would be an important contributor to trust income, but not necessarily the primary one. We would not attempt to offer a steady annual harvest, but rather to take advantage of market conditions. When market conditions were favorable for a given product, we would offer higher volumes for sale. Lands would be managed for sustainable yield over the long term. Maximum harvests would be constrained by marketing of other forest uses; protection of watershed values, wildlife, and T&E species; and by cumulative effects. Salvage of dead and dying material would be pursued as market conditions and staffing allowed.	We would try to offer the highest sustainable annual timber supply from forested state lands. Constraints to our annual harvest would result from T&E species requirements, SMZs, watershed concerns and cumulative effects considerations. Salvage of dead and dying material would be emphasized as market conditions and staffing allowed.	Timber management would be secondary to management for wildlife and recreation. Timber harvests would be used as a tool to improve wildlife habitat or where recreational values are limited. We would not offer a steady annual supply of timber from forested state lands. Salvage of dead and dying material would be conducted where compatible with recreational needs and when economically feasible.	Timber would be managed both for income and as a tool to promote biological diversity. We would offer the highest sustainable supply of timber from forested state lands while providing for necessary biodiversity and as consistent with all other elements of this alternative. Salvage of dead and dying material would occur where economically feasible after sufficient material was retained to address biological diversity issues.

ISSUE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
9) CLEARCUTTING There is strong sentiment for minimizing or eliminating the use of clearcutting. Some people oppose all forms of even-aged management. They see clearcutting as a wasteful, inappropriate practice that benefits only timber production, at an unacceptable cost to other resources. Many people oppose clearcutting simply because of its appearance. Other people believe clearcutting, appropriately used, is a beneficial and cost efficient silvicultural tool. They think it would be a mistake to reject the practice altogether because it has been overused and abused in the past.	Even aged management, including clearcutting, would be used where appropriate. There would be no formal policy favoring even aged or uneven aged management. Scenic values would be considered in harvest design.	Timber harvests would be designed to more closely simulate the effects of natural disturbances. This could include some clearcutting; but even aged management techniques would generally be modified to retain some snags and live trees. Scenic values would be considered in harvest design.	Even aged management would be used only where it would enhance biodiversity and was consistent with the landscape level biodiversity plan. Clearcutting would be avoided. Scenic values would be considered in harvest design.	Even aged management, including some clearcutting, would be used. There would be no formal policy favoring even aged or uneven aged management.	Even aged management, including some clearcutting, would be used. There would be no formal policy favoring even aged or uneven aged management.	Clearcutting would be used on sites where it was compatible with wildlife needs. Clearcuts would generally be used to create small openings for big game forage. Clearcutting would also be used to accomplish silvicultural objectives on tracts that had little recreational value. Scenic values would be considered in harvest design.	Timber harvests would be designed to more closely simulate the effects of natural disturbances. This could include some clearcutting; but even-age management techniques would generally be modified to retain some snags and live trees. Scenic values would be considered in harvest design. Mitigations may be applied as long as they did not result in significant loss of trust revenue.

ISSUE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
10) ECOSYSTEM INTEGRITY There is public concern regarding the impacts of timber harvests on overall ecosystem health. Some people believe that traditional timber harvests alter the function of forest ecosystems, decrease biological diversity and reduces future forests productivity. They believe protection of old-growth forests and maintenance of natural forest characteristics should be a priority. Others believe that old-growth forests are biologically unhealthy and individual dead or dying trees should be harvested to use the resource before it is wasted.	Some practices undertaken to maintain long-term site productivity and stand health may also promote biodiversity; however, we would not normally engage in practices with the expressed purpose of promoting biodiversity. Retention of old-growth would be addressed on a case-by-case basis where it is an issue.	We would promote biodiversity by favoring diversity of stand structures and patterns. We would use landscape evaluations to identify opportunities for meeting this objective while also generating sustained levels of trust revenue. We would attempt cooperation with other land owners through ecosystem management plans that promoted biodiversity across landscapes. Old-growth would be maintained or restored in at least half the amounts that would be expected to occur on state lands under natural processes in similar forest types.	Forested state lands would be managed to maintain and restore natural ecological characteristics. Activities would be guided by landscape-level biodiversity plans. We would attempt cooperation with other land owners through ecosystem management plans that promoted biodiversity across landscapes. We would try to maintain or restore old-growth in amounts similar to those believed to occur as a result of natural processes.	Some practices undertaken to maintain long-term site productivity and stand health may also promote biodiversity; however, we would not normally engage in practices with the expressed purpose of promoting biodiversity. Old-growth would not be protected, except where the trust was compensated, or where necessary to address site-specific issues.	Some practices undertaken to maintain long-term site productivity and stand health may also promote biodiversity; however, we would not normally engage in practices with the expressed purpose of promoting biodiversity. Old-growth would not be protected, except where the trust was compensated, or where necessary to address site-specific issues.	We may engage in practices designed to promote biodiversity in order to support income opportunities related to wildlife and recreation. Old-growth would be maintained or restored in at least half the amounts that would be expected to occur on state lands under natural processes in similar forest types.	We would promote biodiversity by favoring diversity of stand structures and patterns. We would use landscape evaluations to identify opportunities for meeting this objective while also generating sustained levels of trust revenue. We would attempt cooperation with other land owners through ecosystem management plans that promoted biodiversity across landscapes We would seek to maintain or restore old-growth forest in amounts of at least half the average proportion that would be expected to occur with natural processes on similar sites. We would maintain sufficient replacement old-growth to meet this goal given that old-growth does not live forever.

ISSUE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
11) TRUST MGMT POLICY Public opinion and understanding of DNRC's trust mandate varies. Some people believe the trust mandate should be strictly interpreted and environmental protection measures beyond what are legally required should not interfere with trust revenue production. They believe the environment can be adequately protected with minimal impact on trust revenue while also contributing jobs and a tax base to the economy. Others believe that environmental protection must come before trust income. They think DNRC should reduce timber harvests to compensate for activities of other landowners and past harvest practices.	We would accept the traditional belief that the best way to produce long- term trust income is to manage lands for timber production while meeting DNRC standards for environmental protection. Timber would be our primary income source. We would consider outside proposals for other income-producing uses, but we would rarely initiate such projects. We would favor low or non-income producing uses to the degree that they were compatible with timber management. Decisions on short- or long- term values and future land uses would be made on a case-by-case basis. We would view our obligation to local economies as providing a steady timber supply while maintaining aesthetic, recreational and environmental quality.	We would assume that the best way to produce long-term income for the trust would be to manage intensively for healthy and biologically diverse forests. This would provide for sustained income from both timber and a variety of other potential uses. It would also help maintain stable trust income in the face of uncertainty regarding future resource values. Land use decisions would promote diversity as a means to enhance long-term income through projects that also yielded short-term income. We would view our obligation to local economies as maintaining a healthy, diverse forest that yielded a steady stream of timber and other marketable outputs, and also maintaining aesthetic, recreation, and environmental quality.	We would assume that wildland values would be much higher in the future than they are now, so the best way to produce long-term income is to defer uses that prohibit the forest ecosystem from evolving naturally. The value of undisturbed natural forest environments would be so great that the short-term income loss would be less than the long-term gain. We would emphasize modest levels of low impact uses to generate short-term income while managing for long-term ecosystem maintenance. Our obligation to local economies would be seen as one of providing long-term stability, a pleasant living environment and a wide range of future options.	We would assume the best way to produce long-term income for the trust would be to allow market conditions to drive management of state forest lands. We would inventory our resources and actively market the best combination of income producing uses. Relying on a diversified mix of resources to produce income would allow DNRC to take advantage of market conditions and changing resource values. Decisions on short- and long-term values and future land uses would be made on an economic basis with an emphasis on income production. Our obligation to local economies would be viewed as one of providing maximum long-term income to the trust for the support of schools.	We would assume that the best way to produce long term trust income would be to manage lands for timber production while meeting Department standards for environmental protection. We would actively market timber as our primary income-producing activity. We would consider proposals for other uses, and accommodate low- or non-income-producing uses when they were compatible with timber management. Decisions on short- or long-term values and future land uses would be made on a case-by-case basis, with emphasis on long-term timber values. We would view our obligation to local economies as one of providing a steady timber supply to local processing facilities.	The best way to produce long-term income for the trust would be to manage state forest lands primarily for wildlife and recreational values. Income-generating activities that utilized wildlife and recreational resources would be actively marketed. Timber management activities would supplement trust income when compatible with our recreational and wildlife management goals. Decision on long- and short-term values and future land uses would be made on a case-by-case basis, with emphasis on long-term recreation and wildlife values. Our obligation to local economies would be viewed as one of providing aesthetic, recreational and wildlife values in a manner that produced trust revenue for the support of local schools.	The best way to produce long-term income for the trust would be to manage intensively for healthy and biologically diverse forests. Healthy and biologically diverse forests would provide for sustained income from both timber and a variety of other potential uses. It would also help maintain stable trust income in the face of uncertainty regarding future resource values. We would pursue non-timber commercial uses as guided by changing markets for new and traditional uses. Where we pursue non-timber uses, we may not comply with the biodiversity elements of this alternative. However, because we expect these uses to occur on a minor amount of forest acreage, they would not compromise the overall premise of managing for biodiversity.

ISSUE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
12) PUBLIC INVOLVEMENT AND PLANNING							
MEPA and other laws require DNRC to solicit public input in planning and management activities. Some people believe that a sincere and aggressive public involvement effort would prevent domination by special interest and political pressures. Others believe that the public needs to be effectively informed about DNRC activities and management goals. However, excessive public involvement may lead to unwise or political decisions that are contrary to DNRC's management goals and trust responsibilities.	Public participation efforts would conform to current MEPA rules. The degree of public involvement would be project-specific and vary by public interest and uncertainty of, or potential for, significant impacts. Proposed projects would be modified to address public concerns to the extent consistent with our trust obligations. Site-specific management decisions would be made at the most local level possible.	Public participation efforts would conform to current MEPA rules. The degree of public involvement would be project-specific and vary by public interest and uncertainty of, or potential for, significant impacts. Proposed projects would be modified to address public concerns to the extent consistent with our trust obligations. Site-specific management decisions would be made at the most local level possible.	Public participation efforts would conform to current MEPA rules. The degree of public involvement would be project-specific and vary by public interest and uncertainty of, or potential for, significant impacts. Proposed projects would be modified to address public concerns to the extent consistent with our trust obligations. Site-specific management decisions would be made at the most local level possible.	Public participation efforts would conform to current MEPA rules. The degree of public involvement would be project-specific and vary by public interest and uncertainty of, or potential for, significant impacts. Proposed projects would be modified to address public concerns to the extent consistent with our trust obligations. Site-specific management decisions would be made at the most local level possible.	Public participation efforts would conform to current MEPA rules. The degree of public involvement would be project-specific and vary by public interest and uncertainty of, or potential for, significant impacts. Proposed projects would be modified to address public concerns to the extent consistent with our trust obligations. Site-specific management decisions would be made at the most local level possible.	Public participation efforts would conform to current MEPA rules. The degree of public involvement would be project-specific and vary by public interest and uncertainty of, or potential for, significant impacts. Proposed projects would be modified to address public concerns to the extent consistent with our trust obligations. Site-specific management decisions would be made at the most local level possible.	Public participation efforts would conform to current MEPA rules. The degree of public involvement would be project-specific and vary by public interest and uncertainty of, or potential for, significant impacts. Proposed projects would be modified to address public concerns to the extent consistent with our trust obligations. Site-specific management decisions would be made at the most local level possible.

ISSUE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
13) RECREATIONAL OPPORTUNITIES There is broad public interest in maintaining a variety of recreational opportunities on state land. Some people advocate a form of user fee for recreation in addition to hunting and fishing on state land. Others believe that non-consumptive recreational uses should be free. There are opinions that recreational uses could generate substantial income to the trust if those values were marketed. Some people believe that forest practices may render state lands less desirable for recreational opportunities, and criteria should be developed to determine valuable recreational sites.	General recreational use (see definition under Public's Right to Use State Lands) would be allowed on legally accessible lands with the purchase of a Recreational Use License (RUL). Cabinsites would continue to be leased. New cabinsite development would be minimal and only as workload allowed. Outside proposals to develop recreational sites would be considered but would receive a relatively low priority.	General recreational use would be allowed on legally accessible lands with the purchase of a RUL. We would develop recreation uses compatible with maintenance of healthy ecosystems. Cabinsites would continue to be leased and new ones developed where appropriate. We would develop recreation sites if they were compatible with maintenance of a healthy ecosystem.	General recreational use would be allowed on legally accessible lands with the purchase of a RUL. We would promote minimum impact recreation developments that augmented use of the natural ecosystem. Low impact dispersed, recreational uses would be encouraged. Highly-developed recreation sites, such as ski areas, would be discouraged except in areas already unsuitable for restoration of natural conditions. Existing cabinsites would be leased; however, new cabinsite development would only be considered in areas already unsuitable for restoration of natural conditions.	General recreational use would be allowed on most legally accessible lands with the purchase of a RUL. However, some high valued sites could be offered for exclusive hunting, fishing, or other recreational leases. We would propose to increase the uses requiring a RUL and propose that the fees reflect market value. We would actively promote and develop recreational uses on state lands where those uses could generate income to the trust. Some lands would be managed primarily for recreational use where that income potential is greatest. Cabinsites would continue to be leased and new ones developed where appropriate.	General recreational use would be allowed on legally accessible lands with the purchase of a RUL. Cabinsites would continue to be leased. New cabinsite development would be minimal and only as workload allowed. Outside proposals to develop recreational sites would be considered but would receive a relatively low priority.	Income generating recreation and wildlife management would be the primary focus of DNRC's forest land management program. State lands with wildlife and recreational income potential would be reclassified and managed for that use. General recreational use (see definition under Public's Right to Use State Lands) would be allowed on many state lands. However, some high valued sites could be offered for exclusive hunting, fishing, or other recreation leases. Cabinsites would continue to be leased and new ones developed where appropriate.	General recreation use would be allowed on legally accessible lands with the purchase of a RUL. Cabinsites would continue to be leased and new ones developed where appropriate. We would develop recreational opportunities as guided by changing markets for new and traditional uses. These lands may not comply with the biodiversity elements of this alternative. However, because we expect these other income opportunities to occur on a minor amount of forest acreage, these uses would not compromise the overall fundamental premise of managing for biodiversity.

SCENARIOS

In order to develop our assessment of the projected environmental effects of each alternative, we created hypothetical scenarios for timber harvest, grazing levels, recreational use, and road density. These scenarios were developed for the purpose of providing some tangible basis for our resource and economics effects assessments. They are not accomplishment targets. They are simply estimates of probable ranges of activity, given the management philosophy we would adopt under each alternative. Tables II-T1, II-G1, II-R1 and II-RD1 show the estimates of harvest levels, grazing levels, exclusive recreational lease percentages, and road densities that we developed prior to our effects analysis. Appendix SCN details our development of these scenarios. More information on the development of our recreation use estimates is also found in Appendix ECN.

Table II-T1
ESTIMATED RANGE OF TIMBER HARVEST LEVELS FOR EFFECTS ASSESSMENT PURPOSES[1] (MMBF)

	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
HIGH	40	35	10	45	55	20	50
LOW	20	15	5	15	35	10	30

Table II-G1
ESTIMATED LEASED/LICENSED AUMS FOR EFFECTS ASSESSMENT PURPOSES[2]

ALTERNATIVE	AUMS ON FORESTED GRAZING LAND	AUMS ON CLASSIFIED FOREST LAND	TOTAL
ALPHA	10,822	15,594	26,766
BETA	10,822	10,370	21,192
GAMMA	10,822	7,977	18,799
DELTA	8,658	9,752	18,230
EPSILON	10,822	11,168	21,990
ZETA	8,658	9,752	18,230
OMEGA	10,822	10,370	21,192

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1 An explanation of the development of our timber scenarios can be found in Appendix SCN.

2 An explanation of the development of our grazing scenarios can be found in Appendix SCN.

Table II-R1
ESTIMATED PERCENTAGE OF STATE FOREST ACRES OFFERED FOR DISPERSED LEASING FOR EFFECTS ASSESSMENT PURPOSES[3]

ALTERNATIVE	PERCENT	REASONING
ALPHA	10	Based on current levels and alternative philosophy.
BETA	15	Slightly higher priority placed on recreation uses compatible with healthy ecosystems.
GAMMA	20	Promotion of low-impact dispersed recreation use.
DELTA	30	Active promotion of high-value opportunities which may include dispersed recreation.
EPSILON	10	Low priority. Must not interfere with timber management.
ZETA	70	Active promotion of high-value wildlife and recreation opportunities.
OMEGA	15	Development of recreation opportunities as guided by changing markets for new and traditional uses.

3 An explanation of the development of our recreation scenarios can be found in Appendix SCN and in Appendix ECN .

Table II-RD1
ESTIMATED ROAD DENSITIES FOR EFFECTS ASSESSMENT PURPOSES[4]
YEAR 2020

	NWLO		SWLO		CLO		SLO, ELO, NELO		TOTAL	
	TOTAL	OPEN	TOTAL	OPEN	TOTAL	OPEN	TOTAL	OPEN	TOTAL	OPEN
EXISTING	2.7	1.4	2.4	0.6	1.1	0.2	1.1	0.2	2.0	0.8
ALPHA										
High	4.1	2.1	3.6	0.9	1.5	0.2	1.8	0.4	3.0	1.2
Low	3.4	1.7	3.0	0.8	1.3	0.2	1.4	0.3	2.5	1.0
BETA										
High	3.7	1.4	3.3	0.6	1.3	0.1	1.6	0.2	2.8	0.8
Low	3.1	1.2	2.7	0.5	1.2	0.1	1.3	0.2	2.3	0.7
GAMMA										
High	2.9	0.9	2.6	0.4	1.2	0.1	1.2	0.1	2.1	0.5
Low	2.8	0.8	2.4	0.4	1.1	0.1	1.2	0.1	2.0	0.5
DELTA										
High	4.4	2.2	3.8	1.0	1.5	0.2	1.8	0.4	3.2	1.3
Low	3.2	1.6	2.8	0.7	1.2	0.2	1.4	0.3	2.4	1.0
EPSILON										
High	4.6	2.3	4.0	1.0	1.6	0.2	2.0	0.4	3.3	1.3
Low	3.9	2.0	3.4	0.9	1.4	0.2	1.7	0.3	2.9	1.1
ZETA										
High	3.3	1.2	3.1	0.6	1.3	0.1	1.3	0.2	2.5	0.7
Low	3.0	1.1	2.6	0.5	1.2	0.1	1.3	0.2	2.2	0.7
OMEGA										
High	4.0	1.6	3.6	0.7	1.5	0.2	1.7	0.3	2.9	0.9
Low	3.5	1.4	3.0	0.6	1.3	0.2	1.5	0.2	2.6	0.8

4 An explanation of the development of our road density scenario can be found in Appendix SCN.

STRUCTURE OF OUR ANALYSIS

We divided our analysis topically into two categories. The first category, Physical and Biological Environment, includes forest soils, watershed, air quality, vegetation, wildlife, fisheries, historical and archaeological sites, and the visual environment. The second category, Financial and Administrative Environment, includes the administrative organization and economic contributions of DNRC's Trust Land Management Division.

The first part of our analysis, presented in Chapter III, examines the existing environment and describes its current condition. In Chapter IV, we predict the effects of each alternative by estimating impacts on two or more descriptors that we used to measure changes expected to result from the proposed management activities. Each resource analysis has its own descriptors. For example, some of the descriptors used in the vegetation analysis include forest type, stand age, and old-growth amounts, while descriptors for the fisheries analysis included stream temperature, large organic debris, and sediment levels.

ENVIRONMENTAL CONSEQUENCES: CONCLUSIONS OF ANALYSIS

The conclusions of our final environmental impact statement are too complex to be completely summarized here. We can state some of the general results of the analysis for each alternative, however. This summary will focus on three factors in the analysis: (1) the predicted impact of the alternative on forest health, defined as the trend toward historic conditions in forest types, stocking levels, old-growth features, and patch characteristics; (2) its likely impact on other elements of the biological and physical environment; and (3) the Net Present Monetary Value (NPV) of each alternative as we calculated it.

Together, these three factors, forest health, environmental effects, and net present value, describe the predicted effects of each alternative in a way that balances the two parts of the trust mandate: to provide ongoing funds to the common schools, and to care for the trust resource over the long term.

EFFECTS OF ALPHA

Alpha is not predicted to have a net beneficial impact on any component of the physical and biological environment, including forest health. Its projected NPV is the fourth highest, following Epsilon, Omega and Delta.

EFFECTS OF BETA

We predict Beta would have a net beneficial effect on forest health, but only at the high end of its harvest level scenario. There will be fewer negative impacts on other biological and physical resources under Beta than under Alpha, Delta, Epsilon or Omega, but more than under Gamma and Zeta. Projected NPV is ranked fifth, following Epsilon, Omega, Delta, and Alpha.

EFFECTS OF GAMMA

We expect Gamma to offer beneficial conditions for all biological and physical resources except forest vegetation. Its low harvest levels, combined with continued wildfire suppression, would create conditions that could cause forest health to decline further from historical conditions. Gamma has the lowest NPV of any alternative.

EFFECTS OF DELTA

Delta is expected to have the third highest NPV, following Epsilon and Omega. We also predict it would have a somewhat beneficial impact on forest health, depending on harvest levels and the mix of activities under this market-driven alternative. It also has the potential for more adverse impacts on other biological and physical elements than any alternative but Epsilon, again depending on the management program that develops.

EFFECTS OF EPSILON

Epsilon offers the highest NPV of any alternative. It also has the potential to have a net beneficial effect on forest health. It is likely to have some degree of adverse impact on the other biological and physical components.

EFFECTS OF ZETA

Our analysis indicates that Zeta would have little positive effect on forest health, if any. Its impact on other biological/physical components would depend to some extent on their value for recreation and wildlife activities; some would benefit, others would not. Its NPV is the second lowest.

EFFECTS OF OMEGA

Our analysis indicates that Omega would have the second highest NPV, following closely behind Epsilon. Indications are that it has the potential to be the most beneficial alternative for forest health. The expected impact of Omega on other biological and physical resources is less than Alpha, Delta and Epsilon but greater than Beta, Gamma and Zeta.

PREFERRED ALTERNATIVE

Since the release of the DEIS and the development of the Omega alternative, we have identified a preferred alternative based on the following selection criteria:

1) monetary return to the school trust;
2) long term health of our forest resource; and
3) effect on the biological and physical environment.

It was the general opinion of the planning team that two of the alternatives, Gamma and Zeta, are seriously deficient according to one or more of the criteria above.[5] The remaining five alternatives, Alpha, Beta, Delta, Epsilon, and Omega, do satisfy all of the criteria to varying degrees. This is demonstrated in the effects assessment presented in Chapter IV. Of the remaining five, Omega is preferred.

In terms of the selection criteria, Omega is predicted to provide the second highest NPV of all of the alternatives. This prediction is based on the harvest level scenarios with which we conducted our effects assessment. The actual harvest levels will be determined through the sustainable yield study commissioned by § 77-5-221--223 MCA (HB 201 1995). That study will use the management philosophy and RMS of the final alternative to determine what will be our legislatively mandated sustainable harvest.

In addition, Omega allows flexibility for the pursuit of income opportunities other than timber when their revenue potential meets or exceeds that of long-term timber potential. This will allow us to respond to changing markets for new and traditional uses and products, again meeting our trust mandate.

We believe that Omega will provide an opportunity to meet our trust mandate, while also contributing to the health and diversity of state forest lands. The biodiversity management philosophy of Omega, similar to

[5] Public comment on the DEIS asked us to provide more information on why Gamma and Zeta were not preferred alternatives. See page RSP-112 for that information.

those philosophies used nationwide by other state and federal agencies, will allow us to manage the proportion and distribution of forest types and structures that were historically present on the landscape. As a result, we will be able to provide for the long-term health of the forest by reducing risks of catastrophic fires, and insect or disease attacks.

Omega will have a mid-range impact on biological and physical resources, when compared to the other alternatives. However, we believe that the Resource Management Standards developed for Omega will provide sufficient mitigation measures (and in some cases, such as SMZs and BMPs, proactive management to prevent impacts) to protect Montana's resources.

On balance, when we evaluated how each of the alternatives met the selection criteria, we judged that Omega best met the combination of the three selection criteria.

SUMMARY OF ENVIRONMENTAL EFFECTS

The following table presents a concise summary of the environmental, administrative, and economic consequences we would expect with implementation of each alternative. This table can not be fully understood by itself; it is simply a quick way to provide a general idea how the alternatives compare on various important points. The assumptions, analysis procedures, and discussions leading to this brief summary are presented in Chapter IV of this Final Environmental Impact Statement.

SUMMARY OF ENVIRONMENTAL CONSEQUENCES

CONSEQUENCE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
FOREST SOILS							
Availability of Soil Nutrients	Maintain 80%	Maintain 90%	Maintain 90%	Maintain 80%	Maintain 80%	Maintain 90%	Maintain 90%
Accelerated erosion/slope stability	slight increase	slight decrease	decrease	slight increase	increase	decrease	slight increase
Soil compaction and displacement	Keep impacts to less than 20% of site	Keep impacts to less than 15% of site	Keep impacts to less than 15% of site	Keep impacts to less than 20% of site	Keep impacts to less than 20% of site	Keep impacts to less than 15% of site	Keep impacts to less than 15% of site
WATERSHED Impact Ranking: Low Number = Less Adverse Impact							
Sediment and Nutrient Loading Risk[6]	7	3	1	4/5	6	2	4/5

6 Lower number means a lower overall risk of sediment and nutrient loading impacts. This ranking is a function of timber harvest level, percent clearcut, road density, grazing, and recreation as explained on in the Watershed Methodology section of Chapter IV.

CONSEQUENCE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
AIR QUALITY							
Particulate from Wildfires: (Deviation from Current Level)	Slight Increase to Slight Decrease	Slight Increase to Slight Decrease	Increase	Slight Increase to Slight Decrease	Slight Increase to Slight Decrease	Slight Increase	Slight Increase to Slight Decrease
Particulate from Prescribed Burning: (Hi-Lo range, % of 1982-91 avg.)	60-120%	45-105%	15-30%	45-135%	105-165%	30-60%	90-150%

CONSEQUENCE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA

FOREST VEGETATION

Symbols indicate predicted change from present levels:
+ Increase
- Decrease
= Little Change
Multiple + and - Larger magnitude changes.
+/-, =/+, =/- Predicted Changes Vary Depending on Harvest Levels or Other Factors.

CONSEQUENCE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
Stand Size Classes							
Nonstocked:	+/-	+/-	-	+/-	+/-	-	+/-
Seed/sap:	+	+/-	-	+/-	+	+/-	+/-
Poletimber:	--	--	--	--	--	--	--
Sawtimber:	+	+	++	=/+	=	++	+
Stand Age Distribution							
Young:	+	+/-	-	=/+	++	+/-	+/-
Immature:	--	--	--	--	--	--	--
Mature:	++	++	++	++	++	++	++
Older:	+	++	+++	+	+/-	++	+
Forest Types: (Net Shift Toward Earlier- vs. Later-Successional Species.)	Either direction, depending on harvest level and ecological group.	Either direction, depending on harvest level.	Later-successional.	Either direction, depending on harvest level.	Earlier-successional.	Later successional.	Earlier-successional.

CONSEQUENCE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
FOREST VEGETATION (continued)							
Stocking Levels: (Overall Trend)	+	+/-	++	+/-	+/-	+	+/-
Old-growth Net Change:	+/-	=/+	+	+/-	-	+	=/+
Potential for Long-Term Replacement:	Low/Moderate	Moderate/High	Low	Low/Moderate	Moderate	Low/Moderate	Moderate/High
Snag Abundance							
Small Snags:	=/+	+/-	+	=/+	-	+	-
Large Snags:	=/-	=/+	+	=/-	-	+	+
Patch Characteristics--Level of Variation Between							
Small Patches:	-	+	-	-	-	+/-	+
Med. Patches:	+	+/-	-	+/-	+	-	-
Large Patches:	-	+/-	+/-	+/-	-	+/-	+

FOREST VEGETATION (continued)

CONSEQUENCE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
Cumulative Effects (Forest Health) Trend Toward (+) or Away From (-) Historic Conditions in							
Forest Types:	+/-	+/-	-	+/-	+	-	+
Stocking:	-	+/-	-	+/-	+/-	-	+/-
Old-Growth Features:	-	=/+	+	=/-	-	+	=/+
Patch Characteristics:	--	=/+	-	--	--	=/-	=/+

CONSEQUENCE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
PLANT SPECIES OF SPECIAL CONCERN							
Mechanical Disturbances: Level of Impact (Low Number = Less Impact)	4	3	1	6	7	2	5
Exotic Species Infringement: Risk of Spread	moderate - high	low - moderate	low	moderate	high	low - moderate	low - moderate
Grazing Levels (Low Number = Less Grazing)	6	4/5	1	3	5	2	4/5
Risk of Loss or Decline: Rank Order (Low Number = Less Risk)	6	3	1	5	7	2	4

CONSEQUENCE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
NOXIOUS WEEDS							
Area of Disturbance Associated with Land Management Activities (Low Number = Less Disturbance)	5	4	1	3	7	2	6
Priority of Weed Control	low - moderate	high	high	low - moderate	low	moderate - high	moderate - high
Risk of Spread: Rank Order (Low Number = Less Risk)	6	3	1	5	7	2	4

CONSEQUENCE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
WILDLIFE *							
Number of Species Expected to be Positively Affected (or Likely to be Positively Affected) by Changes in Successional Stages:	29	28	34	29	24	34	24
Forest Type:	18	19 (2)	11 (3)	18	3	12	4
Stocking Level:	12	12	12	0 (12)	0 (27)	12	0 (12)
Snag Abundance:	52	28	80	51	0	79	28
Woody Debris:	0	63	68	0	0	68	0
Riparian Condition							
W. of Divide:	0	275	275	275	275	275	275
E. of Divide:	0	0	0	0	0	0	0
Recreation Use:	0	10	10	0	0	5	10
Road Density:	0	25	200	67	0	67	29

* The data presented in these two wildlife tables provides a general comparison of impacts by alternative. This information is not intended to be interpreted alone, but with the narrative presented in Chapter IV, Wildlife Cumulative Effects and the Appendix WLD.

WILDLIFE (continued) *

CONSEQUENCE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
Number of Species Expected to be Adversely Affected (or Likely to be Adversely Affected) by Changes in Successional Stages:	5	5	37	5	5	21	5
Forest Type:	28	28 (2)	34	27 (2)	30 (8)	34	10
Stocking Levels:	31	27 (1)	31	0 (1)	0 (14)	31	0 (20)
Snag Numbers:	28	0	0	28	79	0	52
Woody Debris:	0	0	0	0	68	0	0
Riparian Condition							
W. of Divide:	275	0	0	0	0	0	0
E. of Divide:	295	295	295	295	295	295	275
Recreation Use:	33	23	23	33	33	26	23
Road Density:	200	0 (248)	0	137	200	2	55 (116)

* The data presented in these two wildlife tables provides a general comparison of impacts by alternative. This information is not intended to be interpreted alone, but with the narrative presented in Chapter IV, Wildlife Cumulative Effects and the Appendix WLD.

FISHERIES

Impact Rating: Low Number = Less Adverse Impact

CONSEQUENCE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
Sediment and Nutrient Loading	9.0	5.8	1.6	7.0	10.6	3.4	7.4
Large Organic Debris	5.4	3.8	1.2	7.8	7.8	3.2	4.2
Water Tempera-ture	3.1	2.2	0.6	3.1	3.8	1.6	2.4
Total Rating	17.5	11.8	3.4	17.9	22.2	8.2	14.0

CONSEQUENCE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA

ADMINISTRATIVE ORGANIZATION
Change in FTE (Current = 77.36)

Overall	+10.5	+15.5	-22.5	+15.5	+22.0	-2.5	+30.5
By Program:							
Forest Product Sales	No Change	No Change	-25.0	No Change	+8.0	-18.0	+12.0
State Lands Administration	+4.5	+5.5	+2.5	+6.0	+2.5	+8.0	+5.5
Forest Improvement	+1.5	+3.5	-10.0	No Change	+5.5	No Change	+4.5
Inventory	+1.5	+1.5	No Change	+1.5	+3.0	+1.5	+3.5
Resource Management	+3.0	+5.0	+10.0	+8.0	+3.0	+6.0	+5.0

CONSEQUENCE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
ECONOMICS							
Approx. Share of Total School Funding: (%)	3.5	3.2	0.9	4.3	4.9	2.1	4.6
Net Present Value (High-Low Average in $1,000)							
Baseline Prices	71,550	57,576	8,073	74,929	114,829	35,080	100,952
Highest Prices	90,644	73,540	13,801	94,023	143,313	44,783	126,306
NPV Plus Remaining Timber Asset Value (High-Low Average in $1,000)							
Baseline Prices	377,414	377,997	379,443	380,793	377,022	384,615	377,702
Highest Prices	521,865	525,284	536,656	525,244	512,964	537,573	516,480

CONSEQUENCE	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
ECONOMICS (continued)							
Share of State Totals							
Jobs Supported: (High-Low Average %)	0.36	0.38	0.16	0.38	0.48	0.26	0.45
Incomes Generated: (High-Low Average %)	0.39	0.33	0.11	0.40	0.57	0.22	0.51

INTRODUCTION

HOW THIS FEIS IS ORGANIZED

Chapter I of this Final Environmental Impact Statement (FEIS) discusses the purpose and objectives of the Plan, provides general information about its development and relation to other DNRC planning, and presents the issues used to originally develop the Draft Environmental Impact Statement (DEIS).

In Chapter II, we will describe the alternatives being considered, explain how they were developed, and present a brief summary of the Resource Management Standards (RMS) developed for various resources. Chapter III is a description of the environment that would be affected by implementation of the Plan, and Chapter IV explains in detail the probable environmental consequences of implementing each alternative.

In Chapter V, we present proposed categorical exclusions from the Montana Environmental Policy Act (MEPA) documentation and discuss the probable environmental consequences of activities in those categories. The appendixes contain information supplementing certain parts of the main text, including an explanation of how this EIS was prepared. Appendix RSP contains the public comments received on the DEIS and our responses to these comments.

Most of the subject presentations in Chapter III include a brief discussion of how each topic relates to one or more of the issues listed in Chapter I. We have maintained a parallel structure of topics between Chapters III and IV. As such, Chapter III discussions of the affected environment appear in the same order and with the same general format as their corresponding Chapter IV discussions of environmental consequences. Our intent is to help readers follow the logical flow from an issue raised by the public, to that part of the environment that could be affected, and then to the probable environmental consequences.

CHAPTER I

PURPOSE

PURPOSE OF THE PROPOSED PLAN

The Trust Land Management Division of the Montana Department of Natural Resources and Conservation proposes to implement a State Forest Land Management Plan (Plan) to provide field personnel with consistent policy, direction, and guidance for the management of state forested lands.

We also propose to adopt a list of types of actions that qualify for categorical exclusion from the preparation of an Environmental Assessment (EA) or Environmental Impact Statement (EIS), unless extraordinary circumstances occur.

Historically, the primary income-producing use of forested state lands has been timber harvest. In recent years, social pressure to emphasize other forest resources as well as timber has made management decisions increasingly complex. Despite laws and regulations requiring consideration of multiple uses, there are few legal precedents and established policies for interpreting and implementing multiple use management.

We are bound by law to place heavy management emphasis on the following two criteria:

- long-term monetary returns to the school trust; and
- long-term health of our forest land resource

THE DECISION TO BE MADE

The selected alternative will serve as a programmatic plan, providing policies and guidelines for managing state-owned forest lands. The Plan will not address site-specific issues nor make specific land use allocations. It will contain the general philosophies and management standards that will provide the framework for our project-level decisions. We do not guarantee any projection of outputs, products, or services from implementation of the selected alternative, although we have created plausible scenarios (presented as ranges) as a basis for predicting environmental effects.

In accordance with MEPA rules (ARM 26.2.652(5)), the Director of DNRC will select a final alternative fifteen days after the FEIS has been transmitted to the Governor, the Environmental Quality Council and the public. The selected alternative will be made available to all interested parties in the form of a document called a Record of Decision (ROD). In addition to the required per MEPA (ARM 26.2.658), the ROD will be include all of the elements of the selected alternative necessary for implementation (i.e., philosophy statements and resource management standards). The ROD will, in essence, become known as *the State Forest Land Management Plan.*

The selected alternative will provide a guiding framework for proposing and analyzing site-specific projects. The resulting Plan and this FEIS will be useful reference documents that will make site-specific decisions more efficient by helping us remain consistent with our overall management philosophy, and by saving needless repetition of the reasoning behind policy decisions that have already been made. However, neither the EIS nor the Plan will substitute for public involvement and proper analysis and documentation in future project-specific decisions.

SCOPE OF THE FINAL ENVIRONMENTAL IMPACT STATEMENT

ANALYSIS FRAMEWORK

In this FEIS we present the probable environmental consequences of seven alternatives and their associated resource management standards.

The alternatives analyzed in this FEIS include continuing our present management regime (No Action-Alpha) plus a reasonable range of other approaches to managing state forest lands. Each alternative is designed to respond in a distinctly different way to issues raised through scoping. Six alternatives (Alpha, Beta, Gamma, Delta, Epsilon, and Zeta) were developed and presented in the DEIS. The seventh alternative, Omega, was developed in response to public comments and staff input on the DEIS.

LEGAL FRAMEWORK

Federal lands, called trust lands, were granted to Montana when it was admitted into the Union. Montana's constitution requires that trust lands be managed to provide revenue to support schools. The courts have consistently upheld this requirement. Trust land managers, however, have some discretion in meeting the broad trust management goal. That discretion is necessary because managers are required to not only satisfy trust principles, but also to comply with other constitutional requirements and state and federal statutes. Specifically, Montana's constitution allows that it is within the discretion of trust land managers to manage for long-term income, even at the expense of immediate or short-term returns.

The state and federal laws that apply to Trust lands are essentially those that also apply to private lands. These include air and water quality laws and the Endangered Species Act. A digest of laws that directly affect management of state forest lands is included in this EIS as Appendix LGL, and would be included in the selected Plan.

ADMINISTRATIVE FRAMEWORK

State trust lands are legally assigned to one of four "highest and best use" categories: Forest, Grazing, Agricultural, or Other. The "Other" category includes such things as administrative sites, and would not be affected by the proposed Plan. The Forest Management Bureau of the Trust Land Management Division is charged with directing the management of classified Forest lands and has assumed lead responsibility for development and implementation of the State Forest Land Management Plan. The proposed Plan would address responsibilities of the Forest Management Bureau and to some degree the responsibilities of the Special Uses Management and Agriculture & Grazing Management Bureaus.

An important qualifier relates to the Grazing Resource Management Standards presented in Appendix RMS. Forested classified Grazing lands account for nearly 25 percent of all lands covered by the proposed Plan (see Chapter III, Table III-I1). It is also true that about 33 percent of our classified Forest lands are currently licensed for grazing.

Because this is a <u>forest</u> land management plan, we have not addressed a very large body of public issues and resource concerns related to the state's 4.1 million acres of grazing land, roughly 96 percent of which are non-forested. However, we face a dilemma on that four percent of Classified Grazing lands that are also forested and therefore under the jurisdiction of the proposed Plan.

The dilemma is that more often than not, small parcels of forested classified Grazing land adjoin much larger parcels of non-forested Grazing land. There are usually no fences to establish boundaries between forest and non-forest, nor are there logical places to put fences that would not create problems such as blocking livestock access to shade and water. Therefore, if we apply forest land Grazing Resource Management Standards, we either effectively extend the impact of those standards far beyond forested lands alone, or we put managers in a position of making case-by-case decisions as to where the standards apply and where they do not. Case-by-case application could easily lead to grazing lessees facing different standards at different times and places.

After long and difficult internal dialogue, we reached the following decisions. Forested Land Grazing Resource Management Standards would apply only to classified Forest lands. They would be used as guidelines in the design of forestry projects proposed on classified Grazing lands, but the degree of compliance on those lands would be left to the discretion of the Unit or Area Manager.[1] All effects assessments in Chapter IV are based on the premise that Grazing Resource Management Standards would be implemented in this manner.

We have adopted the following criteria to define those lands to which the proposed Plan would apply:

1) All lands classified as Forest by the Montana Code (§ 77-1-401, MCA).

2) Lands classified as Grazing, Agricultural, or Other which meet the following criteria:

   a) Lands that are at least 10 percent stocked (by canopy cover) with trees of any size and capable of producing timber or other wood products.

   b) Lands from which the trees described in (a) have been removed or reduced to less than 10 percent stocking, but which have not been developed for other uses.

   c) Lands not necessarily producing timber or other wood products, but 10 percent stocked with conifers and generally surrounded by land described in (a) and (b), above.

   d) Cottonwood and other hardwood cover types, only when adjacent to land described in (a), (b), or (c), above.

3) Lands not clearly defined by the above criteria which, in the judgment of the Area Manager and the Trust Land Management Division, have qualities or values consistent with a forest environment.

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1 Notes and memos relating to this decision are filed at pages 1373, 1387-1394, 1417, and 1420 of the Project Record.

Several other government agencies and landowners could be affected by implementation of the proposed Plan. For example, the Montana Department of Fish, Wildlife and Parks (MDFWP) is responsible for managing fish and wildlife populations throughout the state, and consequently must collaborate its activities with DNRC's management of the habitat in which fish and wildlife live. Large private industrial forest landowners could also be affected by the proposed Plan. There could be changes in the state's policy regarding granting rights-of-way, managing cumulative environmental impacts, and otherwise coordinating with adjoining landowners. The timber industry could be affected by changes in the timber supply from state lands.

RELATIONSHIP TO OTHER PLANS AND GOALS

1) This planning effort is consistent with goals set by our Forestry Program Plan for carrying out its mission of being a leader in protecting and managing Montana's forest resources in a manner consistent with the public interest.[2]

2) The Forest Management Bureau has completed management plans and environmental impact statements on the Swan River State Forest (1978) and Bear Canyon (1983). These area-based management plans would be superseded upon adoption of the State Forest Land Management Plan. Planning for individual projects will still be required to comply with MEPA and could potentially tier to this programmatic EIS.

3) The Forest Management Bureau has developed interim standards and guidelines in the following areas:

   - Grizzly bear management
   - White-tailed deer winter range
   - Elk winter habitat management
   - Road management
   - Watershed management
   - Silvicultural treatment
   - Timber sale cruising

   Variations of these, as well as some additional resource management standards, are included as parts of the alternatives considered in this Final Environmental Impact Statement (see Appendix RMS). The resource management standards included in the Record of Decision/State Forest Land Management Plan will supersede our present interim direction.

[2] The Forestry Program Plan is available for public viewing at the DNRC State Forester's Office in Missoula.

ISSUES OUTSIDE THE SCOPE OF THE DECISION

Certain matters of significant concern to Montanans are outside the Trust Land Management Division's decision-making authority and will not be addressed by this planning effort. The following issues are included in this category:

THE LEGAL RIGHT TO ACCESS STATE LANDS

The 1991 Legislature passed House Bill 778 allowing general recreational use of state lands that are legally accessible by state highways, county roads or other federal lands.[3] The law requires the purchase of a Recreational Use License (RUL) for recreational use of state school trust lands.[4]

We have received many comments regarding the public access issue; however, it is outside our authority to change the law. Some alternatives we are considering could lead to recommendations to change the range of activities covered by the Recreational Use License, or the size of the fee. It would be up to the Legislature, the State Land Board, and/or the rule-making process whether or not to adopt those recommendations.

ELIMINATION OF THE TRUST MANDATE

Some people would like to dispense entirely with the use of trust lands for revenue production. Many have suggested finding alternative revenue sources, such as additional taxes, for the support of education. It is beyond our authority to make such a change because the Montana Constitution requires that trust lands be used to produce revenue for the benefit of public schools.

MINIMIZING PUBLIC INVOLVEMENT

Some people believe that public involvement can detract from professional management of state lands for maximum revenue. They favor restricting opportunities for the public to oppose timber harvests or other commodity uses of state lands. However, the Montana Environmental Policy Act requires that we make our decision-making process visible and that we provide ample opportunities for public involvement in decisions that may affect the environment. Restricting public involvement is beyond our authority, nor do we have any wish to do so.

INCREASED GRAZING FEES

Some people think that grazing fees are too low and should be increased. They believe the state is not receiving full market value for grazing, as required by law, and that the low grazing fees may promote overgrazing and resource damage. Minimum grazing fees are set by the Land Board and apply to nonforested as well as forested lands. Adjustment of those statutory fees is outside the scope of the Plan and will not be considered. Our treatment of this topic will be limited to assessment of the environmental effects of, and financial returns from, grazing on forested lands covered by the proposed Plan.

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[3] "General recreational use" has a specific meaning defined by HB 778 and subsequent rules.

[4] The license fee is currently under review and may be raised.

ISSUES RAISED BY THE PUBLIC AND OTHER AGENCIES

We have identified two major sets of issues to be considered in the selection of an alternative: (1) those raised by the public and other agencies, and (2) those raised by our own employees. The issues raised by our employees can be found in the Project Record. They include questions about Department management framework and policies, resource management, resource allocation, resource valuation, marketing, managing across ownerships, and categorical exclusions that our employees wanted the Plan to answer. Many of these questions will be answered by the Plan or EIS, while others will be answered outside the Plan during implementation training and elsewhere.

The following thirteen issues raised by the public and other agencies were based on responses to press releases and to our initial public mailing, and affirmed by a series of public meetings held at five locations throughout Montana. We have divided the issues into three categories: those that concern patterns of use on state lands, those that concern the environmental effects of management activities, and considerations for trust land management.

ISSUES THAT CONCERN PATTERNS OF USE

1) Access

Public Access to State Forest Lands

The issue of public access to state lands has generated a heavy response. Most aspects of this issue are outside the scope of the Plan because the issue has been addressed through enactment of House Bill 778 in the 1991 legislative session, and through rules recently adopted under this law. However, some related issues that are relevant to the Plan exist.

Some people suggest that a fee be charged for public uses other than general recreation use as defined by state law. This would provide an additional source of trust income, and could reduce the state's dependence on timber harvest as a source of trust revenue.

Right-of-Way Across State Lands

Concerns have also been expressed regarding public right-of-way across state lands to access federal lands. There is general anxiety that the public's right to access and use federal lands is being eroded by regulation and restrictions imposed by surrounding property owners. Most comments received indicated that public access across state lands to adjacent federal lands should be developed as opportunities exist. Similar concerns were expressed about access through state lands to private residential areas, primarily for structural fire protection.

Timber Purchaser Access

Some concern has been expressed about access to state lands for timber sale purchasers. Many parcels of state land can only be accessed through private land, and some private landowners insist on dealing directly with the sale purchaser, rather than the state, for timber sale right-of-way. However, the lack of guaranteed access adds an additional element of uncertainty for prospective bidders on state timber sales.

2) Road Management and Maintenance

Forest road development and management has generated considerable public discussion. A variety of potential impacts are associated with the construction and use of forested roads.

The extent of road development may affect wildlife security and is often used as a key element for defining effective habitat for various species. Restricting the public use of the roads either seasonally or permanently can reduce the impacts to wildlife. However, the existence of roads and trails, even if closed to motor vehicle use, increases access to an area and thereby reduces security. Many people favor closing or obliterating roads and minimizing new construction to increase wildlife security.

Road construction and use can adversely impact water quality and fisheries. Road surfaces have been shown to be a primary sediment source to forest streams. Increased sedimentation associated with road development may adversely impact fisheries. Impacts may be reduced through prudent road location, design and construction, and by installation of drainage features to reduce erosion. Prompt revegetation of disturbed sites and seasonal restriction of road use may also reduce impacts.

Maintaining the road system, drainage features, signs and closures can be costly. Enforcement of road use regulations and maintenance of road systems may be inadequate without sufficient planning and budgeting.

Some people view road systems as an asset to the forest, necessary for the development, protection, and productivity of the land. They provide access, allowing the public to use and enjoy the forest. Many people believe roads should remain open to motor vehicle use to provide recreational opportunities for all of the public, including handicapped access.

Others believe that the environmental costs of road development outweigh the benefits. They believe that the values of forested lands can best be realized without additional road construction and advocate a minimal amount of additional development.

3) Coordination and Cooperation Among Landowners

Administrative Coordination

There is general agreement that coordination and cooperation among adjacent landowners would be beneficial and efficient. Management costs could be reduced by sharing road systems and maintenance costs. Coordinated road development can reduce environmental impacts by reducing the number of miles constructed and coordinating road use restrictions. Cooperative arrangements can also benefit fire suppression and weed control efforts.

Some people have promoted land exchange programs with other agencies or private landowners. Consolidating state ownership would increase efficiency and manageability of state lands, but consummating land exchange proposals tends to be time-consuming and costly.

Cumulative Environmental Effects

Controversy develops when the cumulative effects of actions on intermingled lands require mitigating measures. Conflicts occur over which landowner should modify its forest management activities, and to what extent because of cumulative impacts. Some people want DNRC to avoid any activities on state lands that may contribute to undesirable cumulative effects.

Others want DNRC to do its part to meet environmental standards on state lands, but not to make adjustments for cumulative effects across all ownerships. They do not believe it is DNRC's function to compensate for the management actions of others unless required to do so by law.

Conflicting Land Uses

Residential development in Montana's forests is increasing annually. Activities on state lands are not always compatible with residential development. Similarly, activities and land uses on adjoining lands may impose constraints on management of state lands. Some people believe DNRC should take an active role to resolve these conflicts. Others are opposed to any attempts to limit the property rights of landowners, fearing this would border on land use planning or zoning. The individual property rights of landowners in Montana is a highly emotional issue.

ENVIRONMENTAL EFFECTS ISSUES

4) Wildlife

There is increasing public sentiment to recognize the importance of wildlife values associated with Montana's forests. The big game hunting season contributes an increasing percentage of the state's economic base. Some communities receive a substantial portion of their annual revenue from hunting-related activities. Non-game species are increasingly perceived as an integral part of forest ecosystems, and may also provide local economic benefits through wildlife viewing.

Forest management activities can adversely impact wildlife species by modifying habitat and directly disturbing animals. This may have adverse impacts on wildlife populations, which in turn may result in harm to forest ecosystems, poorer success in hunting and wildlife viewing, more restrictive hunting seasons, and adverse impacts on Montana's economy. Accordingly, many people place a high priority on preserving or protecting wildlife habitat on state lands. Others believe that wildlife habitat protection should not be allowed to interfere with commodity uses of state lands.

The mobility of wildlife species makes it difficult to determine the relative value of habitat on a given tract of land. People disagree substantially on the minimum habitat requirements of many wildlife species. Consequently, estimating the effects of a proposed action on wildlife populations is especially dependent upon professional evaluations of probabilities and risks. Some people believe that management decisions should be conservative to minimize the risks of adverse impacts to wildlife. Others feel that use of other resources should not be limited unless clear impacts on wildlife habitats can be demonstrated.

Forest practices on state lands have potential impact on threatened, endangered and sensitive species. Many people place a high priority on the conservation and recovery of these species, and support management activities on state lands only if full provision for threatened and endangered species is assured. Others believe that scattered and limited acreage of state lands reduces its value for the survival of such species. They believe that DNRC should only restrict its activities for threatened and endangered species to the degree that is legally required.

5) Watershed Management

Forest lands have high values as watersheds that support cold water fisheries and provide for orderly runoff of high quality water. Road construction, timber harvest, livestock grazing, and other land-disturbing activities can substantially impact these values. Public concern for protecting watershed integrity and water quality is widespread.

Most comments indicated a concern that forest practices should be conducted in a manner to protect water quality. Controversy arises on what management practices constitute an adequate level of protection for maintaining water quality. The pollution resulting from forest practices is diffuse in nature, often due to erosion from roads and harvest units. The impacts are often subtle in nature and difficult to discern. It is not possible to control all of the pollutants. Best Management Practices (BMPs) set the minimum standard for controlling water quality impacts from forestry activities. To be effective, BMPs must be tailored to fit site-specific conditions, applied where appropriate, applied in a timely manner, and maintained in a functional status. BMPs must be monitored for adequate implementation and to determine if they are providing adequate protection for beneficial uses.

Riparian areas are of prime importance, and management practices should be modified within riparian and streamside management zones to protect watershed values. Protection measures include retention of merchantable and submerchantable trees and restrictions on equipment operation, road construction, and slash disposal, as well as other special management practices.

A thorough cumulative effects analysis completed prior to timber harvest is necessary to ensure that the amount of activity in a watershed is limited to a level below which adverse cumulative impacts from water yield or sediment increases are anticipated. Activities on all ownerships should be included. Thresholds are established based on watershed condition to determine the level of impact allowed. Establishing watershed thresholds and watershed modeling are far from exact science. Controversy often arises when these factors are used to constrain timber harvest. Because of past levels of activity in many drainages, cumulative watershed effects are currently a major constraint to timber harvest.

6) Weed Management

The spread of noxious weeds throughout Montana has become an important issue with many land management programs. Weeds can easily be established on disturbed sites such as those associated with logging activity. Livestock use and motorized recreational activities can increase noxious weed distribution. Introduced weeds can displace native vegetation, interfere with forage and crop production, and have adverse impacts on wildlife habitats and grazing values. Weeds established on state lands can easily spread to other ownerships and interfere with uses of adjoining lands.

The Department of Natural Resources and Conservation must comply with existing laws pertaining to management of noxious weeds. DNRC has weed management plans and agreements with various County Weed Boards. Revegetating disturbed sites and controlling weeds in the early stages of infestations can reduce the spread of weeds. Weed control measures are expensive, and costs substantially increase as infestations become established. The wide variety of forest uses that contribute to the spread of noxious weeds could be required to contribute to the cost of control. There is some public concern regarding the use of chemical control measures because of the potential for impacts to fisheries, water quality, vegetation and human health.

7) Grazing

Livestock grazing of forested areas is a traditional use that is becoming increasingly controversial. Impacts from forest grazing activities can affect water quality, stream channel stability, riparian habitat, understory vegetation and weed infestations. Timber management activities and livestock grazing sometimes conflict. This can cause additive impacts on resources.

There is concern that grazing practices are generally unregulated and are loosely managed. Some people suggest that grazing programs should be more closely managed to minimize damage to riparian zones. Limiting livestock numbers, regulating grazing seasons, fencing and water developments can be used to maintain forested rangeland quality.

Others want to see grazing continued as an active revenue-producing use of state lands, and do not want to see other issues or uses such as recreational access interfere. Some of the forested state lands are classified as principally valuable for grazing purposes. Grazing lessees of state lands are responsible for the development and maintenance of their leases.

8) Timber

Timber Supply

Strong public sentiment exists both for increasing and for reducing the amount of timber harvested from state lands.

The amount of timber to be harvested from state lands will have impacts on trust income and timber supply. Some people argue that harvesting timber at the maximum sustainable level would help optimize trust income and meet DNRC's legal trust mandate. It would also provide timber to help keep mills operating and maintain wood products jobs.

Others argue that reducing timber harvests on state lands would benefit other resources and ecosystem health, with minimal impacts on regional timber supplies. High levels of timber harvest may have adverse impacts on other resources such as wildlife, water quality and recreational use, and may impact the function, health and long-term productivity of ecosystems. Reducing current harvest levels would also leave more timber to be harvested in the future, when timber values are predicted to be much higher in real terms than they are now.

Sustained-Yield Management for Long-term Productivity

Management practices that produce sustained and sustainable levels of timber harvest were identified as important.

Some people define sustained yield strictly in terms of optimizing timber production. Up-to-date forest inventories would be used to set harvest levels that match timber growth on harvestable lands. Management activities such as prompt reforestation, thinning, and control of insects and diseases would be favored in order to increase long-term sustained yields of timber.

Others define sustained yield in terms of producing sustainable levels of other resources as well as timber, and avoiding environmental degradation. This would require additional measures to ensure that the entire forest ecosystem is maintained indefinitely. These measures would include accurate multi-resource inventories, best management practices, modified harvest methods, and harvesting at levels that sustain all resources.

Utilization and Salvage

Better timber utilization is advocated by some people in order to minimize waste and generate trust income. Presale post and pole harvest, prompt salvage of dead and dying timber, and allowing firewood removal before removing slash would increase utilization and produce additional revenue. This would also reduce amount of snags and large down logs, which are old-growth features. This could have adverse impacts on species and ecosystem functions that depend on these features.

9) Harvest Practices/Clearcutting

Public sentiment to eliminate or at least minimize clearcutting appears to be very strong, even with some people who advocate increased timber harvests. Some people oppose all forms of even-age management. Clearcutting is seen as benefitting only timber production at the cost of all other resources and values. It is also seen as wasteful and inappropriate, given the methods and technology available today. Many opponents to clearcutting state no specific reason for their opposition and seem to find the practice itself offensive. Some people advocate "selective" logging, uneven-age management, salvage logging or "new forestry" as alternatives to clearcutting.

Other people believe that clearcutting can be a beneficial, cost-effective silvicultural treatment for certain tree species and conditions. These people feel strongly that it would be a mistake to categorically reject clearcutting through overreaction to past abuses of this method.

10) Ecosystem Integrity

There is considerable concern about the impacts of timber harvest and forest management on overall health of the ecosystem. Harvest of timber can alter the structure, function and composition of forest ecosystems. This can reduce biological diversity and adversely affect natural adaptations to insects, disease and fire, and may reduce productivity of the forest for future generations.

Harvesting can reduce the amount and quality of old-growth forest and eliminate habitats for plant and animal species that depend on it. Management practices that maintain or restore natural forest characteristics, including protection of old-growth, may prevent or minimize damage to forest ecosystems. These practices would involve reducing harvest levels and using more costly treatments in many cases, but they may sustain greater forest productivity in the long term.

Others believe that old-growth timber should be targeted for harvest. Harvesting of individual mature trees, especially dead and dying trees, would reduce the amount of this material that goes unused. This would generate trust revenue with high-value timber, and provide an alternative to clearcutting.

TRUST LAND MANAGEMENT CONSIDERATIONS

11) Trust Management Policy

Regional Economy, Jobs, and Incomes

Harvest of forest products is seen to have both positive and negative impacts on the economy of Montana.

Many people see timber harvest as providing jobs, a tax base and funds for education. However, others believe that preserving natural resources will benefit wildlife, fisheries, and scenery, and will have a net benefit for Montana's economy by favoring tourism and recreation. Resource extraction may also provide short-term economic benefits, at the expense of long-term benefits.

Interpretation of Trust Mandate

Opinions on how the trust mandate should be interpreted vary widely. Some people believe the trust mandate should be interpreted strictly. They maintain that environmental protection measures beyond those legally required should not be allowed to interfere with producing trust income from commodity uses such as timber. They believe that adequate environmental protection can be provided with minimal restraints on harvest.

Others interpret the trust doctrine more broadly, and hold that environmental protection must come before income production. They advocate reducing timber harvests to compensate for past activities and actions by adjacent landowners. Multiple use rather than exclusive use should be emphasized, and long-term income should be favored over short-term income. Some people believe that maximum sustained trust revenue will result from keeping many options open by reducing current harvests, because resources will be much more valuable in the future.

Some people want to see commodity uses de-emphasized as a source of trust income, in favor of nonconsumptive uses such as recreation.

12) Public Involvement and Planning

Some people believe that a sincere and effective effort at public involvement is a critical element in planning and decision-making. This will help prevent domination by special interests and political pressures, and help ensure sound scientific management for multiple resources.

Others are concerned that public involvement may result in unwise decisions that unnecessarily detract from managing state lands for trust revenue. They emphasize that the public must be effectively informed about the state's management goals and practices before they can provide useful comments.

A few people and agencies want to be involved in projects of particular interest to them. This includes groups or individuals with expertise in particular issues, or those owning lands intermingled with state lands.

13) Recreation Opportunities

Interest in maintaining a variety of recreational opportunities on state lands is broad. Interests include hunting, fishing, camping, and other types of motorized and primitive recreation.

Some people advocate some form of user fee for public recreation use of state lands in addition to hunting and fishing, or would at least accept such a fee. A user fee for recreation would provide some compensation for the trust, which would remove some pressure to depend upon timber harvest as the dominant use of state forests.

Criteria to determine the best uses of various state forest lands would help determine places where recreation may provide the most trust income. This would help achieve optimal trust income from recreation.

Some forest management activities may render state lands less desirable for recreational uses. This may reduce the potential for trust income and general economic benefit to the state from recreation. However, road development associated with some management activities may increase opportunities for motorized recreation.

PREFERRED ALTERNATIVE

Since the release of the DEIS and the development of the Omega alternative, we have identified a preferred alternative based on the following selection criteria:

1) monetary return to the school trust;
2) long term health of our forest resource; and
3) effect on the biological and physical environment.

It was the general opinion of the planning team that two of the alternatives, Gamma and Zeta, are seriously deficient according to one or more of the criteria above.[5] The remaining five alternatives, Alpha, Beta, Delta, Epsilon, and Omega do satisfy all of the criteria to varying degrees. This is demonstrated in the effects assessment presented in Chapter IV. Of the remaining five, Omega is preferred.

In terms of the selection criteria, Omega is predicted to provide the second highest NPV of all of the alternatives. This prediction is based on the harvest level scenarios with which we conducted our effects assessment. The actual harvest levels will be determined through the sustainable yield study commissioned by § 77-5-221--223 MCA (HB 201 1995). That study will use the management philosophy and RMS of the final alternative to determine what will be our legislatively mandated sustainable harvest.

In addition, Omega allows flexibility for the pursuit of income opportunities other than timber when their revenue potential meets or exceeds that of long-term timber potential. This will allow us to respond to changing markets for new and traditional uses and products, again meeting our trust mandate.

We believe that Omega will provide an opportunity to meet our trust mandate, while also contributing to the health and diversity of state forest lands. The biodiversity management

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[5] Public comment on the DEIS asked us to provide more information on why Gamma and Zeta were not preferred alternatives. See page RSP-112 for that information.

philosophy of Omega, similar to those philosophies used nationwide by other state and federal agencies, will allow us to manage the proportion and distribution of forest types and structures that were historically present on the landscape. As a result, we will be able to provide for the long-term health of the forest by reducing risks of catastrophic fires, and insect or disease attacks.

Omega will have a mid-range impact on biological and physical resources, when compared to the other alternatives. However, we believe that the Resource Management Standards developed for Omega will provide sufficient mitigation measures (and in some cases, such as SMZs and BMPs, proactive management to prevent impacts) to protect Montana's resources.

On balance, when we evaluated how each of the alternatives met the selection criteria, we judged that Omega best met the combination of the three selection criteria.

CHAPTER II

THE ALTERNATIVES

In Chapter II, we describe the alternative approaches to state forested land management being considered for implementation. We also explain how they were developed and provide a summary of the Resource Management Standards (RMS) for each alternative.

HOW THE ALTERNATIVES WERE DEVELOPED[1]

ISSUES RAISED BY OUR OWN EMPLOYEES

We began development of our alternatives by meeting as a planning team and asking ourselves, "What questions would a useful management plan answer?" After developing a list of our own ideas, we posed the same question to all DNRC field employees (formerly DSL employees; does not include employees of DNRC before July 1, 1995 reorganization). Members of the planning team conducted thirteen in-house scoping meetings between January 7 and February 5, 1991. Their findings were summarized in a total of over 270 written comments which led to the "Issues Raised by Our Own Employees".[2] These issues were stated in question form to reflect the team's intent to create a plan that would be a useful information source to field people.

ISSUES RAISED BY MEMBERS OF THE PUBLIC

On September 23, 1991 we supplied a press release announcing the Plan and inviting public comment to all daily newspapers in the state, the major weekly papers, and two news agencies. We also mailed a two-page invitation to comment to 442 people and organizations on our mailing list. We asked people to: (1) identify their areas of concern with regard to our management of forest lands; (2) indicate their level of interest in remaining involved in our planning process; and (3) suggest other people or organizations that we should contact.

Public response was excellent. We received over 250 written replies, including 20 percent of our original mailing list, plus about 160 additional replies from people and organizations that had not been on the original list. We identified seventeen issues based on these public responses. The first thirteen issues have guided the remainder of our planning process, and are listed in Chapter I under the heading, "Issues Raised by the Public and Other Agencies." The last four were, for the reasons stated in their respective descriptions, considered outside the scope of the proposed Plan and were not given further consideration. These are presented in Chapter I under the heading, "Issues Outside the Scope of the Decision."

FOCUS GROUP MEETINGS

We wanted more public input to help us build management alternatives that would meaningfully address the thirteen issues we had identified. We also wanted to check whether our issues were the right ones; that is, had we correctly understood what people were trying to tell us?

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1 "Appendix SCP - Scoping" is a detailed description of our scoping and alternative development process.

2 Complete documentation of in-house issue development is found on page S-109 of the Project Record.

Between May 19, 1992 and June 4, 1992, we held public focus group meetings in Missoula, Dillon, Bozeman, Kalispell, and Billings. Our objectives were to: (1) check the accuracy with which we had interpreted earlier public comments; and (2) generate a range of new ideas that would help us develop alternatives for managing state forest lands.

A total of 120 people attended the meetings and provided nearly 30 small-group responses.[3] We did not get as many new ideas as we had expected, but the group input reflected a good understanding of the revenue-generating mission of DNRC, and of the range of management problems the Plan would have to address. We took the scarcity of new ideas as an indication that our issues and position statements had done an acceptable job of capturing public concerns.

DEVELOPMENT OF CORE CONCEPTS

Next, we used the scoping input to help develop draft alternatives for preliminary review by our own employees and by the public. Using the process described in Appendix SCP, the team drafted core concepts for managing state forest lands. Each concept represented a different approach to addressing the planning issues, yet each approach was, in the eyes of team members, a reasonable land management alternative.

Before going further, we undertook a rigorous screening process in which we tested the core concepts against the following five criteria:

1) our in-house questions;
2) the planning issues;
3) the focus group input;
4) the original public comments; and
5) the Plan objectives.

This screening led to additions and changes that closed gaps and resolved contradictions and inconsistencies in the core concepts. Writing the core concept narratives and completing the screening process began in mid-July 1992 and were finished in early January 1993.

THE ALTERNATIVES

Six alternative plans resulted originally from our work and were presented in the DEIS. After trying a variety of naming schemes, we chose Greek letters to identify our alternatives. We wanted a neutral naming scheme, and we reasoned that Greek letters are unfamiliar enough that they would not immediately rank the alternatives in peoples' minds as numbers, Roman letters, or names might.

ALTERNATIVES DEVELOPMENT BETWEEN DEIS AND FEIS

The State Forest Land Management Plan Draft Environmental Impact Statement (DEIS) was released to the public for review on June 19, 1995. The comment period lasted for 45 days and closed on August 4, 1995.

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3 A consolidation of all the focus group responses begins at page S-382 of the Project Record. We mailed a copy of this summary to each person who participated in the focus group process.

One hundred seventy-four responses were received in the form of letters, phone calls, and testimony at public hearings. The comments came from 98 individuals, 51 organizations, 12 agencies (federal, state, local government), 8 schools, and 3 legislators. Each member of the planning team provided written responses to each of the comments relating to their resource area. Those responses are presented in Appendix RSP of this FEIS.

After careful evaluation of the public comments and staff concerns, an additional alternative, named Omega, was developed for consideration. In an effort to keep the public informed on Plan developments after the formal DEIS comment period, on February 23, 1996, we mailed a Plan update to approximately the 400 people on our mailing list.[4] The update included a summary of the Omega alternative. Recipients were also offered a copy of the complete text of the Omega alternative if they contacted DNRC in Missoula. Over 30 people requested and were sent the expanded text.

DESCRIPTION OF ALTERNATIVES

The narratives below explain the core concepts of each alternative. Each approach represents differing beliefs and assumptions as to the best way to meet the trust mandate. Alternative Alpha describes the current DNRC approach to managing its forest lands. Alternatives Beta, Delta and Omega emphasize managing the land intensively for many products. Epsilon and Zeta emphasize a single use. Gamma minimizes our current intervention and allows nature to preserve future options in its own way. Our assessment of the environmental impact each alternative plan would have is summarized in the Chapter II Summary of Environmental Consequences.

ALPHA

This is the way we do things now, and it is the path we would continue to follow in the absence of major changes in legislative or policy direction. We would provide income to the trust by marketing a sustainable harvest of forest products while allowing other revenue-generating uses, such as grazing and cabin-site leasing, in response to applications initiated by the public.

We would meet legal and/or generally accepted standards of environmental protection. Existing interim standards and guidelines would become permanent, and all other current plans would remain in effect. Standards and guidelines would be modified or expanded when conditions warranted such action.

Each land office would have an annual timber sale target. Units would develop sale lists, and timber sale projects would be proposed each year depending on budget and staffing allocations. Proposals for dominant land uses other than timber management would normally be initiated by the public or other agencies. We would respond to cabinsite, land exchange, right-of-way, grazing, and other special use proposals as we had time, but our highest work priorities would be activities that supported the timber program.

Roads would be built as needed to support land management activities (primarily timber sales). Roads would be considered a permanent investment and would generally not be obliterated unless doing so would mitigate impacts that could otherwise limit management opportunities. We would

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[4] This list included those people who, when queried, asked to remain on the mailing list throughout this project.

consider seasonal and year-long closures, subject to management concerns, maintenance costs, use levels, and adjacent ownership needs.

This time allocation would result in the continuation of timber management as our dominant land use, with other uses developing primarily in response to outside demand.

BETA

Under this strategy, we assume that intensive management would promote healthy and productive ecosystems while yielding greater long-term income than natural processes alone would produce. We would promote an ecologically diverse, resilient, and productive forest. Managing for diversity of stand structures could provide a sustainable yield of timber and other outputs whose cumulative value would exceed that from timber alone.

Timber harvest would play the dual role of directly generating revenue, as in the past, while also serving as our primary tool for producing the desired range of stand structures and patterns. We would also use other measures such as minimizing roads and rehabilitating damaged watersheds to enhance environmental quality. Because diverse wildlife habitat would be supported by managing for a variety of forest conditions, we would de-emphasize standards for individual species.

Each land office would have annual goals including a timber sale target as well as goals for marketing other uses. Many of these goals would include the use of timber harvest as a tool. For example, forests dominated by immature second-growth timber might be thinned to produce small logs and pulpwood, while reducing stand stress levels and hastening development of old-growth features and high-value forest products. In areas with considerable old-growth, some stands might be managed on long rotations to perpetuate old-growth, while others might be managed on shorter rotations to produce high yields of timber.

We would actively seek ways to minimize the amount of new roads needed to support management activities. We would promote cooperative road management planning among adjacent landowners as one way to minimize roads. We would consider obliterating roads that are not primary access routes. We would close most roads following use in order to minimize open road mileage, unless they provide planned public access or regular administrative access.

Other goals would have us pursue income opportunities from old-growth and other distinctive features without using timber harvest. These activities could include fee-based wildlife viewing, environmentally-friendly recreation developments, conservation easements and leases, and educational programs.

GAMMA

An underlying assumption of Gamma is that a growing population and a fixed land base will cause the value of forested lands to be driven high enough that a diverse array of small annual yields from natural ecosystems will produce the greatest possible long term average trust income. Current uncertainty in the politics of natural resource allocation makes it smarter for us to preserve the widest and richest possible array of future options, rather than maximize revenue in the short run at the risk of significantly limiting future options.

Our program direction would emphasize restoring and maintaining natural ecosystems under the assumption that we can do little to improve on nature's ability to sustain a productive and healthy ecosystem. We would expect relatively small marketable yields each year, but would expect the quality and diversity of marketable opportunities to grow rather than diminish with passing time.

In most cases, the dominant land uses would be activities that maintained or enhanced undeveloped forest conditions. Program goals might include a target income from dispersed recreation fees or leases, development of fee-access wildlife observation blinds, or timber harvest on some number of acres to simulate the effects of wildfire where fire protection had altered natural conditions.

We would emphasize activities that do not substantially change the appearance or function of the naturally occurring forest, such as hiking, wildlife watching, and campgrounds that affect only small areas while serving as a base for other activities. We would use timber harvesting as a tool to approximate naturally occurring events such as fires, or to rehabilitate areas that have been altered in the past and are in poor condition. Low-impact harvesting could be used as an income source when it is clearly compatible with natural succession.

On lands that are already developed, or surrounded by development to the point that restoration of natural conditions would be impractical, the dominant use would be that which best supported this management philosophy. For example, in an area already heavily roaded and intermingled with private residential development, our program might call for closing some roads, upgrading others, and planning for a commercial lease activity compatible with public use of nearby undeveloped lands.

DELTA

Under this alternative, we assume that the greatest long-term average return would come from competitively marketing our resources, focusing on flexibility, creativity, and attention to financial rate of return. Forest land management would be strongly influenced by market conditions.

We would inventory potential money-making opportunities and use financial analysis as the first indicator for initiation and timing of projects. Our decisions would balance our response to changing market conditions with maintaining technical adaptability, so that we would not abruptly drop one activity to begin another. However, we would be strongly influenced by market conditions such as cycles in demand and price for commodities or unique recreational demands. Timber lands would be managed for sustained yield over the long term, with harvest activities concentrated during periods of high timber values. Dominant land uses could shift with changing market trends, but we would not normally make disruptive changes in response to temporary market variations. This approach would emphasize a high degree of flexibility in choosing dominant land uses, and a wide range of skills within our work force.

From our inventory of potential money-making opportunities, we would list those that could be marketed and which would not have clearly unacceptable environmental impacts. Our annual program goals might include a marketing goal of receiving some number of viable proposals for developing listed opportunities, a goal of entering into contracts or leases for developing some number of previously listed opportunities, and a maintenance or management goal of enhancing existing leases or contracts so as to increase their annual revenue yield.

Opportunities under Delta might include development rights on a parcel of waterfront land with high recreation potential; leasing an entire drainage with substantial low-elevation old-growth to a coalition of environmental groups; or a land exchange program designed to increase the average income-producing value of our holdings.

Lands identified for high recreation and wildlife values could be marketed by several different methods: (1) competitive bidding, (2) soliciting Requests For Proposal, (3) issuing licenses that set fees as a percentage of gross profit, or (4) leasing general recreation rights based on outside requests. We would attempt to provide resident and non-resident recreational opportunities, realizing that the highest revenue potential probably would come from developments that would attract non-residents. Other recreational opportunities on non-leased or non-licensed sites would remain available to the general public at a minimal fee.

If a particular tract did not appear to have any potential that could be readily marketed by DNRC, it could become a candidate for exchange, or simply be held for the future with little or no current management. We would also conduct an active land exchange program to consolidate our holdings into blocks if we could manage them more efficiently than scattered parcels; for example, blocks of forest subdivision, recreational lands, or waterfront properties.

We would meet the minimum acceptable standards of environmental protection. In cases where the standards allowed discretion, we would accept some adverse environmental effects in order to earn larger long-term monetary returns to the school trust. In cases of uncertain environmental impacts, we would take some risk in favor of earning greater monetary return.

Roads would be built as needed to support land management activities. Roads would be considered a permanent investment and would generally not be obliterated unless doing so would mitigate forest impacts that could otherwise limit management opportunities. We would consider seasonal and year-long closures subject to management concerns, maintenance costs, use levels, and adjacent ownership needs.

EPSILON

Under this program, we assume that the relative market value of timber, the existence of a manufacturing and marketing infrastructure, and our own technical expertise and long experience give us a natural advantage that makes timber management the best way to maximize long-term average trust income. Consequently, we would formalize timber marketing as our primary business. We would maintain an up-to-date inventory of our timber growing sites and compile a list of timber sales that offered the highest near-term income potential. Our main program goal would be to offer the harvest level and mix of sales most appropriate for current market conditions and long-term sustainable yield.

Other revenue-generating activities, such as grazing and cabin-site leasing, could be allowed in response to applications initiated by the public as long as they do not substantially interfere with our timber marketing program. However, we would not devote money and staffing to initiating other types of proposals. If a proposal comes to us, we would, as time permits, consider its environmental impacts and revenue potential, as compared to timber harvest on the same lands. If the proposal clearly offers better long-term prospects than timber management on those lands, we would grant approval.

Lands that are not suitable for profitable timber management would either be managed for the next most profitable use that did not conflict with present or future timber harvest, be considered for exchange, or be held for the future with only minimal management.

We would meet the minimum acceptable standards of environmental protection. In cases where the standards allowed discretion, we would accept some adverse environmental effects in order to earn larger long-term monetary returns to the school trust. In cases of uncertain environmental impacts, we would take some risk in favor of earning greater monetary return.

Roads would be built as needed to support timber management activities. Roads would be considered a permanent investment and would generally not be obliterated unless doing so would mitigate impacts that could otherwise limit management opportunities. Roads would not be built for other uses unless they were paid for by the proposed use and would not limit timber management. We would consider seasonal and year-long closures subject to management concerns, maintenance costs, use levels, and adjacent ownership needs.

ZETA

Under this program, we assume that changing social values, an increasing demand for quality outdoor experiences, and our status as a large forest landowner puts us in a unique position to maximize long-term average trust revenue by specializing in marketing outdoor recreation and wildlife related opportunities. Our program direction would emphasize wildlife and recreation management first, and other activities to the degree that they do not conflict with, or would enhance, these primary resource values.

We would inventory opportunities for making money through emphasis on recreation and/or wildlife management. Our annual program goals might include a marketing goal of receiving some number of viable proposals for developing listed opportunities, a goal of entering into contracts or leases for actually developing some number of previously listed opportunities, and a maintenance or management goal of enhancing existing leases or contracts so as to increase their annual revenue yield. Under this strategy, we would concentrate our efforts towards initiating and actively marketing proposals that would provide income from wildlife and recreation management.

Lands identified for high recreation and wildlife values could be marketed by several different methods: (1) competitive bidding, (2) soliciting Requests For Proposal, (3) issuing licenses setting fees as a percentage of gross profit, or (4) leasing recreation rights based on outside requests. We would attempt to provide resident and non-resident recreational opportunities, realizing that the highest revenue potential may come from developments that would attract non-residents. Other recreational opportunities on non-leased or non-licensed sites would remain available to the general public at a minimal fee.

Proposals from outside the agency could displace wildlife/recreation use, but their revenue potential and environmental impacts would have to be more favorable than those expected from recreation or wildlife management.

Lands that did not have marketable wildlife or recreation potential could be managed for the next most profitable use as long as doing so would not diminish wildlife/recreation opportunities for the future. Management for other uses would be done in ways that maintained or enhanced future wildlife/recreation potential. For example, grazing leases could pay special attention to protecting riparian areas, prairie dog communities, or access roads.

We would build roads primarily to enhance or promote profitable recreation and wildlife management opportunities. However, we would actively seek ways to minimize roads through cooperative road planning. We would use selective road closures to maximize recreational opportunities while protecting wildlife and water quality. Closed roads could be used for recreational activities such as hiking, skiing and snowmobiling.

We would exceed minimum environmental protection standards only when doing so would enhance wildlife and recreation economic values.

OMEGA

Our premise is that the best way to produce long-term income for the trust is to manage intensively for healthy and biologically diverse forests. Our understanding is that a diverse forest is a stable forest that will produce the most reliable and highest long-term revenue stream. Healthy and biologically diverse forests would provide for sustained income from both timber and a variety of other potential uses. They would also help maintain stable trust income in the face of uncertainty regarding future resource values. In the foreseeable future timber management will continue to be our primary source of revenue and primary tool for achieving biodiversity objectives. By promoting biodiversity we will protect the future income-generating capacity of the land by maintaining or restoring healthy and productive ecosystems.

We would take a 'coarse filter' approach to biodiversity by favoring an appropriate mix of stand structures and compositions on state lands. A coarse filter approach "assumes that if landscape patterns and process (similar to those species evolved with) are maintained, then the full complement of species will persist and biodiversity will be maintained" (Jensen and Everett 1993). A diversity of stand structures and compositions provides a broad range of current and prospective revenue opportunities through a sustained yield of timber and other outputs and maintenance of forest health and biodiversity, while reducing risks of catastrophic fires, insect and disease attacks.

The coarse filter approach supports diverse wildlife habitat by managing for a variety of forest structures and compositions, instead of focusing on habitat needs for individual, selected species. Because we cannot assure that the course filter approach will adequately address the full range of biodiversity, we would also employ a 'fine filter' approach for threatened, endangered, and sensitive species. The fine filter approach focuses on single species' habitat requirements.

Within areas of large, blocked ownership, we would manage for a desired future condition characterized by the proportion and distribution of forest types and structures historically present on the landscape. Our typical analysis unit would be a third order drainage wherein we would focus on maintaining or restoring the forest conditions that would have naturally been present given topographic, edaphic and climatic characteristics of the area. Any particular combination of site, topography and climate has an associated disturbance regime and range of possible forest conditions. Among the forest conditions we will consider are successional stage, species composition, stand structure, patch size and shape, habitat connectivity and fragmentation, disturbance regime, old-growth distribution and composition, and habitat type. Timber harvests would be designed to promote long-term diversity and an appropriate representation of forest conditions across the landscape. Where our ownership contains forest structures made rare on adjacent lands due to the management activities of others, we would not necessarily maintain those structures in amounts sufficient to compensate for their loss when assessed over the broader landscape. However, if our ownership contains rare or unique habitat elements occurring naturally (e.g, bog, patches of a rare plant), we would manage so as to retain those elements.

On areas of smaller and/or scattered ownership we would not frequently be in a position to provide for appropriate representation of forest conditions across the broader landscape level. Our activities would still be based on restoring a semblance of historic conditions within our ownership. We would consider management of our lands to contribute to the diversity of forest conditions over the larger landscape. Where our ownership contains forest structures made rare on adjacent lands due to others' management activities, we would not necessarily maintain those structures in amounts sufficient to compensate for their loss when assessed over the broader landscape. However, if our ownership contains rare or unique habitat elements occurring naturally (e.g, bog, patches of a rare plant), we would manage so as to retain those elements.

In both types of ownership, timber harvest would play the dual role of generating revenue while also serving as our primary tool for producing the desired range of stand structures and distributions. The relative market value of timber, the existence of a manufacturing and marketing infrastructure, and our own technical expertise and long experience give us an advantage for using timber management as the primary tool to achieve biologically diverse forests. We would maintain an up-to-date inventory of our forest sites. We would compile a list of timber sales that contribute to the goals of biodiversity and offer the highest near-term income potential.

We would manage so as to meet annual sustained yield levels identified in the study mandated by HB 201 (§ 77-5-221--223, MCA). That study will incorporate both the philosophy and standards of this alternative. Fundamental to this philosophy is the concept that managed forests should reflect historic distributions and patterns of forest types and successional stages. We will re-evaluate our annual sustained yields at least once every 10 years, as required by § 77-5-221-223, MCA.

Each land office would have annual goals including a timber sale target as well as goals for marketing other uses. Many of these goals would include the use of timber harvest as a tool. For example, forests dominated by immature second-growth timber might be thinned to produce small logs and pulpwood, while reducing stand stress levels and hastening development of old-growth features and high-value forest products. In areas with considerable old-growth, some stands might be managed on long rotations to perpetuate old-growth, while others might be managed on shorter rotations to produce high yields of timber.

Management for forest health and biodiversity would provide us with a consistent basis from which to develop action alternatives at the project level. Within the landscape, reference to a historical condition supplies us with an estimate of future risk and an ecologically defensible desired state.

Prescribed fire will play a larger role in Omega than in any of the other alternatives. Restoration of historical forest conditions to the landscape requires that prescribed burning be among the management tools available. For centuries, fire was the predominant disturbance agent on the landscape. The last several decades have seen timber harvest replace fire as the primary disturbance agent in our forests. This has caused shifts in species compositions and the representation of various forest cover types.

Within this alternative, fire may be prescribed as an underburn treatment in some types of stands, or as a post-harvest treatment in other types. We would continue to suppress wildfire, however. The Biological Diversity Strategies for Forest Type Groups attachment (see Appendix RMS) would serve as a guideline describing situations where we may use prescribed fire.

We would actively seek ways to minimize the amount of new roads needed to support management activities. We would promote cooperative road management planning among adjacent landowners as one way to minimize roads. We would consider obliterating roads that are not primary access routes. We would close most new roads following use in order to minimize open road mileage, unless they provide planned public access or regular administrative access.

We would pursue other income opportunities as guided by changing markets for new and traditional uses. These uses may replace timber production when their revenue exceeds long-term timber production revenue potential. Where we pursue non-timber uses, we may not comply with the biodiversity elements of this alternative. Opportunities might include development rights on a parcel of waterfront land with high recreation potential; homesite development; leasing an entire drainage with substantial low-elevation old-growth to a coalition of environmental groups; or a land exchange program designed to increase the average income-producing value of our holdings. However, because we expect these other income opportunities to occur on a minor amount of the forest acreage, these uses would not compromise the overall fundamental premise of managing for biodiversity.

SUMMARY OF RESOURCE MANAGEMENT STANDARDS

Once we had our core concept narratives, we were able to draft RMS as they would be applied under each alternative. These in turn influenced our analysis of environmental effects. These standards, summarized here, take into account the alternatives' different management emphases. The summary in this chapter presents the major differences between RMS as they would be applied under each alternative. The complete RMS can be found in Appendix RMS.

BIODIVERSITY RESOURCE MANAGEMENT STANDARDS

Alpha

- DNRC would normally use management practices that sustain site productivity and reduce the risk of losses to damaging agents, which may help promote certain elements of biodiversity, but promoting biodiversity itself would not be a primary goal.
- On projects where elements of biodiversity are identified as issues, DNRC would evaluate these elements at a landscape level. These evaluations must consider all ownerships and identify opportunities to mitigate impacts while meeting project objectives.
- Where landscape evaluations identify opportunities to mitigate biodiversity impacts, DNRC may incorporate such measures into management activities if there is a known connection to long-term timber productivity, or it would prevent significant environmental impacts.
- DNRC would not initiate cooperative ecosystem management planning with adjoining landowners, but may participate if initiated by others where it would promote long-term trust revenue opportunities.
- Interim old-growth standards for Stillwater, Coal Creek, and Swan River State Forests would no longer be in force upon Plan adoption.

Beta

- DNRC would promote biodiversity by favoring a variety of stand structures and patterns on state lands, thus maintaining representation of habitats for native plant and animal species.

- When land management activities are being considered, DNRC would evaluate the distribution and arrangement of stand structures at a landscape level. These evaluations would consider all ownerships and identify opportunities to promote a desirable distribution of stand structures and patterns.
- DNRC would use information from landscape evaluations to design management activities so that they will maintain or promote a favorable distribution of stand conditions. Timber harvests will be designed to promote the long-term diversity and balanced representation of forest conditions across the landscape.
- DNRC would make reasonable attempts to develop cooperative ecosystem management planning with adjoining landowners.
- We would seek to maintain and restore old-growth in at least half the amounts expected to occur on state lands with natural processes in similar types of forest.
- We would not maintain additional old-growth to compensate for its loss on adjoining ownerships, unless agreed upon in cooperative ecosystem management plans.

Gamma

- DNRC would promote biodiversity with management activities that maintain and restore natural ecological characteristics.
- When land management activities are being considered, DNRC would prepare landscape-level biodiversity plans for specific actions which would promote natural ecological characteristics that promote biodiversity.
- All management activities would be consistent with actions identified in the landscape-level biodiversity plans.
- DNRC would attempt to develop cooperative ecosystem management planning with adjoining landowners.
- DNRC would seek to maintain old-growth in amounts consistent with natural processes in similar forest types. Old-growth conditions would be developed or maintained on enough additional acres to provide for replacement of existing old-growth over time.

Delta and Epsilon

- DNRC would normally use management practices that would sustain site productivity and reduce the risk of losses to damaging agents. Some of these practices might help promote certain elements of biodiversity; however, promoting biodiversity itself would not be a primary goal except where it provided direct trust income.
- On projects where elements of biodiversity are identified as issues, DNRC would evaluate these elements at a landscape level. These evaluations must consider all ownerships and identify opportunities to mitigate impacts while meeting project objectives.
- Where landscape evaluations identify opportunities to mitigate biodiversity impacts, DNRC may incorporate such measures if there is a known connection to trust revenue opportunities, or if trust revenue would not be diminished.
- In situations where cumulative impacts to biodiversity would limit DNRC's income-producing capability, DNRC would make reasonable attempts to develop cooperative ecosystem management plans with adjoining landowners, with the objective of promoting biodiversity at a landscape level while equitably maintaining or promoting long-term trust revenue opportunities.
- Old-growth would not be specifically protected from harvest unless the trust were compensated or protection was agreed upon as part of a cooperative ecosystem management plan.

Zeta

- DNRC would promote biodiversity where it supports income opportunities based on wildlife and recreation. Promoting biodiversity would also be a primary goal where it provides direct income by means such as conservation easements or leases, wildlife viewing areas, or nature trail development.
- On projects where elements of biodiversity are identified as issues, DNRC would evaluate these elements at an appropriate spatial scale. These evaluations would consider all ownerships and identify opportunities to mitigate impacts while meeting project objectives.
- DNRC may incorporate measures to mitigate biodiversity issues if they appear to promote or directly provide trust revenue opportunities.
- In situations where cumulative impacts to biodiversity would limit DNRC's income-producing opportunities, we would make reasonable attempts to develop cooperative ecosystem management planning with major adjoining landowners, with the objectives of promoting biodiversity at a landscape level and equitably maintaining or promoting long-term trust revenue opportunities.
- Within an appropriate ecosystem analysis area, DNRC would seek to maintain or restore old-growth forest in amounts of at least half the average proportion that would be expected to occur with natural processes in similar forest types. Old-growth conditions would be developed or maintained on enough additional acres to provide for replacement of existing old-growth over time.
- We would not maintain additional old-growth to compensate for its loss on adjoining ownerships, unless agreed upon in cooperative ecosystem management plans.

Omega

- DNRC would promote biodiversity by taking a "coarse filter" approach thereby favoring an appropriate mix of stand structures and compositions on state lands. Appropriate stand structures and compositions would be based on ecological characteristics.
- The coarse filter approach supports diverse wildlife habitat by managing for a variety of forest structures and compositions, instead of focusing on habitat needs for individual, selected species. DNRC would also employ a 'fine filter' approach for T&E and sensitive species focusing on single species' habitats.
- Within areas of large, blocked ownership, DNRC would manage for a desired future condition characterized by the proportion and distribution of forest types and structures historically present on the landscape. The typical analysis area would be a third-order drainage with the focus on maintaining or restoring forest conditions that would have naturally been present given topographic, edaphic and climatic characteristics of the area. Where our ownership contained forest structures made rare on adjacent lands due to others' management activities, we would not necessarily maintain those structures in amounts sufficient to compensate for their loss when assessed over the broader landscape. However, if our ownership contains rare or unique habitat elements occurring naturally (e.g., bog, patches of a rare plant), we would manage so as to retain those elements.
- On areas of smaller and/or scattered ownership, DNRC would not frequently be in a position to provide for appropriate representation of forest conditions across the broader landscape level. DNRC activities would still be based on restoring a semblance of historic conditions within state ownership. Where our ownership contains forest structures made rare on adjacent lands due to others' management activities, we would not necessarily maintain those structures in amounts sufficient to compensate for their loss when assessed over the broader landscape. However, if our ownership contained rare or unique habitat elements occurring naturally (e.g., bog,

patches of a rare plant), we would manage so as to retain those elements.

- Within an appropriate ecosystem analysis area, DNRC would seek to maintain or restore old-growth forest in amounts of at least half the average proportion that would be expected to occur with natural processes on similar sites.
- DNRC would maintain sufficient replacement old-growth to meet this goal given that old-growth does not live forever. However, DNRC would not maintain additional old-growth to compensate for loss of old-growth on adjoining ownerships.

SILVICULTURE RESOURCE MANAGEMENT STANDARDS

Alpha, Beta, Delta, Zeta and Omega

- All prescribed silvicultural treatments would maintain the long-term productivity of the soil and site to ensure long-term capability to produce trust revenue and maintain soil hydrologic function.
- Management regimes would be designed to realize the productive capability of the site for producing desired products and benefits, and minimize the risk of losses to biotic or abiotic agents.
- The long-term quality of the genetic base would be maintained or improved.
- Diversity of ages, species, and structure would be maintained within or between stands in order to maintain a complex and stable ecosystem.
- Silvicultural prescriptions would be prepared for all planned treatments.
- A financial evaluation would be done for all proposed silvicultural treatments.
- All treatments would have to produce a net return higher than the net return for no action.
- All silvicultural treatment regimes would meet other RMS and comply with all appropriate statutes and regulations.

Gamma

- All prescribed silvicultural treatments would maintain the long-term productivity of the soil and site to ensure long-term capability to produce trust revenue and maintain soil hydrologic function.
- Management regimes would be designed to realize the productive capability of the site for producing desired products and benefits, and to minimize the risk of losses to biotic or abiotic agents.
- The long-term quality of the genetic base would be maintained or improved.
- Diversity of ages, species, and structure would be maintained within or between stands, in order to maintain a complex and stable ecosystem.
- Silvicultural prescriptions would be prepared for all planned treatments.
- A financial evaluation would be done for all proposed silvicultural treatments.
- All treatments except those done specifically for ecosystem rehabilitation must produce a net return higher than the net return for no action.
- All silvicultural treatment regimes would meet other RMS and comply with all appropriate statutes and regulations.

Epsilon

- All prescribed silvicultural treatments would maintain the long-term productivity of the soil and site to ensure long-term capability to produce trust revenue and maintain soil hydrologic function.

- Management regimes would be designed to realize the productive capability of the site for producing desired products and benefits, and to minimize the risk of losses to biotic or abiotic agents.
- All regeneration harvest units would be reforested to prescribed stocking levels as rapidly as site conditions allow.
- The long-term quality of the genetic base would be maintained or improved.
- Diversity of ages, species, and structure would be maintained within or between stands, in order to maintain a complex and stable ecosystem.
- Silvicultural prescriptions would be prepared for all planned treatments.
- A financial evaluation would be done for all proposed silvicultural treatments.
- All treatments must produce net return higher than net return for no action.
- All silvicultural treatment regimes would meet other RMS and comply with all appropriate statutes and regulations.

ROAD MANAGEMENT RESOURCE MANAGEMENT STANDARDS

Alpha

- Location, design, construction, and maintenance of all roads would be consistent with BMPs, SMZ rules, Watershed RMS, other State Land Resource Standards, and the conditions of all appropriate permits.
- Transportation planning would be conducted in the early stages of project level planning.
- The transportation system would be planned to minimize road miles while best meeting current and future management needs.
- Outside SMZs, we would build new roads if use of existing roads would produce more undesirable impacts than new construction. Inside SMZs, we would refer to the Watershed RMS.
- We would locate and design roads to minimize maintenance needs.
- Maintenance would be adequate to ensure continued road use and resource protection.
- DNRC would determine road density at the Unit or Land Office level to meet Threatened and Endangered Species, Big Game, Sensitive Species and Biodiversity RMS, as well as road surface protection and other resource needs.
- In the Swan River State Forest, road closures would be planned in accordance with the 1994 Swan Valley Grizzly Bear Conservation Agreement.

Beta

- Location, design, construction, and maintenance of all roads would be consistent with BMPs, SMZ rules, Watershed RMS, other State Land Resource Standards, and the conditions of all appropriate permits.
- Transportation planning would be conducted as a part of comprehensive landscape-level planning.
- The transportation system would be planned to minimize road miles while best meeting current and future management needs. We would evaluate and use alternative transportation systems that do not require roads whenever possible.
- Outside SMZs, we would build new roads if use of existing roads would produce more undesirable impacts than new construction. Inside SMZs, we would refer to the Watershed RMS.
- We would locate and design roads to minimize maintenance needs.

- Maintenance would be scheduled and funded to ensure continued road use and resource protection. Drainage structures and other resource protection measures would be maintained on restricted as well as open roads.
- DNRC would plan road density to meet landscape-level ecosystem plans and other RMS. DNRC would determine road density to meet Threatened and Endangered Species, Big Game, Sensitive Species and Biodiversity RMS, as well as road surface protection and other resource needs.
- On roads which are deemed non-essential to near-term future management plans, DNRC would emphasize revegetation and slash obstruction to minimize maintenance costs, erosion and enhance road closure and effectiveness while leaving the capital investment intact.
- In the Swan River State Forest, road closures would be planned in accordance with the 1994 Swan Valley Grizzly Bear Conservation Agreement.

Gamma

- Location, design, construction, and maintenance of all roads would be consistent with BMPs, SMZ rules, Watershed RMS, other State Land Resource Standards, and the conditions of all appropriate permits.
- Transportation planning would be conducted as a part of comprehensive landscape-level ecosystem planning.
- The transportation system would be planned to reduce current road miles, obliterate and rehabilitate unnecessary roads, and develop a more balanced transportation system that would meet current and future management needs.
- Outside SMZs, we would build new roads if use of existing roads would produce more undesirable impacts than new construction. Inside SMZs, we would refer to the Watershed RMS.
- We would locate and design roads to limit the amount of required maintenance.
- Maintenance would be scheduled and funded to ensure continued road use and resource protection. Drainage structures and other resource protection measures would be maintained on restricted as well as open roads.
- DNRC would plan road density to minimize open roads on state land. Only those roads that could be regularly maintained and provided planned public or permanent administrative access would remain open. Threatened and Endangered Species, Big Game, Sensitive Species, and Biodiversity RMS, as well as road surface protection and other resource needs, would be used to determine which system roads should remain open.
- In the Swan River State Forest, road closures would be planned in accordance with the 1994 Swan Valley Grizzly Bear Conservation Agreement.

Delta

- Location, design, construction, and maintenance of all roads would be consistent with BMPs, SMZ rules, Watershed RMS, other State Land Resource Standards, and the conditions of all appropriate permits.
- Transportation planning would be conducted to provide for efficient access for the variety of uses proposed for each tract.
- The transportation system would be planned to minimize road miles while best meeting current and future management needs.
- Outside SMZs, we would build new roads if use of existing roads would produce more undesirable impacts than new construction. Inside SMZs, we would refer to the Watershed RMS.

- We would locate and design roads to minimize maintenance needs.
- Maintenance would be scheduled and funded to ensure continued road use and resource protection. Drainage structures and other resource protection measures would be maintained on restricted as well as open roads.
- DNRC would determine road density to meet Threatened and Endangered Species, Big Game, Sensitive Species, and Biodiversity RMS, as well as road surface protection and other resource needs.
- In the Swan River State Forest, road closures would be planned in accordance with the 1994 Swan Valley Grizzly Bear Conservation Agreement.

Epsilon

- Location, design, construction, and maintenance of all roads would be consistent with BMPs, SMZ rules, Watershed RMS, other State Land Resource Standards, and the conditions of all appropriate permits.
- Transportation planning would be conducted in the early stages of project level planning.
- The transportation system would be planned to minimize road miles while best meeting current and future management needs.
- Outside SMZs, we would build new roads if use of existing roads would produce more undesirable impacts than new construction. Inside SMZs, we would refer to the Watershed RMS.
- We would locate and design roads to minimize maintenance needs.
- Maintenance would be scheduled and funded to ensure continued road use and resource protection. Drainage structures and other resource protection measures would be maintained on restricted as well as open roads.
- We would plan road density to meet timber harvesting schedules. DNRC would determine maximum allowable road densities to meet Threatened and Endangered Species, Big Game, Sensitive Species, and Biodiversity RMS, as well as road surface and other resource needs.
- In the Swan River State Forest, road closures would be planned in accordance with the 1994 Swan Valley Grizzly Bear Conservation Agreement.
- Closure locations and the choice of roads to be opened and closed would be adjusted to facilitate timber harvesting plans.

Zeta

- Location, design, construction, and maintenance of all roads would be consistent with BMPs, SMZ rules, Watershed RMS, other State Land Resource Standards, and the conditions of all appropriate permits.
- Transportation planning would be conducted in connection with wildlife and recreational value inventories.
- The transportation system would be planned to minimize road miles, close and rehabilitate unnecessary roads, and develop a more balanced transportation system that focuses on access for recreation and wildlife management needs and objectives.
- Outside SMZs, we would build new roads if use of existing roads would produce more undesirable impacts than new construction. Inside SMZs, we would refer to the Watershed RMS.
- We would locate and design roads to minimize maintenance needs.
- We would also locate and design roads and other transportation systems to take advantage of scenic views, properly approach wildlife areas, and provide recreational opportunities.

- Maintenance would be scheduled and funded to ensure continued road use and resource protection. Drainage structures and other resource protection measures would be maintained on restricted as well as open roads.
- DNRC would determine road densities to meet Threatened & Endangered Species, Big Game, Sensitive Species, Biodiversity RMS, as well as recreational plans, road surface protection and other resource needs.
- In the Swan River State Forest, road closures would be planned in accordance with the 1994 Swan Valley Grizzly Bear Conservation Agreement.

Omega

- DNRC will only build necessary roads, that is, those needed for current and near-term management objectives, as consistent with the other resource management standards.
- We would evaluate and use alternative transportation systems that do not require roads whenever possible.
- Location, design, construction, and maintenance of all roads would be consistent with BMPs, SMZ rules, Watershed RMS, other State Land Resource Standards, and the conditions of all appropriate permits.
- Transportation planning would be conducted as a part of comprehensive landscape-level planning.
- Outside SMZs, we would build new roads if use of existing roads would produce more undesirable impacts than new construction. Inside SMZs, we would refer to the Watershed RMS.
- We would locate and design roads to minimize maintenance needs.
- Maintenance would be scheduled and funded to ensure continued road use and resource protection. Drainage structures and other resource protection measures would be maintained on restricted as well as open roads.
- DNRC would plan road density to meet landscape level ecosystem plans and other RMS. DNRC would determine road density to meet Threatened and Endangered Species, Big Game, Sensitive Species and Biodiversity RMS, as well as road surface protection and other resource needs.
- On roads which are deemed non-essential to near-term future management plans, DNRC would emphasize obliteration through revegetation and slash obstruction. This would minimize maintenance costs, erosion and enhance road closure and effectiveness while leaving the capital investment intact.
- In the Swan River State Forest, road closures would be planned in accordance with the 1994 Swan Valley Grizzly Bear Conservation Agreement.

WATERSHED RESOURCE MANAGEMENT STANDARDS

Alpha

- We would manage watersheds, soil resources, and bodies of water to maintain high quality water that meets or exceeds state water quality standards, and to protect designated beneficial uses.
- Forest management practices would incorporate BMPs into project design and implementation.
- Projects involving substantial vegetation removal or ground disturbance would require an assessment of cumulative watershed effects to ensure that the project will not increase impacts beyond the physical limits imposed by the stream ecosystem for supporting its most restrictive beneficial use.

- Threshold values for cumulative watershed effects would be set at a level to ensure protection of beneficial water uses with a low to moderate degree of risk.
- DNRC would cooperate with other landowners to manage cumulative watershed effects within prescribed thresholds.
- We would manage Streamside Management Zones (SMZs), riparian areas, and wetlands in a manner that complies with appropriate laws and regulations and protects and maintains water quality and beneficial uses.
- SMZ width would depend on erosion potential, level of disturbance proposed, and beneficial uses of the stream. Maximum 100-foot wide SMZ in all but exceptional cases of steep slopes, erosive soils, and sensitive streams.
- Trees would be retained in the SMZ as prescribed in the SMZ rules.
- A 25-foot wide SMZ would be maintained around isolated wetlands greater than one-half acre.
- Existing roads in SMZs would be used if the potential water quality impacts are adequately mitigated.
- We would rehabilitate or mitigate the adverse effects of fire, flood, and other natural or management-related events as funds are available.

Beta

- We would manage watersheds, soil resources, and bodies of water to maintain high quality water that meets or exceeds state water quality standards, and to protect designated beneficial uses.
- An inventory and analysis of watershed impacts would be conducted on state-owned forest land as funding allowed, sufficient to identify causes of watershed degradation and set priorities for watershed restoration. We would emphasize mitigation to provide greater opportunities to produce trust income while maintaining beneficial uses.
- Forest management practices would incorporate BMPs into project design and implementation.
- Projects involving substantial vegetation removal or ground disturbance would require an assessment of cumulative watershed effects to ensure that the project will not increase impacts beyond the physical limits imposed by the stream ecosystem for supporting its most restrictive beneficial use.
- Threshold values for cumulative watershed effects would be set at a low to moderate degree of risk.
- DNRC would cooperate with other landowners to manage cumulative watershed effects within prescribed thresholds.
- We would manage SMZs, riparian areas, and wetlands in a manner that complies with appropriate laws and regulations and protects and maintains water quality and beneficial uses.
- SMZ width would be dependent on erosion potential, level of disturbance proposed, and beneficial uses of the stream. Maximum-200 foot SMZ.
- Trees would be retained in the SMZ as prescribed in the SMZ rules.
- A 50-foot SMZ would be maintained around isolated wetlands greater than one-quarter acre.
- Existing roads in SMZS would be used if potential impacts are adequately mitigated.
- We would rehabilitate or mitigate the adverse effects of fire, flood, and other natural or management-related events as funds are available.
- For development activities, we would ensure that adequate reclamation plans and bonds are included in the approved plans of operation.
- We would locate fire management bases, camps, helibases, staging areas, and other centers for incident activities outside of the SMZ.
- We would use fire suppression methods that would result in the least soil disturbance possible in the SMZ.

Gamma

- We would manage watersheds, soil resources, and bodies of water to maintain high quality water that meets or exceeds state water quality standards, and to protect designated beneficial uses.
- An inventory and analysis of watershed impacts would be conducted on state-owned forest land as funding allowed, sufficient to identify causes of watershed degradation and set priorities for watershed restoration. We would emphasize an aggressive program of mitigation to remedy water-quality impacts caused by past activities, using restoration methods that promote long-term ecological integrity of the restored ecosystem.
- Forest management practices would incorporate BMPs into project design and implementation.
- Projects involving substantial vegetation removal or ground disturbance would require an assessment of cumulative watershed effects to ensure that the project will not increase impacts beyond the physical limits imposed by the stream ecosystem for supporting its most restrictive beneficial use.
- Threshold values for cumulative watershed effects would be set at a low degree of risk.
- SMZ width would be dependent on type of waterbody.
  - Fish-bearing streams would have an SMZ 300 feet horizontal distance in width on each side.
  - Permanently flowing non-fish-bearing streams would have a 150-foot wide SMZ.
  - Lakes would have a 300-foot wide SMZ.
  - Seasonally flowing or intermittent streams would have a 100-foot wide SMZ.
- Trees would be retained in the SMZ as prescribed in the SMZ rules.
- A 100-foot wide SMZ would be maintained around isolated wetlands greater than one-quarter acre.
- We would abandon and rehabilitate existing roads in SMZs where possible. Where there are no reasonable alternative routes, we would apply the most effective mitigation measures possible.
- We would rehabilitate or mitigate the adverse effects of fire, flood, and other natural or management-related events as funds are available.
- For development activities, we would ensure that adequate reclamation plans and bonds are included in the approved plans of operation.
- We would locate fire management bases, camps, helibases, staging areas, and other centers for incident activities outside of the SMZ.
- We would use fire suppression methods that would result in the least soil disturbance possible in the SMZ.

Delta and Epsilon

- We would manage watersheds, soil resources, and bodies of water to maintain high quality water that meets or exceeds state water quality standards, and to protect designated beneficial uses.
- An inventory and analysis of watershed impacts would be conducted on state-owned forest land as funding allowed, sufficient to identify causes of watershed degradation and set priorities for watershed restoration. We would emphasize mitigation to provide greater opportunities to produce trust income.
- Forest management practices would incorporate BMPs into project design and implementation.
- Projects involving substantial vegetation removal or ground disturbance would require an assessment of cumulative watershed effects to ensure that the project will not increase impacts beyond the physical limits imposed by the stream ecosystem for supporting its most restrictive beneficial use.

- Threshold values for cumulative watershed effects would be set at a moderate to high degree of risk.
- DNRC would cooperate with other landowners to manage cumulative watershed effects within prescribed thresholds. DNRC would mitigate for other owners' current and past activities, as well as our own, only to the extent necessary to comply with requirements for water protection.
- SMZs, riparian areas, and wetlands would be managed to comply with appropriate laws and regulations and protect and maintain water quality for beneficial uses.
- SMZ width would be set according to SMZ rules, except in sensitive locations.
- Trees would be retained in the SMZ as prescribed in the SMZ rules.
- We would retain a 25 foot-wide SMZ around isolated wetlands greater than one-half acre.
- Existing roads in SMZs would be used if potential impacts are adequately mitigated.
- We would rehabilitate or mitigate the adverse effects of fire, flood, and other natural or management-related events as funds are available.
- For development activities, we would ensure that adequate reclamation plans and bonds are included in the approved plans of operation.
- We would locate fire management bases, camps, helibases, staging areas, and other centers for incident activities outside of the SMZ.
- We would use fire suppression methods that would result in the least soil disturbance possible in the SMZ.

Zeta

- We would manage watersheds, soil resources, and bodies of water to maintain high quality water that meets or exceeds state water quality standards, and to protect designated beneficial uses.
- An inventory and analysis of watershed impacts would be conducted on state-owned forest land as funding allowed, sufficient to identify causes of watershed degradation and set priorities for watershed restoration. We would emphasize an aggressive program of mitigation to remedy water-quality impacts caused by past activities. Rehabilitation efforts that enhance fisheries or recreation would be given priority.
- Forest management practices would incorporate BMPs into project design and implementation.
- Projects involving substantial vegetation removal or ground disturbance would require an assessment of cumulative watershed effects to ensure that the project will not increase impacts beyond the physical limits imposed by the stream ecosystem for supporting its most restrictive beneficial use.
- Threshold values for cumulative effects would be set at a low to moderate degree of risk.
- DNRC would cooperate with other landowners to manage cumulative watershed effects within prescribed thresholds.
- SMZ width would be dependent on erosion potential, level of disturbance proposed, and beneficial uses of stream. Maximum 200-foot SMZ.
- Trees would be retained in the SMZ as prescribed in the SMZ rules.
- We would maintain a 50-foot SMZ around isolated wetlands greater than one-quarter acre.
- Existing roads in SMZs would be used if potential impacts are adequately mitigated.
- We would rehabilitate or mitigate the adverse effects of fire, flood, and other natural or management-related events as funds are available.
- For development activities, we would ensure that adequate reclamation plans and bonds are included in the approved plans of operation.

- We would locate fire management bases, camps, helibases, staging areas, and other centers for incident activities outside of the SMZ.
- We would use fire suppression methods that would result in the least soil disturbance possible in the SMZ.

Omega

- We would manage watersheds, soil resources, and bodies of water to maintain high quality water that meets or exceeds state water quality standards, and to protect designated beneficial uses.
- An inventory and analysis of watershed impacts would be conducted on state-owned forest land as funding allowed, sufficient to identify causes of watershed degradation and set priorities for watershed restoration. We would emphasize mitigation to provide greater opportunities to produce trust income while maintaining beneficial uses.
- Forest management practices would incorporate BMPs into project design and implementation.
- Projects involving substantial vegetation removal or ground disturbance would require an assessment of cumulative watershed effects to ensure that the project will not increase impacts beyond the physical limits imposed by the stream ecosystem for supporting its most restrictive beneficial use.
- Threshold values for cumulative watershed effects would be set at a low to moderate degree of risk. On the Stillwater, Coal Creek and Swan River State Forests, we would establish thresholds at a level to ensure protection of beneficial water uses with a low degree of risk.
- DNRC would cooperate with other landowners to manage cumulative watershed effects within prescribed thresholds. DNRC would continue to participate in cooperative monitoring efforts, such as the Flathead Basin Commission's Monitoring Plan.
- We would manage SMZs, riparian areas, and wetlands in a manner that complies with appropriate laws and regulations and protects and maintains water quality and beneficial uses.
- SMZ width would be dependent on erosion potential, level of disturbance proposed, and beneficial uses of the stream. Maximum 200-foot SMZ.
- Trees would be retained in the SMZ as prescribed in the SMZ rules.
- A 50-foot equipment restriction would be maintained around isolated wetlands greater than one-quarter acre.
- Existing roads in SMZs would be used if potential impacts are adequately mitigated.
- We would rehabilitate or mitigate the adverse effects of fire, flood, and other natural or management-related events as funds are available.
- For development activities, we would ensure that adequate reclamation plans and bonds are included in the approved plans of operation.
- We would locate fire management bases, camps, helibases, staging areas, and other centers for incident activities outside of the SMZ.
- We would use fire suppression methods that would result in the least soil disturbance possible in the SMZ.
- DNRC will develop a monitoring strategy to assess watershed impacts of land use activities and the effectiveness of mitigation measures.
- If monitoring indicated watershed impacts from management or other activities, problems would be corrected. The information collected would be used to identify the need for mitigation measures and modification of future activities to avoid similar impacts.
- Upon request, monitoring data will be made available to the public. DNRC will compile the results of monitoring into a report for the Land Board by October 2000 and every five years thereafter.

FISHERIES RESOURCE MANAGEMENT STANDARDS

Alpha

- DNRC would coordinate with MDFWP in design and implementation of projects that may affect the fisheries resource.
- Activities in the Flathead Basin would be designed to protect bull trout and west slope cutthroat trout habitat.
- We would minimize impacts to fisheries by implementing RMS and Best Management Practices (BMPs) and complying with the Streamside Management Zone Law and other laws and regulations.
- We would implement immediate actions as interim measures to conserve bull trout habitat, as recommended by the Governor's Bull Trout Restoration Team.

Beta, Gamma, Zeta and Omega

- DNRC would coordinate with MDFWP in design and implementation of projects that may affect the fisheries resource.
- Activities in the Flathead Basin would be designed to protect bull trout and west slope cutthtroat trout habitat.
- We would manage activities outside the Flathead basin to sustain and enhance bull trout, west slope cutthroat, Yellowstone cutthroat, and all other designated "sensitive" species, and Species of Special Concern.
- We would minimize impacts to fisheries by implementing RMS and BMPs and complying with the Streamside Management Zone Law and other laws and regulations.
- We would construct, reconstruct, and maintain road crossing structures on fish-bearing streams to provide for fish passage.
- Silvicultural treatments adjacent to fish-bearing streams would prescribe for steady entry of pool-forming trees into the stream system.
- Fisheries designated as "sensitive" or containing Species of Special Concern would be managed so as to comply with additional, and possibly more restrictive, direction specified in the Sensitive Species RMS.
- We would cooperate with other agencies to prevent stocking of non-native fish, over-fishing, and poaching.
- We would implement immediate actions as interim measures to conserve bull trout habitat, as recommended by the Governor's Bull Trout Restoration Team.

Delta and Epsilon

- DNRC would coordinate with MDFWP in design and implementation of projects that may affect the fisheries resource.
- Activities in the Flathead Basin would be designed to protect bull trout and west slope cutthtroat trout habitat.
- We would minimize impacts to fisheries by implementing RMS and BMPs and complying with the Streamside Management Zone Law and other laws and regulations.
- We would construct and maintain road crossing structures on fish-bearing streams to provide for fish passage.
- Fisheries designated as "sensitive" or containing Species of Special Concern would be managed so as to comply with additional, and possibly more restrictive, direction specified in the Sensitive Species RMS.

- We would implement immediate actions as interim measures to conserve bull trout habitat, as recommended by the Governor's Bull Trout Restoration Team.

THREATENED AND ENDANGERED SPECIES RESOURCE MANAGEMENT STANDARDS

Alpha

- DNRC would implement its 1988 grizzly bear management standards and guidelines for the west side of the Northern Continental divide, or updates of those standards.
- DNRC would participate on interagency working groups to develop guidelines and implement recovery plans for grizzly bear, bald eagle and wolf (there are no working groups for Peregrine falcons).
- DNRC might modify activities to promote recovery of T&E plant and animal species when consistent with producing revenue through sustained harvest of forest products. We would comply with Section 9 of the Endangered Species Act, which prohibits any action that may be considered a "taking," but would not unilaterally promote recovery.
- In the Swan River State Forest, DNRC would adhere to the set of management guidelines contained in the 1994 Swan Valley Grizzly Bear Conservation Agreement.

Beta

- DNRC would implement federal and working group standards, or DNRC standards of equivalent conservation effect, for grizzly bear management.
- DNRC would participate on interagency working groups to develop guidelines and implement recovery plans for grizzly bear, bald eagle and wolf (there are no working groups for Peregrine falcons).
- DNRC would promote recovery of threatened and endangered plant and animal species.
- In the Swan River State Forest, DNRC would adhere to the set of management guidelines contained in the 1994 Swan Valley Grizzly Bear Conservation Agreement.

Gamma

- DNRC would promote recovery of grizzly bears on state lands. We would adopt and implement federal and working group standards and guidelines for grizzly bear management on state lands in each designated recovery area.
- DNRC would participate on interagency working groups to develop guidelines and implement recovery plans for grizzly bear, bald eagle and wolf (there are no working groups for Peregrine falcons).
- We would promote recovery of all threatened and endangered plant and animal species.
- In the Swan River State Forest, DNRC would adhere to the set of management guidelines contained in the 1994 Swan Valley Grizzly Bear Conservation Agreement.

Delta and Epsilon

- DNRC would no longer implement the 1988 DNRC interim grizzly bear management standards and guidelines for the west side of the Northern Continental Divide.
- DNRC would review information from interagency working groups established to develop guidelines and implement recovery plans for T&E plant and animal species.
- DNRC would comply with Section 9 of the Endangered Species Act, which prohibits actions that may be considered a "taking."

- DNRC would not routinely implement federal and working group guidelines to promote recovery of threatened and endangered species.
- In the Swan River State Forest, DNRC would adhere to the set of management guidelines contained in the 1994 Swan Valley Grizzly Bear Conservation Agreement.

Zeta

- DNRC would either adopt and implement federal and working group standards and guidelines for grizzly bear management, or develop its own standards, to the extent that doing so would not conflict with trust management policy.
- We would participate on interagency working groups to develop guidelines and implement recovery plans for grizzly bear, bald eagle and wolf (there are no working groups for Peregrine falcons).
- DNRC might modify activities to promote recovery of T&E plant and animal species, when doing so is consistent with producing trust revenue. We would comply with Section 9 of the Endangered Species Act, which prohibits any actions that may be considered a "taking," but we would not unilaterally promote recovery.
- In the Swan River State Forest, DNRC would adhere to the set of management guidelines contained in the 1994 Swan Valley Grizzly Bear Conservation Agreement.

Omega

- DNRC would participate in recovery efforts of T&E plant and animal species and would confer with the U.S. Fish and Wildlife Service (USFWS) to develop habitat mitigation measures. These measures might differ from federal management guidelines as DNRC plays a subsidiary role to federal agencies in species recovery.
- We would participate on interagency working groups to develop guidelines and implement recovery plans for grizzly bear, bald eagle and wolf (there are no working groups for Peregrine falcons).
- In the Swan River State Forest, DNRC would adhere to the set of management guidelines contained in the 1994 Swan Valley Grizzly Bear Conservation Agreement.

SENSITIVE SPECIES RESOURCE MANAGEMENT STANDARDS

Alpha, Delta, Epsilon, and Zeta

- DNRC would consider sensitive species in project planning through the MEPA process. Sensitive species and their habitats identified in the project area would be given consideration during project planning in an attempt to mitigate potential adverse impacts.
- Measures to protect sensitive species would be implemented if they can be reconciled with other management goals.
- Where management of sensitive species is deemed compatible with other management goals, we would maintain important site characteristics so long as this would not substantially reduce trust revenue.
- Field surveys by qualified professionals might be required in project areas where sensitive plant species could be impacted by project actions.

Beta and Gamma

- DNRC would manage so as to support and, where appropriate, enhance populations of sensitive species on state land.
- Sensitive species and their habitats identified in the project area would be conserved.
- Appropriate measures would be taken to ensure adequate conditions to support these species or contribute to their habitats.
- Field surveys by qualified specialists would be required to determine the presence and location of sensitive plant species. Existing site conditions that could affect the continued maintenance of local populations would be documented.

Omega

- DNRC would manage so as to generally support populations of sensitive species on state land.
- For sensitive plant species, important sites and/or site characteristics would be protected.
- For sensitive animal species, DNRC would provide habitat characteristics recognized as suitable for individuals to survive and reproduce in situations where land ownership patterns and the underlying biological and geographical conditions allow for them.
- Periodic field surveys by qualified specialists would be conducted to assess how well management actions have provided for site conditions needed to support sensitive plant species.

BIG GAME RESOURCE MANAGEMENT STANDARDS

Alpha

- DNRC would manage big game habitats as a potential source of income to the school trust. To accomplish this, DNRC would keep winter ranges and all other seasonally important big game habitats in a condition capable of supporting big game populations, unless such measures were not compatible with annual program objectives.
- We would implement the elk and white-tailed deer winter range standards and guidelines drafted November 1989.
- DNRC would consult with MDFWP to determine if seasonally important big game habitat exists within each proposed project area and, if so, to determine which habitat values might be affected by the proposed action.
- More detailed analysis would be necessary if MDFWP determines that a proposed action might conflict with management of big game habitat. When big game needs are not compatible with other management objectives, conflicts would be addressed on a case-by-case basis.

Beta and Gamma

- DNRC would promote a diversity of stand structures and landscape patterns and rely on them to provide good habitat for native wildlife populations.
- Big game habitat needs would be a secondary consideration in management decisions. However, measures to mitigate potential impacts would be implemented if they were consistent with overall management objectives and the Biodiversity RMS.
- The current elk and white-tailed deer management standards and guidelines drafted in November 1989 would no longer be adopted as Department policy.
- DNRC would consult with MDFWP to determine which big game habitat values are most likely to be affected by proposed management actions.

Delta

- DNRC would manage aggressively to produce revenue from available forest resources.
- On some lands, management of big game species would represent the best way to maximize trust income. Habitat manipulations would be designed to maintain or improve current and future revenue opportunities from fee-based hunting, wildlife viewing, and conservation leases or easements to interested parties.
- Big game habitat needs would be given low priority in situations where revenue potential is greater from management of other resources. Mitigation measures would be implemented to ensure that big game species and their essential habitats are likely to remain in each third-order watershed following any proposed DNRC action.
- The current elk and white-tailed deer management standards and guidelines drafted in November 1989 would no longer be adopted as Department policy.
- DNRC would consult with MDFWP to determine which big game habitat values are most likely to be affected by proposed management actions.

Epsilon

- DNRC would manage forest lands to produce trust income through a sustained annual timber sale level, while attempting to incorporate big game habitat needs consistent with primary timber management objectives.
- DNRC would keep winter ranges and other seasonal ranges in a condition capable of supporting big game populations, unless this is not compatible with timber harvest objectives.
- DNRC would implement the elk and white-tailed deer management standards and guidelines drafted in November 1989 where they are compatible with timber management goals.
- DNRC would consult with the MDFWP to determine if seasonally important big game habitat exists within each proposed project area and, if so, to determine which habitat values might be affected by the proposed action.
- DNRC would consult with MDFWP to determine if important big game habitat exists within each proposed timber sale. Mitigation measures would be implemented to ensure that big game species and their essential habitats are likely to remain in each third-order watershed following any proposed DNRC action.

Zeta

- DNRC would emphasize revenue production from recreational development and wildlife management.
- Big game habitat needs would be secondary where revenue potential from management of other resources is clearly higher. When managing other resources, wildlife mitigation measures would be designed to maintain at least 50-60 percent of the potential wildlife habitat value.
- The current elk and white-tailed deer management standards and guidelines drafted in November 1989 would no longer be adopted as Department policy.
- DNRC would consult with MDFWP to determine how best to enhance big game and other wildlife habitat values in situations where big game management is a priority. In areas managed for other resources, consultations with wildlife biologists would be used to develop appropriate mitigation measures.

Omega

- DNRC would promote a diversity of stand structures and landscape patterns and rely on them to provide good habitat for native wildlife populations.
- To the extent possible, DNRC would manage to provide for big game habitat. Measures to mitigate potential impacts would be implemented if they were consistent with overall management objectives and the Biodiversity RMS.
- The current elk and white-tailed deer management standards and guidelines drafted in November 1989 would no longer be adopted as Department policy.
- DNRC would consult with MDFWP to determine which big game habitat values are most likely to be affected by proposed management actions and would cooperate with MDFWP to limit detrimental impacts to big game.

CLASSIFIED FOREST LAND GRAZING RESOURCE MANAGEMENT STANDARDS

Alpha

- Grazing licenses would indicate the number of Animal Unit Months (AUMs) and grazing period of use. Grazing leases would specify AUMs only.
- Lessees and licensees would have primary responsibility for developing and maintaining rangeland improvements, and for maintaining or improving range condition.
- Stocking rates would be estimated by visual assessment of existing vegetative plant species composition.
- Riparian management concerns would be considered only in isolated instances, primarily in conjunction with mixed ownership allotments.

Beta and Omega

- Grazing licenses and leases would specify AUMs, kinds of livestock, and period of use. Lease/license stipulations would be set at the time of renewal.
- Lessees and licensees would have primary responsibility for developing and maintaining rangeland improvements, and for maintaining or improving range condition.
- DNRC would support rangeland improvements through technical and financial assistance as workload and budget allow.
- Stocking rates would be estimated by visual assessment of existing vegetative plant species composition.
- Livestock management practices would be designed to prevent damage to streambanks that results in non-point source pollution.
- Mineral, protein, and other supplements would be placed to maximize animal distribution away from riparian areas. Holding facilities would be placed outside of riparian areas.
- Continuous, season-long grazing would be authorized, with the level of forage utilization not to exceed 60 percent and with healthy riparian function maintained.

Gamma

- Grazing licenses and leases would specify AUMs, kinds of livestock, and period of use. Lease/license stipulations would be set at the time of renewal.
- Lessees and licensees would have primary responsibility for developing and maintaining rangeland improvements, and for maintaining or improving range condition.

- DNRC would support rangeland improvements through technical and financial assistance as workload and budget allow.
- Stocking rates would be estimated by visual assessment of existing vegetative plant species composition.
- Livestock management practices would be designed to prevent damage to streambanks that results in non-point source pollution.
- Mineral, protein, and other supplements would be placed to maximize animal distribution away from riparian areas. Holding facilities would be placed outside of riparian areas.
- Continuous season-long grazing would not be allowed.

Delta and Epsilon

- Grazing licenses and leases would specify AUMs and period of use. Lease/license stipulations would be set at the time of renewal.
- Lessees and licensees would have primary responsibility for developing and maintaining rangeland improvements, and for maintaining or improving range condition.
- DNRC would support rangeland improvements through technical assistance as workload and budget allow.
- Stocking rates would be estimated by visual assessment of existing vegetative plant species composition.
- Livestock management practices would be designed to prevent damage to streambanks that results in non-point source pollution.
- Mineral, protein, and other supplements would be placed to maximize animal distribution away from riparian areas. Holding facilities would be placed outside of riparian areas.
- Season-long grazing would be authorized when it has been demonstrated to be consistent with achieving properly functioning range condition, including healthy riparian areas.

Zeta

- Grazing licenses and leases would specify AUMs, kinds of livestock, and grazing period of use. Lease/license stipulations would be set at the time of renewal.
- Lessees and licensees would have primary responsibility for developing and maintaining rangeland improvements, and for maintaining or improving range condition.
- DNRC would support rangeland improvements through technical and financial assistance as workload and budget allow.
- Stocking rates would be estimated by visual assessment of existing vegetative plant species composition.
- Livestock management practices would be designed to prevent damage to streambanks that results in non-point source pollution.
- Mineral, protein, and other supplements would be placed to maximize animal distribution away from riparian areas. Holding facilities would be placed outside of riparian areas.
- Season-long grazing would be authorized with the level of forage utilization not to exceed 30 percent.

NOXIOUS WEEDS RESOURCE MANAGEMENT STANDARDS

Alpha

- Forested state lands would be managed to prevent or control the spread of noxious weeds. We would comply with weed management laws, through revegetation plans and agreements with county weed boards.
- DNRC would submit revegetation plans to county weed boards for their review of land-disturbing projects such as road construction.
- DNRC would cooperate with weed districts for control projects across ownerships.
- We would promote the prevention of weed spread by requiring measures such as cleaning heavy equipment, prompt revegetation of roads, and reducing ground disturbance.
- Stipulations and control measures to prevent the spread of weeds would be included in timber sale contracts.
- Herbicide treatments would be limited to areas where they offer the most cost-effective means of control and when funds are available. New outbreaks would have first priority for control. Management of large areas of infestation may be limited to perimeter containment.
- On unleased/unlicensed state lands, DNRC would be responsible for weed control.
- A lessee or licensee of state land would be responsible for weed control on the leased/licensed land at his cost, and must comply with the Montana County Weed Management Act.
- All right-of-way agreements would require the permittee to control weed problems along the right-of-way.
- A portion of recreational access fees would be used, as available, for weed control on sites where weeds are introduced by recreation use.

Beta, Zeta and Omega

- Forested state lands would be managed to prevent or control the spread of noxious weeds. We would comply with weed management law by inventorying noxious weed occurrences, developing management plans, and allocating funds for weed control projects.
- DNRC would submit revegetation plans to county weed boards for their review of land-disturbing projects such as road construction. We would promptly revegetate with site-adapted grasses that emphasize native species.
- DNRC would cooperate with weed districts for control projects across ownerships.
- We would use an integrated pest management approach.
- We would promote prevention of weed spread by requiring measures such as the use of weed-free equipment, prompt revegetation of roads, and reducing ground disturbance.
- Stipulations and control measures to prevent the spread of weeds would be included in timber sale contracts. Where stipulated, weed control efforts would continue for two years following land disturbance
- Herbicide treatments would be limited to areas where they offer the most cost-effective means of control and where biological and mechanical control measures are ineffective. New outbreaks and locations where native plant communities are threatened would have first priority for control. Management of large areas of infestation may be limited to perimeter containment.
- On unleased/unlicensed state lands, DNRC would be responsible for weed control.
- A lessee or licensee of state land would be responsible for weed control on the leased/licensed land at his cost, and must comply with the Montana County Weed Management Act.

- All right-of-way agreements would require the permittee to control weed problems along the right-of-way.
- A portion of recreational access fees would be used, as available, for weed control on sites where weeds are introduced by recreation use.

Gamma

- Forested state lands would be managed to prevent or control the spread of noxious weeds. We would comply with weed management laws by inventorying noxious weed occurrences, developing management plans, and allocating funds for weed control projects.
- DNRC would submit revegetation plans to county weed boards for their review of land-disturbing projects such as road construction. We would promptly revegetate with site-adapted grasses that emphasize native species.
- DNRC would cooperate with weed districts for control projects across ownerships.
- We would use an integrated pest management approach.
- We would promote prevention of weed spread by requiring road construction and harvest equipment to be cleaned prior to moving equipment into a project area.
- Stipulations and control measures to prevent the spread of weeds would be included in timber sale contracts. On weed-free areas, contractors would be responsible for weed control for two years following land disturbance.
- Herbicide treatments would be very limited, to areas where they offer the most cost-effective means of control and where native plant communities are threatened. Herbicide treatments would focus on narrow/site-specific applications.
- On unleased/unlicensed state lands, DNRC would be responsible for weed control.
- A lessee or licensee of state land would be responsible for weed control on the leased/licensed land at his cost, and must comply with the Montana County Weed Management Act.
- All right-of-way agreements would require the permittee to control weed problems along the right-of-way. Vehicle restrictions to reduce the spread of weeds would be integrated into road management plans and right-of-ways.
- A portion of recreational access fees would be used, as available, for weed control on sites where weeds are introduced by recreation use. If recreational use funds are not available, DNRC would supplement weed control.

Delta

- Forested state lands would be managed to prevent or control the spread of noxious weeds and improve the economic return from those lands. We would comply with weed management laws through revegetation plans and agreements with county weed boards.
- DNRC would submit revegetation plans to county weed boards for their review of land-disturbing projects such as road construction.
- DNRC would cooperate with weed districts for control projects across ownerships.
- We would promote prevention of weed spread by requiring road construction and harvest equipment to be cleaned prior to moving equipment into a project area.
- Stipulations and control measures to limit the spread of weeds would be attached to timber sale contracts.
- Herbicide treatments would be limited to areas where they offer the most cost-effective means of control, where biological and mechanical control measures are less effective, and where reduced weeds and improved forage would increase income potential. New outbreaks would have first priority for control. Management of large areas of infestation may be limited to perimeter containment.

- On unleased/unlicensed state lands, DNRC would be responsible for weed control.
- A lessee or licensee of state land would be responsible for weed control on the leased/licensed land at his cost, and must comply with the Montana County Weed Management Act.
- All right-of-way agreements would require the permittee to control weed problems along the right-of-way.
- A portion of recreational access fees would be used, as available, for weed control on sites where weeds are introduced by recreation use.

Epsilon

- Forested state lands would be managed to prevent or control the spread of noxious weeds. We would comply with weed management laws, through revegetation plans and agreements with county weed boards.
- DNRC would submit revegetation plans to county weed boards for their review of land-disturbing projects such as road construction.
- DNRC would cooperate with weed districts for control projects across ownerships.
- We would promote prevention of weed spread by requiring road construction and harvest equipment to be cleaned prior to moving equipment into a project area.
- Stipulations and control measures to limit the spread of weeds would be attached to timber sale contracts.
- Herbicide treatments would be limited to areas where they offer the most cost-effective means of control and where biological and mechanical control measures are less effective. New outbreaks would have first priority for control. Management of large areas of infestation may be limited to perimeter containment.
- On unleased/unlicensed state lands, DNRC would be responsible for weed control.
- A lessee or licensee of state land would be responsible for weed control on the leased/licensed land at his cost, and must comply with the Montana County Weed Management Act.
- All right-of-way agreements would require the permittee to control weed problems along the right-of-way.
- A portion of recreational access fees would be used, as available, for weed control on sites where weeds are introduced by recreation use.

SUMMARY OF ALTERNATIVES

In the DEIS, we included the exact table in both the Executive Summary and Chapter II which summarized the ways each alternative would respond to each of the thirteen issues raised by the public. In an effort to reduce duplication, this table can now be found only in the Executive Summary of this FEIS on pages SUM-32 to SUM-47. It has been deleted from Chapter II.

SCENARIOS

In order to develop our assessment of the projected environmental effects of each alternative, we created plausible scenarios for timber harvest, grazing levels, recreational use, and road density. These scenarios were developed for the purpose of providing some tangible basis for our resource and economics effects assessments. They are not accomplishment targets. They are simply estimates of probable ranges of activity, given the management philosophy we would adopt under each alternative. Tables II-T1, II-G1, II-R1 and II-RD1 show the estimates of harvest levels, grazing

grazing levels, exclusive recreational lease percentages, and road densities that we developed prior to our effects analysis. Appendix SCN details our development of these scenarios. More information on the development of our recreation use estimates is also found in Appendix ECN.

Table II-T1
ESTIMATED RANGE OF TIMBER HARVEST LEVELS FOR EFFECTS ASSESSMENT PURPOSES[5] (MMBF)

	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
HIGH	40	35	10	45	55	20	50
LOW	20	15	5	15	35	10	30

Table II-G1
ESTIMATED LEASED/LICENSED AUMS FOR EFFECTS ASSESSMENT PURPOSES[6]

ALTERNATIVE	AUMS ON FORESTED GRAZING LAND	AUMS ON CLASSIFIED FOREST LAND	TOTAL
ALPHA	10,822	15,594	26,766
BETA	10,822	10,370	21,192
GAMMA	10,822	7,977	18,799
DELTA	8,658	9,752	18,230
EPSILON	10,822	11,168	21,990
ZETA	8,658	9,752	18,230
OMEGA	10,822	10,370	21,192

5 An explanation of the development of our timber scenarios can be found in Appendix SCN.

6 An explanation of the development of our grazing scenarios can be found in Appendix SCN.

Table II-R1
ESTIMATED PERCENTAGE OF STATE FOREST ACRES OFFERED FOR DISPERSED LEASING FOR EFFECTS ASSESSMENT PURPOSES[7]

ALTERNATIVE	PERCENT	REASONING
ALPHA	10	Based on current levels and alternative philosophy.
BETA	15	Slightly higher priority placed on recreation uses compatible with healthy ecosystems.
GAMMA	20	Promotion of low-impact dispersed recreation use.
DELTA	30	Active promotion of high-value opportunities which may include dispersed recreation.
EPSILON	10	Low priority. Must not interfere with timber management.
ZETA	70	Active promotion of high-value wildlife and recreation opportunities.
OMEGA	15	Development of recreation opportunities as guided by changing markets for new and traditional uses.

7 An explanation of the development of our recreation scenarios can be found in Appendix SCN and in Appendix ECN.

Table II-RD1
ESTIMATED ROAD DENSITIES FOR EFFECTS ASSESSMENT PURPOSES[8]
YEAR 2020

	NWLO		SWLO		CLO		SLO, ELO, NELO		TOTAL	
	TOTAL	OPEN	TOTAL	OPEN	TOTAL	OPEN	TOTAL	OPEN	TOTAL	OPEN
EXISTING	2.7	1.4	2.4	0.6	1.1	0.2	1.1	0.2	2.0	0.8
ALPHA										
High	4.1	2.1	3.6	0.9	1.5	0.2	1.8	0.4	3.0	1.2
Low	3.4	1.7	3.0	0.8	1.3	0.2	1.4	0.3	2.5	1.0
BETA										
High	3.7	1.4	3.3	0.6	1.3	0.1	1.6	0.2	2.8	0.8
Low	3.1	1.2	2.7	0.5	1.2	0.1	1.3	0.2	2.3	0.7
GAMMA										
High	2.9	0.9	2.6	0.4	1.2	0.1	1.2	0.1	2.1	0.5
Low	2.8	0.8	2.4	0.4	1.1	0.1	1.2	0.1	2.0	0.5
DELTA										
High	4.4	2.2	3.8	1.0	1.5	0.2	1.8	0.4	3.2	1.3
Low	3.2	1.6	2.8	0.7	1.2	0.2	1.4	0.3	2.4	1.0
EPSILON										
High	4.6	2.3	4.0	1.0	1.6	0.2	2.0	0.4	3.3	1.3
Low	3.9	2.0	3.4	0.9	1.4	0.2	1.7	0.3	2.9	1.1
ZETA										
High	3.3	1.2	3.1	0.6	1.3	0.1	1.3	0.2	2.5	0.7
Low	3.0	1.1	2.6	0.5	1.2	0.1	1.3	0.2	2.2	0.7
OMEGA										
High	4.0	1.6	3.6	0.7	1.5	0.2	1.7	0.3	2.9	0.9
Low	3.5	1.4	3.0	0.6	1.3	0.2	1.5	0.2	2.6	0.8

SUMMARY OF ENVIRONMENTAL CONSEQUENCES

In the DEIS, we included Table II-ALT6, which presented a concise summary of the environmental, administrative, and economic consequences we would expect with implementation of each alternative. As with the alternatives summary table, we included this same table in both the Executive Summary and Chapter II. Again, in an effort to reduce duplication, this table can now be found only in the Executive Summary of this FEIS on pages SUM-54 to SUM-66. It has been deleted from Chapter II.

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[8] An explanation of the development of our road density scenario can be found in Appendix SCN.

CHAPTER III

THE AFFECTED ENVIRONMENT

In this chapter, we describe the environment that could be affected by implementation of the proposed State Forest Land Management Plan (Plan). This information will provide a baseline against which we can compare environmental changes that we would expect to occur under each of the alternatives.

METHODOLOGY

In order to conduct a meaningful assessment of how each alternative management program would affect the human environment, we have had to make some assumptions as to what specific outcomes might result from the alternatives. As such, we face a dilemma. In choosing to develop a programmatic plan, we are not making any site-specific decisions; therefore, we do not know exactly what environmental impacts will be caused. Yet in order to make an informed choice of a management philosophy, we must have at least a good approximation of the environmental impacts of each alternative plan.

The best way we have found for managing this dilemma has been to create plausible scenarios that represent our best estimates of the range of resource use levels likely to occur under each alternative. This was a necessary step in our analysis, but these are not in any way intended to be target output levels.

Through an interdisciplinary process, we estimated high and low use levels for grazing, recreation, timber harvest, and non-recreation special uses under each fully-implemented alternative.[1] We believe these uses represent the majority of activities that are likely to occur on school trust lands under the jurisdiction of the proposed Plan.

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1 Our estimating process and the resulting Plausible Output Scenarios are presented in Appendix SCN.

ORGANIZATION

Chapter III is organized according to the following topical outline:

- General Description of Lands Administered by DNRC
- Relationship of DNRC to Other Resource Management Entities
- General Description of Forested DNRC Lands
- Individual Resource Conditions on Forested DNRC Lands

  Physical and Biological Environment:
  - Soils
  - Watershed
  - Air Quality
  - Vegetation:
    - Forest Vegetation
    - Plant Species of Special Concern
    - Noxious Weeds
  - Wildlife
  - Fisheries

  Cultural and Aesthetic Environment:
  - Historical and Archaeological Sites
  - Visual Concerns

  Financial and Administrative Environment:
  - Administrative Organization
  - Economics

The Resource Condition discussions are organized as follows:

Introduction

An explanation of what components of the environment are included in this "resource" category and how they relate to our overall land management.

Current Conditions

A description of existing conditions and trends in components of the environment that could be changed by implementation of one of the alternatives.

Issue Ties

A brief discussion of the ties between each of the resources and the issues of public concern listed in Chapter I.

GENERAL DESCRIPTION OF LANDS ADMINISTERED BY DNRC

The Department of Natural Resources and Conservation administers a total of 5.2 million acres of school trust lands. Small parcels of state land are widely distributed all across Montana with the significant exceptions of Glacier National Park, the Blackfeet and Fort Peck Indian Reservations, and most National Forests. The dominant pattern is scattered sections, many of which are the original Sections 16 and 36 designated in Montana's Enabling Act. There are also significant blocks of contiguous ownership, including seven designated State Forests in the western third of the state.

Trust lands are placed in one of four classifications to reflect what, at the time of classification, appeared to be their "highest and best use." The four classes are Grazing, Agriculture, Forest, and Other Uses. Other Uses include cabinsites, military sites, commercial leases, and any uses that do not fit into any of the other three classes.

Grazing, with 4.1 million acres, is by far the largest classified use of state lands, followed by 550 thousand acres of classified Agricultural land, 455 thousand acres of classified Forest land, and roughly 100 thousand acres classified for Other Uses.[2] However, none of these lands are restricted exclusively to their classified uses. Grazing takes place on many parcels of classified Forest land in Western Montana, and nearly one-third of our merchantable timber stands are located on classified Grazing lands.

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[2] Data supplied by Scott Frickel, DNRC Agriculture and Grazing Management Bureau, Helena, MT; and Brian Long, DNRC Forest Management Bureau, Missoula, MT.

GENERAL DESCRIPTION OF DNRC FORESTED LANDS

The forested land base covered by the proposed management Plan totals 655 thousand acres which are distributed as shown in Table III-1.

Table III-1
FORESTED LANDS COVERED BY THE PROPOSED PLAN
(Acres)

Cover Type	Classified Forest Land	Non-Forested Forest Land[3]	Forested Classified Grazing Land	Total Covered by Plan
Softwoods	438,983		161,159	600,142
Hardwoods				
Aspen	297		1,806	2,103
Cottonwood	2,801		11,802	14,603
Non-forested		38,861		38,861
Total Area	442,081	38,861	174,767	655,709

Contiguous or near-contiguous blocks formally designated as State Forests total 213,872 acres, about 47 percent of classified Forest lands and roughly 32 percent of all lands covered by the proposed Plan. Just under 25 percent of the covered "forest" lands are actually classified Grazing lands.[4]

3 Nearly 40,000 acres of classified State forest land are nonforested. Vegetation type data is not currently available for this acreage. It appears that most of this land is grassland, with lesser amounts of nonforested wetlands occupied by grasses or shrubs, alpine tundra, shrublands and juniper woodlands.

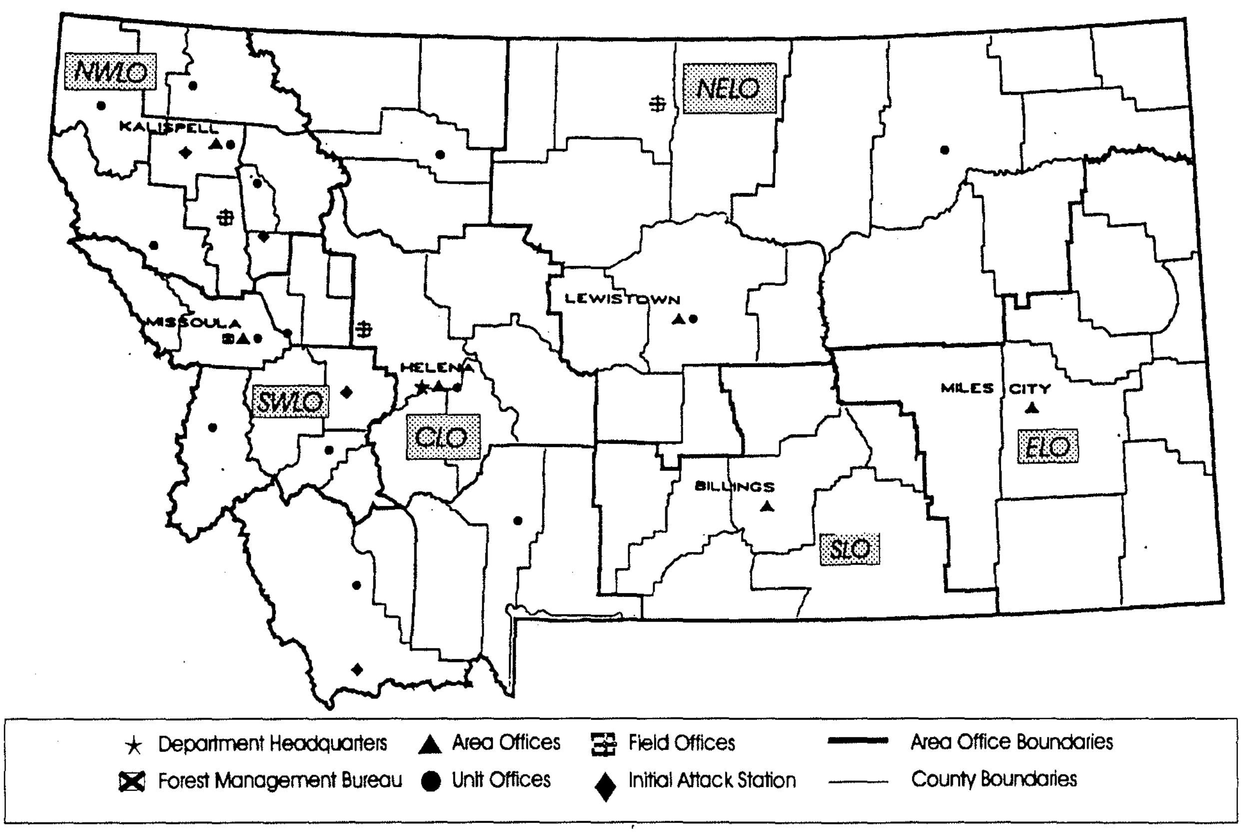
4 We presented our definition of "forested" lands in Chapter I. We adopted a biological definition, rather than an administrative one, to avoid on-the-ground decisions that violated common sense simply because of different classifications on adjoining lands of similar character.

Table III-2 shows the distribution of forested state lands by Land Office. Land Office boundaries are shown in Figure III-1.

Table III-2
DISTRIBUTION OF FORESTED STATE LANDS BY LAND OFFICE

Land Office	Acres	Percent of Total
Northwestern	299,788	46%
Southwestern	163,329	25%
Central	105,308	16%
NELO, ELO, SLO[5]	87,284	13%

Figure III-1
LAND OFFICE BOUNDARIES



5 Data for the Northeastern, Eastern, and Southern Land Offices are combined.

RELATIONSHIP OF DNRC TO OTHER RESOURCE MANAGEMENT ENTITIES

The actions and policies of other large forest landowners and of state and federal regulatory agencies affect the management of DNRC forested lands. This section discusses the relationships and interactions among major forest landowners and the state and federal agencies with regulatory jurisdictions that overlap the jurisdiction of DNRC.

INTERACTION WITH MAJOR FOREST LANDOWNERS

Major forest landowners whose activities may affect forested state lands include Plum Creek Timber Company (PCTC), the USDA Forest Service (USFS), the USDI Bureau of Land Management (BLM), the National Park Service (NPS), the Montana Department of Fish, Wildlife and Parks (MDFWP), and the Confederated Salish and Kootenai, Crow, Rocky Boy, and Fort Belknap Native American tribal governments. Major portions of DNRC and PCTC ownership are on scattered blocks that do not follow watershed or ecological boundaries. The contiguous blocks of federal and tribal ownerships are interspersed with DNRC and PCTC sections. Cooperative efforts among forest landowners are increasingly necessary as resource values and activities escalate in watersheds or on landscapes.

Each state, federal, private, and tribal entity manages its lands with some similar yet some different mandates and goals. The relationships and interactions among forest landowners determine what level of cooperative effort is required as one or more entities propose management activities in a co-owned watershed or on the landscape. For example, if DNRC proposes an activity in a watershed shared with other forest landowners, present and past activity by all landowners must be considered in the effects assessment performed by DNRC. If a determination is made that any further activity in a particular watershed may unacceptably impact water or other resources, it may be necessary to cancel or delay the proposed activity, or mitigate for past activities to such a degree that no net increase in impacts occurs. Past and present DNRC activity may also affect future management options for other management entities. Sharing of management records among landowners allows DNRC to adequately evaluate project level and cumulative effects.

There is a crucial need for cooperation among landowners in the development and use of roads. The checkerboard pattern of ownership dictates that entities work with each other to obtain right-of-way passage across adjoining lands.

OTHER AGENCIES WITH OVERLAPPING JURISDICTIONS

Federal Regulatory Agencies

The jurisdiction of several federal regulatory agencies includes forested state lands. The USDI Fish and Wildlife Service (USFWS) implements the Endangered Species Act (ESA) for all species except some marine species. They develop recovery plans for listed species and consult with other federal agencies for activities within recovery areas. DNRC manages habitat for Threatened and Endangered species such as grizzly bears and bald eagles to comply with the ESA.

The National Marine Fisheries Service (NMFS) implements the ESA for marine fisheries and most marine mammals, which includes providing plans for regulation of rivers. Timber harvest activities on state lands affect watershed runoff timing and intensity, as well as potentially impacting sediment levels.

The U.S. Army Corps of Engineers (COE) regulates activities on commercially navigable waterways and controls the filling or dredging of wetlands. DNRC manages lands with wetlands that could be affected by COE regulation. Property adjacent to navigable rivers that could be affected by state land management activities could also be affected by COE regulation.

DNRC commercial road building and log harvesting operations are potentially affected by the Occupational Safety and Health Agency (OSHA). For example, current Streamside Management Zone (SMZ) snag retention guidelines are in conflict with safety regulations proposed by OSHA. The new regulations would govern forestry activities near snags determined to be safety hazards. Other safety practices proposed by OSHA may affect the administration of timber sale contracts and the economic viability of some harvest operations.

The U.S. Department of Energy (DOE) regulates hydropower generation projects. Microhydropower facilities located on state forest lands fall under its jurisdiction.

The Interstate Commerce Commission (ICC) regulates commercial vehicle traffic, including the transport of forest products.

The Confederated Salish and Kootenai Tribes require an Aquatic Lands Conservation Ordinance for activities associated with waterways under their jurisdiction. They also have designated tribal sacred areas, where non-tribal members are not allowed. Some of these sacred areas contain state forest land.

Montana State Regulatory Agencies

The Montana Department of Environmental Quality (MDEQ)[6] regulates air and water quality programs consistent with state laws and federal regulations established by the Environmental Protection Agency (EPA). DNRC management activities can affect municipal watersheds. In addition, DNRC may consider proposals to lease state land for such things as municipal sewage treatment facilities. Further, slash and prescribed burning impact airsheds and air quality. MDEQ-enforced ordinances that affect DNRC include short-term stream turbidity regulations, special restrictions associated with municipal watersheds, and permits for pollution discharges to surface or groundwater. MDEQ also issues permits for burning conducted on state lands and enforces seasonal restrictions to protect public health.

The Montana Department of Fish, Wildlife and Parks (MDFWP) oversees the actions of government agencies in state waters and regulates game laws. For example, MDFWP supplies DNRC with permits for stream crossings and is also the agency that grants approval for game depredation hunts if an overpopulation of game animals were causing excessive resource damage on state lands.

The Water Resources Division of DNRC regulates water rights and dam safety. Some dams on state land fall under DNRC safety jurisdiction and private landowners often have water rights originating on or crossing state lands.

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[6] Formerly the Montana Department of Health and Environmental Sciences (MDHES).

The Montana Historical Society's State Historic Preservation Office (SHPO) oversees the State Historic Preservation Program. As outlined in the Montana State Antiquities Act (§ 22-3-421--22-3-442, MCA), all state agencies are responsible for being thoughtful stewards of significant historic and prehistoric resources on state-owned lands. DNRC commonly receives SHPO clearance for proposed projects to ensure that stewardship considerations and/or actions are applied to all sites with identified historic or prehistoric resources.

The Department of Commerce enforces workers compensation programs. Its Bureau of Safety and Health publishes "Rules Related to Logging Departments and Logging Operations in Montana," which regulates logging operations on state land. The Commerce Department also maintains a list of certified businesses in Montana. Only certified individuals and corporations are allowed to conduct operations on state land.

The Department of Livestock regulates grazing laws regarding open range and trespass.

The Department of Agriculture administers noxious weed control laws through local weed districts, certifies and regulates the application of pesticides, and oversees the interstate transportation of plant materials. DNRC works with local weed districts and with state land lessees/licensees and timber purchasers to control weeds in the course of land management activities. DNRC sometimes uses pesticides in the control of weeds, unwanted vegetation and insects. DNRC also buys and sells plant materials across state boundaries.

The Montana Department of Transportation (MDT) regulates traffic and traffic safety on public highways. Purchasers of forest products are required to comply with seasonal weight restrictions, safety signing, over-the-road vehicle specifications, and speed limits imposed by MDT.

The Department of Administration regulates budgeting, contracting, and purchasing rules for DNRC.

County Governments

The primary area of interaction between DNRC and county governments concerns land use planning. Zoning for residential and business development, as well as open space planning, sometimes involves state trust lands. Most interactions are associated with timber harvests and special uses development. Any new cabinsite development normally goes through a subdivision review process.

PHYSICAL AND BIOLOGICAL ENVIRONMENT

FOREST SOILS

INTRODUCTION

Soil is a basic natural resource essential for forest growth and human survival. Rich, healthy soil provides economic opportunities for growth and development. It is essential to monitor the effects of forest management activities on soils to ensure that long term soil productivity is maintained. State forest lands cross a diverse landscape of soils, varying with changes in geologic parent material, climate, vegetation and age of weathering. Throughout Montana, forest soils are typically of young age, have higher coarse fragment contents and occur on steeper slopes than agricultural lands. Lesser areas of soils with low rock contents and clay rich soils also occur on State forest lands.

Maintaining soil productivity is vital to sustaining the long-term return to the school trust and is an important objective of this Plan. In the remainder of this section, we describe the composition and location of forest soils on state lands.

CURRENT CONDITIONS

We can group forest soils on state lands according to the bedrock or parent material deposits in which the soils are forming. Soil surveys by the USFS, Natural Resource Conservation Service (NRCS) or DNRC have either been completed or are underway on most DNRC ownership. Detailed soils information for planning and project evaluation is kept at the DNRC Forest Management Bureau in Missoula.

Northwestern Land Office Soils

The forest soils of the DNRC Northwestern area include deep glacial tills, outwash deposits, and residual soils forming from weathered bedrock. The bedrock types are mainly quartzites, argillites, and limestone formations of resilient Belt precambrian rocks. These relatively young soils have weak development and commonly have gravelly loam and gravelly silt loam textures. A high percentage of forest lands have a productive volcanic ash-influenced light surface soil that retains moisture and nutrients important to plant growth. Forest growth potential is highest in this area of the state because of its precipitation levels and productive soils.

Southwestern Land Office Soils

The forest soils of the DNRC Southwestern area are mainly residual soils weathering from bedrock, with some glacially-influenced soils. Bedrock/parent material types are more diverse in the Southwestern area than in the Northwestern, and so are the soils. Roughly one-quarter of these lands have a volcanic ash-influenced surface, which increases soil productivity. Some of the more sensitive soils are forming in granitics on the Sula State Forest. Forest productivity is more moderate in this area due in part to lower precipitation rates and more droughty soils.

Central Land Office Soils

The forest soils of the DNRC Central area are similar to those in the Southwestern Land Office, although this area has more high elevation sites and climate limitations. Cold soils and seasonally droughty conditions limit tree growth. Localized areas of high productivity typically occur around moist sites and riparian areas. This area includes the greatest diversity of geology and soils where water is less limiting.

Northeastern, Southern, and Eastern Land Office Soils

The forest soils of the DNRC Northeastern, Southern, and Eastern areas are largely formed on sandstones, siltstones, clay shales, and some volcanic rocks. Soils are typically more developed and have higher clay content. Drier forest types and forest/grassland are more common in these areas. Seasonally droughty soils limit tree growth.

Soil Conditions by Land Office Area

Earlier in Montana's history, loggers gave less consideration to soil impacts and their effect on future forests than they do today. Past logging activities may have affected 30 percent or more of a harvest site; however, our limited records do not allow us to make an accurate assessment of past soil effects. Current harvest methods minimize the area of impact by using existing trails and disturbed areas. Modern equipment, harvest planning, and RMS combine to reduce the impact on soils and help maintain long-term soil productivity.

To assess the current effects of timber harvest on soil productivity, we reviewed DNRC harvest plans from the past five years. Approximately 90 percent of these harvests were done with conventional tractors or rubber-tired skidders, while ten percent required some other method of harvest, such as soft tractor skidders, cable, helicopter, or horses. Table III-S1 shows our estimates of disturbed soils over the past five years of timber harvest operations.

Table III-S1
DISTURBED SOILS DUE TO TIMBER HARVEST
1990-1994

	NWLO	SWLO	CLO	SLO	NELO	ELO	TOTAL
1.Total acres logged (3% of operable land)	11,732	5,789	1,599	1,130	210	544	21,004
2. Ground-based harvest acres	10,324	4,978	1,599	1,130	210	544	18,785
3. Ground-based harvest area protected by special mitigation measures: % of area logged	24%	24%	33%	35%	0%	33%	
4. Area of long-term (irreversible) soil effects: % of area logged[7]	11.9%	11.8%	9.5%	6.8%	10.6%	6.9%	
5. Area of short-term and intermediate-term soil effects: % of area logged[8]	18.2%	17.9%	13.6%	6.5%	12.0%	6.6%	

ISSUE TIES

During our planning process, public concern for forest soils focused on maintaining soil productivity to sustain forest vegetation and ensure income potential.

[7] Includes area committed to roads, main skid trails, and landings which will not be returned to productive use.

[8] These are areas of reduced soil productivity estimated to last up to 50 years.

WATERSHED

INTRODUCTION

The management activities we conduct on state forest lands, and how we conduct them, affect the water resource. Forest management activities are typically considered a non-point source of water pollution. Non-point source pollution has diffuse sources and cannot be traced to an exact origin, as opposed to point source pollution, such as a single pipeline emitting waste. Increased sediment and elevated nutrient levels are indicators of the type of non-point source pollution that can result from forest management activities.

In the remainder of this section, we describe the current condition of the water resource in terms of lakes, streams, and wetland and riparian areas across Montana. The discussion centers on sources of pollution and extent of impairment to these watershed resources.

CURRENT CONDITIONS

Montana is dissected by 178,896 miles of streams and contains more than 10,000 lakes, reservoirs and ponds which cover 979,433 acres of water surface area. Freshwater wetlands and riparian areas cover between one and five percent of the state (Hansen, personal communication).

Despite their relatively small land area, riparian-wetland communities occupy a unique position on the landscape, with their importance far exceeding their total area. The abundance of shelter, water, and forage make these areas attractive for many animal species. Riparian zones support a greater concentration of wildlife species and activities than other locales on the landscape (Thomas et al 1979, Pfister and Batchelor 1984, Oakley et al 1985).

In addition, these areas play a critical role, both hydrologically and geomorphically, in the stream ecosystem. Bank stability, water quantity, stream temperature, and water chemistry are all functions of the health of the streamside plant community.

Historically, grazing, logging and resource extraction practices have degraded watershed health. In recent years, however, state and federal governments have taken steps towards slowing and perhaps reversing this downward trend. Through laws (e.g., the Montana Stream Protection Act, the Montana Natural Streambed and Land Preservation Act, the Federal Clean Water Act, and the Streamside Management Zone Law), regulations and education, landowners and users have been encouraged to minimize their impact on streams, lakes and riparian areas. Since the watershed resource is affected by all of its users, cooperative planning and action with adjoining landowners will be an important factor in determining the effectiveness any watershed protection program.

WATER QUALITY IMPAIRMENT STATUS

The Water Quality Division of MDEQ,[9] in compliance with the federal Clean Water Act §305(b), is required to submit a biennial report to the EPA on the status of the state's water quality. The Montana §305(b) report details the impairment of stream and lake water bodies throughout the state. We assume that the lands affected by this plan are adequately depicted in the Montana § 305(b) report. This may be a conservative assumption, because there is evidence that the state's

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[9] Formerly the Water Quality Bureau of Montana Department of Health and Environmental Sciences

management of its water resource on forested tracts is better than the average for all forest ownership in Montana (Schultz 1990; Schultz 1992; Frank 1994). Four impairment classifications were used in the assessment. An impairment was defined as the violation of some water quality standard, whether qualitative or quantitative.

Fully Supporting Water Bodies had no significant or known use impairments.

Threatened Water Bodies were also Fully Supporting water bodies, but at risk of degradation.

Partially Supporting Water Bodies had one or more uses slightly or moderately impaired, but with most uses supported.

Not Fully Supporting Water Bodies had one or more uses severely impaired, but with most uses supported.

Ninety percent of the total stream miles assessed in Montana fully support all their designated uses (MDHES 1992). The majority of Not Fully Supporting stream miles were polluted by nonpoint sources. The major sources of impairment were irrigated crop production and rangeland activities (Table III-WS1). The dominant causes in Not Fully Supporting streams were flow alteration, suspended solids, and siltation (Table III-WS2).

Table III-WS1
MAJOR NONPOINT SOURCES OF IMPAIRMENT FOR MONTANA'S STREAMS (MILES)

	IMPACTS		
Source Categories	Major	Moderate /Minor	Total
Agriculture:			
Pasture Land	51	829	880
Range Land	103	6,162	6,265
Irrigated Crop Production	349	6,973	7,322
Silviculture:			
General	26	1,614	1,640
Harvest/Restoration/Residue Mgt.	0	247	247
Road Construction/Maintenance	0	252	252
Resource Extraction:			
Surface Mining	6	152	158
Subsurface Mining	237	303	540
Placer Mining	64	241	305
Hydromodification:			
Channelization	25	678	703
Dam Construction	19	462	481
Flow Regulation/Modification	145	1,673	1,818
Riparian Vegetation Removal	0	521	521
Streambank Destabilization	94	3,801	3,895
Other:			
Atmospheric Deposition	7	0	7
Natural	822	6,338	7,160
Upstream Impoundment	24	348	372

Modified from Montana §305(b) Report (1994)

Table III-WS2
MAJOR CAUSES AND STREAM MILES CLASSIFIED AS NOT FULLY SUPPORTING

	IMPACTS		
Cause Categories	Major	Moderate/ Minor	Total
Flow Alteration	519	6,697	7,216
Suspended Solids	369	6,465	6,834
Siltation	421	6,549	6,970
Nutrients	104	6,056	6,160

Modified from Montana §305(b) Report (1994)

Not Fully Supporting lakes were also affected primarily by nonpoint sources. The vast majority of Not Fully Supporting lakes were impaired due to irrigated crop production, flow regulation, and range land activities (Table III-WS3).

Table III-WS3
MAJOR NONPOINT SOURCES OF IMPAIRMENT FOR MONTANA'S LAKES (ACRES)

	IMPACTS		
Source Categories	Major	Moderate/ Minor	Total
Agriculture	12,900	348,488	361,388
Silviculture	0	34,332	34,332
Mining	0	1,600	1,600
Dam Construction & Operation	0	330,428	330,428
Municipal Sewage Plants	0	132,959	132,959
Natural	22,949	313,664	338,613

Modified from Montana §305(b) Report (1994)

The most prevalent symptoms of a Not Fully Supporting lake were flow alterations and changes in nutrient, metals, and suspended solids levels (Table III-WS4).

Table III-WS4
MAJOR CAUSES AND LAKE ACREAGE CLASSIFIED NOT FULLY SUPPORTING

	IMPACTS		
Cause Categories	Major	Moderate/ Minor	Total
Flow Alteration	0	346,390	346,390
Nutrients	0	446,111	446,111
Metals	19,349	302,175	321,524
Suspended Solids	0	310,530	310,530
Siltation	0	72,737	72,737
Eutrophication	0	259,353	259,353
Thermal Changes	0	25,918	25,918
Habitat Alteration	0	5,549	5,549

Modified from Montana §305(b) Report (1994)

Table III-WS5 shows the distribution of impaired water bodies for all ownerships within each of DNRC's land office boundaries. Statewide, roughly 11 percent of total stream miles are impaired. About 62 percent of all Montana lakes, reservoirs, and ponds are classified as impaired.

Table III-WS5
APPROXIMATE DISTRIBUTION OF IMPAIRED WATERBODIES
(ALL LANDS WITHIN DNRC LAND OFFICE BOUNDARIES)

Land Office	NWLO	SWLO	CLO	NELO	SLO	ELO
Stream Miles	1,467	2,096	5,366	2,864	1,690	4,225
Lake Acreage	199,922	6,768	105,242	283,197	12,561	0
% Total Impaired Miles	0.8	1.2	3.0	1.6	1.0	2.4
% Total Impaired Miles	20.4	0.7	10.8	28.9	1.3	0.0

Modified from Montana §305(b) Report (1992)

The distribution of major stream impairment sources for all lands within DNRC land office boundaries is shown in Table III-WS6. Silvicultural impairment sources occur statewide, but predominate west of the Continental Divide. Agricultural sources also occur statewide, but are the major factor east of the Continental Divide.

Table III-WS6
PREVALENCE AND DISTRIBUTION OF MAJOR STREAM IMPAIRMENT SOURCES (MILES)

Sources*	NWLO	SWLO	CLO	NELO	SLO	ELO
Pasture Land						
H	0	25	26	0	0	0
M	54	328	127	59	19	0
S	27	45	152	0	0	0
T	73	8	149	0	8	0
Range Land						
H	2	3	98	0	0	0
M	158	197	847	759	97	80
S	67	200	1,169	608	328	1,473
T	35	193	419	203	22	239
Silviculture						
H	2	5	19	0	0	0
M	309	171	130	0	0	0
S	153	176	422	142	0	0
T	336	192	178	3	8	0
Harvesting, Restoration, Residue Mgt.						
M	13	104	10	0	0	0
S	0	88	23	0	0	0
T	13	19	22	0	0	0
Road Construction/ Maintenance						
M	13	121	0	0	0	0
S	0	144	14	0	0	0
T	8	78	10	0	0	0

Modified from Montana §305(b) Report (1992)

KEY: H = High; M = Moderate; S = Slight; T = Threatened

*All Lands Within DNRC Land Office Boundaries

DEFINITION AND VULNERABILITY OF RIPARIAN AREAS AND WETLANDS

Riparian areas have been described as zones of transition between upland and aquatic environments in which vegetation and microclimate are strongly influenced by the aquatic system (Gregory et al 1991). A more visually descriptive definition would be that riparian areas are "green zones associated with lakes, reservoirs, estuaries, potholes, springs, bogs, fens, wet meadows, and ephemeral, intermittent, or perennial streams" (Hansen et al 1991).

Hall (1988) reported that riparian ecosystems can be changed by management activities such as livestock grazing, timber harvesting, road building, or through natural factors such as fire, stream energy and beaver activity. Other wildlife activities that affect riparian conditions are known to occur, at least locally. However, since wildlife species are not concentrated or restricted by fences, as are livestock, it is generally felt that impacts from wildlife are negligible when considered statewide.

Analysis of historical conditions suggests that the integrity of riparian areas has been compromised by the often combined effects of beaver removal, large organic debris removal, logging, livestock grazing, and road construction. The impact of these activities on plant communities, stream morphology, and water quality and quantity depends on the care taken to minimize and mitigate damage from such activities. Mountain riparian ecosystems probably have not changed as much as more accessible lowland floodplain areas. Meehan (1991) provides a good summary of the effects of physical disturbances and forest and rangeland management activities on the water resource.

Significant degradation of Montana wetlands began with beaver trapping in the early 1800's. In the last 100 years the rate of change in riparian areas has increased significantly due to ever growing human pressures. As land values and product demands increased, there was great economic pressure to plant, graze, harvest, and build as much as feasible. Some of these sites were associated with wetland or riparian areas and were significantly affected by these human activities.

STATUS OF RIPARIAN AREAS AND WETLANDS

At the present time, a complete assessment of Montana's wetland and riparian resources is not available, but a broad scale description of the condition of the state's wetland and riparian conditions can be made. The Montana Riparian and Wetland Association characterizes wetlands and riparian areas as either Functional, Functional-At-Risk, or Non-Functional.

Functional wetlands or riparian areas are capable of filtering sediment, maintaining streambank stability, building banks, dissipating water energy, storing water and aquifer recharge, among others.

Functional-At-Risk connotes wetlands or riparian areas that are presently capable of functioning properly but are in danger of decline through natural or human activity.

Non-Functional, as the name indicates, are those wetlands or riparian areas that are not functioning properly.

Functioning wetland and riparian areas can be found throughout Montana, but they are usually small and isolated. Glacier National Park and Jewel Basin in the Flathead National Forest, two large functioning riparian areas, are exceptions to this rule. Throughout the state, however, most wetlands are classified as Functional-At-Risk or Non-Functional.

The riparian areas in the eastern part of the state are the most strongly affected, primarily along smaller streams. Many stream riparian areas are significantly degraded. In fact, very few prairie streams have not been altered in terms of riparian vegetation, riparian function, stream stability, or wildlife habitat (Hansen, personal communication). The vast majority of east-side riparian areas are classified as Non-Functional to marginally Functional-At-Risk. Scattered small mountain ranges (e.g., Snowy, Judith, and Belt Mountains) show signs of significant riparian impacts but are still functional. The majority of these riparian areas are Functional-At-Risk; some are Non-Functional. The impact on the east side of Montana may be directly related to the ease of human and animal access to wetlands and riparian areas.

The rugged mountains and broad intermontane valleys in Western Montana can be divided into two areas: Northwest and Southwest. The Southwest shows some fairly significant riparian degradation from livestock grazing. The impact of silviculture is not nearly as severe as that of grazing, but is nonetheless important (Hansen, personal communication). Riparian function in Southwest Montana seems to be between Functional-At-Risk and Non-Functional.

In the Northwest portion of Montana, livestock grazing is not as prevalent as in the Southwest, but silvicultural impacts are most widespread there. Overall, riparian function is higher than in the Southwest but is still only Functional-At-Risk in the majority of reaches. In general, the lower the elevation in mountainous regions, the greater the degradation of wetland and riparian resources due to their accessibility and the human desire to build homes and other structures in these areas.

Characterizing a statewide trend in riparian condition would be a tenuous effort at best. However, considering the amount of publicity and time devoted to educating landowners about the inherent worth and productivity of riparian areas in combination with state and federal legislative efforts aimed at protecting them, we may assume that the steep downward trend in riparian condition has leveled a bit in recent years. Certainly areas do exist where riparian condition has improved or degraded measurably, but as a whole the trend is probably toward less degradation.

An even greater threat than a downward trend in condition is widespread wetland loss. A report on the status of the nation's wetlands by Feierabend and Zelazny (1987), as cited by Hansen, et al. (1995), estimated a 50 percent reduction in riparian acreage has occurred since colonial times. Feierabend and Zelazny (1987) estimate the present yearly loss of riparian areas is between 300,000 and 450,000 acres. Again, a stabilization of wetland and riparian loss may occur in the near future through education and legislation and a greater awareness of riparian importance not only for water quality but also for livestock production and wildlife habitat.

ISSUE TIES

Watershed maintenance is a key issue related to most of the thirteen issues of public concern. Road management and maintenance, cooperation and coordination among adjoining landowners, grazing, and timber harvesting all have the potential to affect the health of the watershed resource. In turn, the health of the watershed will have profound effects on wildlife, fisheries, and timber on state lands, all of which play a part in producing trust revenue. A degraded watershed resource would greatly compromise the integrity of forest ecosystems and reduce recreational opportunities involving wildlife, fish, and water sports. Finally, the need to maintain watershed health requires careful monitoring of state land access which might degrade the resource.

AIR QUALITY

INTRODUCTION

State forest land management primarily affects air quality by producing smoke particulate from prescribed burns for slash disposal and forest site preparation. Smoke is also produced by wildfires, which forest management may indirectly influence through fire suppression and timber harvest. Both of these factors change the amount and distribution of live vegetation and dead fuels. These factors in turn influence the likelihood of fire ignition, its rate of spread, its intensity, and the difficulty of fire control. The concentration of particulate in the air from prescribed burning and wildfire will depend on the amount of smoke produced and the atmospheric conditions for dispersal.

In the remainder of this section, we describe the current level of particulate emissions produced by wildfires and prescribed burning on state lands. Quantified measurements of wildfire particulates are not available, but we have gathered narrative information to help determine relative trends. Our estimate of particulate emissions from previous prescribed burning is based on average annual timber harvests.

CURRENT CONDITIONS

Particulate emissions from prescribed burning are directly affected by the amount of burning that is done. The extent of wildfire is directly influenced by wildfire suppression programs.

The amount of smoke produced by a fire is generally proportional to the amount of fuel consumed. This depends on factors such as the amount of fuel present (fuel loading), the arrangement and continuity of fuels, and fuel moisture (Prescribed Fire and Fire Effects Working Team 1985).

The concentration of particulate in the air from a given amount of smoke will depend on the dispersion conditions. When air is calm and stable, dispersion is poorer, and the smoke is diluted in a smaller volume of air. Stable conditions tend to occur at night and with high-pressure areas. Poor dispersion conditions are most common in the fall and winter.

PARTICULATE FROM WILDFIRES

Particulate emissions are generally expressed in pounds or tons of particulate produced from a fire. Lacking availability of such a measure for wildfires on state lands, we assume that the amount of particulate produced from wildfire is approximately proportional to wildfire acreage over a period of time. We were unable to assemble comprehensive data across ownerships or for state lands, but narrative information and limited data are available for determining relative trends.

The acreage burned in wildfires varies greatly by year, depending on moisture and weather conditions. Longer-term trends are related to climatic cycles, the effectiveness of fire suppression, and fuel loadings.

Information from the Flathead National Forest (1992) is indicative of trends in wildfire acreage over the past century. From the 1890s through the 1920s, an average of about 100 thousand acres burned per decade on the Flathead National Forest. The 1910s were an exception; more than 600 thousand acres burned in that decade. From the 1930s through the 1980s, however, no more than 20 thousand acres has burned in any decade. It is widely understood that such reductions in wildfire acreage have occurred throughout the Inland West due to active wildfire suppression (Arno 1976, Freedman and Habeck 1984, Habeck 1990, Mutch et al. 1993, Covington et al. 1994).

Most wildfire activity occurs in the late summer in this region, when the weather is hot and dry, grassy fuels are cured, and lightning storms are common. Smoke dispersal conditions generally are relatively good during this time period, so occurrence of poor air quality from wildfires is uncommon.
The effects of wildfire suppression include increased stand density, increased representation of fire-susceptible tree species, and greater fuel accumulations. This has already led to conditions in which wildfires are more intense and harder to suppress (Mutch et al. 1993, Covington et al. 1994). As a consequence, improvements in summer air quality from wildfire suppression may have reached their limits.

PARTICULATE FROM PRESCRIBED BURNING

The amount of particulate from prescribed burning is estimated from timber harvest volume. Timber harvest volume is generally measured in thousand board feet, Scribner rule.

We assume that particulate from prescribed burning related to timber harvest, and associated air quality impacts, are approximately proportional to the volume of timber harvested when averaged over a period of time. Individual harvests vary greatly by the degree and method of slash disposal, as well as in fuel and dispersion conditions at the time of burning. However, these variations should average out to a large degree over a geographic area and period of time.

Timber harvest volume will not predict particulate produced by prescribed burning outside timber harvest areas, such as wildlife habitat improvement burning. Almost all prescribed burning on forested state lands is related to timber harvest.

Table III-A1 shows average annual timber harvests on state lands and all Montana ownerships for the period 1945-1991, and also for the last ten years of that time period. Data was calculated from information in Flowers et al. (1993).

Table III-A1
AVERAGE ANNUAL TIMBER HARVESTS
(Thousand board feet Scribner)

	State Lands	All Ownerships
1945-1991 Period (47 Yr. Avg.)	39,797	974,717
1982-1991 Period (10 Yr. Avg.)	33,324	1,129,289

The relative air quality impacts per volume harvested may have decreased over the time period shown in Table III-A1. Timber utilization standards have improved somewhat during this period. Prescribed burning technology has also improved, partially in response to increased concern about air quality.

In contrast to wildfire occurrence, most prescribed burning is done during the fall and to a lesser degree in the spring, when fuel conditions are safer. However, dispersion is often poorer in the fall, and air quality impacts can be substantial. While the amount of particulate from wildfires has undoubtedly declined substantially over the past century, prescribed burning has contributed additional particulate.

Montana-Idaho Smoke Management Group

The need for restrictions on prescribed burning are specifically related to federal law. The federal Clean Air Act (as amended 1990) established a classification system known as National Ambient Air Quality Standards (NAAQS) to protect human health and welfare. NAAQS have been established for "criteria" air pollutants, including particulate matter (PM-10, particular matter smaller than 10 micrometers), sulfur dioxide, nitrogen dioxide, ozone, carbon monoxide, and lead. The Clean Air Act requires each state to develop, adopt, and implement a State Implementation Plan (SIP) to ensure that NAAQS are attained and maintained for the criteria pollutants. SIPs contain regulations for areas that have violated one or more of the NAAQS; referred to as "nonattainment areas." In Montana, 3 nonattainment areas have been designated for carbon monoxide, 1 for lead, 2 for sulfur dioxide, and 10 for PM-10.

PM-10 is a term used to describe airborne solid and liquid particles 10 micrometers or smaller in size. Particulate matter is of interest because: 1) of the large quantities emitted from fires; 2) the potential contribution of PM-10 from prescribed and wildfires to pollutant concentrations above the PM-10 standard (set by the EPA under the federal Clean Air Act); 3) the major reduction of visibility caused by PM-10; and 4) the role PM-10 plays as a carrier of other toxic pollutants.

In 1978, a Memorandum of Agreement was signed by state, federal and private organizations considered major prescribed burners in Montana (DSL, MDHES, BIA, USFS, BLM, Plum Creek Timber Company, Glacier and Yellowstone National Parks, National Weather Service, MDFWP, USFWS and the Missoula City-County Air Pollution Control Board). The agreement was also expanded to include state, federal and private organizations in Idaho, from the Salmon River north to Canada. The signatories formed the Montana-Idaho Smoke Management Group to coordinate the operation of the Smoke Management Plan.

The objectives of the Plan are twofold:

> 1) To minimize or prevent the accumulation of smoke in Montana to such a degree as necessary to protect State and federal ambient air quality standards when prescribed burning is necessary for the conduct of accepted forest practices such as hazard reduction, regeneration and wildlife habitat improvement. The development of alternative methods shall be encouraged when such methods are practical.
>
> 2) To develop a smoke management plan for reporting and coordinating burning operations on all forest and range lands in the cooperating states. Guidelines in the plan are based on technical information currently available on smoke dispersion and on State and federal air quality regulations (MOA 1978).

Prior to September 1 of each year, all cooperating members are required to provide the Monitoring Unit of the Group a list of all prescribed burns planned for the fall burning season. During the months of September through November, the Monitoring Unit is responsible for the daily monitoring of meteorological data, air quality information and planned forestry burning. Unfortunately, due to the type of equipment used by MDEQ for monitoring PM-10 levels, real time PM-10 data is not available to the Monitoring Unit. As such, the Unit conducts an analysis of all available information concerning planned burning, forecast meteorological conditions and existing air quality to decide on a daily basis whether prescribed burning could lead to violations of NAAQS standards for PM-10. If violations are likely, the Unit places airshed, impact zone, or time period restrictions on prescribed burning for the following day.

The Group publishes an annual report for each fall burning season.[10] The annual report includes data on airshed conditions, climate, daily PM-10 levels and associated restrictions, planned and accomplished burns by participant, and a review of public complaints (MISMG/MSAG 1996).

ISSUE TIES

The four public issues most closely tied to air quality are timber management, harvest practices, ecosystem integrity and recreational opportunities. The extent and timing of tree harvest on state lands affects air quality as a result of prescribed burning after harvest is complete. The harvest level of the chosen alternative will make a difference in the amount of prescribed burning that takes place, and thus will make some slight difference in air quality.

Related to the issue of ecosystem integrity, fire suppression has greatly altered natural ecosystems with adverse consequences for forest health, as described in the forest vegetation discussion. Increased use of prescribed burning has been recommended to help restore ecosystem health (Mutch et al. 1993, Covington et al. 1994), but this may adversely affect spring and fall air quality. In contrast, increasingly intense wildfires and deteriorated summer air quality are likely if such measures are not taken on a broad scale.

[10] Copies of Montana State Airshed Group Annual Reports are available from Ed Mathews, Fire Prevention Supervisor and MSAG Monitoring Unit Coordinator, Fire and Aviation Management Bureau, DNRC Forestry Division, 2705 Spurgin Road, Missoula, Montana.

FOREST VEGETATION

INTRODUCTION

The State Forest Land Management Plan potentially affects 660,000 acres of forested land. While this acreage represents less than three percent of Montana's forested area, it contains a diverse array of ecological zones and tree species. In order to categorize the current condition of the vegetative environments that will be affected by Plan, we evaluated not only the current status of those lands but how that status has changed from its historical condition. It is important to consider the direction and not just the magnitude of direct environmental effects on vegetation under each alternative. Actions that continue these trends will further increase the cumulative effects of changes over the past century or so. Actions that reverse some of these trends, on the other hand, will tend to reduce the level of cumulative effects.

We determined that we could divide forested state trust lands into six different ecological groups which depict different forest environments. These differences were shaped by variation in temperature, moisture and topography, which in turn affect species composition, stand development, and cycles of fire and other disturbances. We also included descriptions of forested lands which did not fit the ecological group habitat types and nonforested lands.

In the remainder of this section, we describe the ecological groups. We then estimate the amount of forested land in each group from habitat type and forest type data. These estimated amounts are shown by land office in Table III-V1. Finally, we summarize the analysis of current conditions of state forested lands.

CURRENT CONDITIONS

The first step in analyzing the current condition of the vegetative environment was to develop ecological group descriptions.

ECOLOGICAL GROUP DESCRIPTIONS

Ecological Group A

Ponderosa pine forests on hot to warm, dry to moderately moist habitat types. Ecological Group (EG) A sites are common in Northwestern, West-central, Central and Southeastern Montana. These are warm sites with relatively high levels of moisture stress that were dominated by ponderosa pine prior to European settlement. Natural wildfires were frequent and generally low-intensity, resulting predominantly in open, parklike stands with an old-growth character. These stands were generally uneven-aged or comprised of small even-aged clumps with small openings.

Fire suppression and partial cutting practices have allowed dense stands, often dominated by Douglas-fir, to develop. Increased competition for limited moisture has resulted in higher stress levels and much greater susceptibility to insect outbreaks, disease levels and intense wildfires.

Ecological Group B

Western larch/Douglas-fir forests on warm to cool, moderately moist habitat types. EG B forests are the most common type on state lands in Northwestern Montana, and are also common in West-central Montana. These forests exist in more moderate environments than the previous group. Fires were less frequent and were variable in intensity. Prior to European settlement, these forests tended to have a patchy structure, with various age classes of western larch, Douglas-fir, lodgepole pine and ponderosa pine. An overstory of western larch that had survived multiple fires was common. While the overstory stocking was sometimes sufficient to provide old-growth stands, old-growth was less common than in ponderosa pine-dominated stands (see Losensky 1993).

As with EG A forests, fire suppression has tended to increase the overall density of stands and the representation of shade-tolerant species. The loss of shade-intolerant species, especially western larch, has been accelerated by partial cutting in many places. Even-age management has generally provided for reestablishment of larch and lodgepole pine, but has changed the stand structure mosaic in many cases.

Ecological Group C

Western larch/Douglas-fir, western white pine, and mixed-conifer forests on warm to cool, moist habitat types. These forests predominate in relatively warm but moist conditions in portions of Northwestern Montana with a maritime climatic influence. Under natural conditions, the low-stress environment resulted in predominantly dense stands and long fire-free intervals averaging 100-200 years. When fires did occur, they tended to be intense and stand-replacing, leading to establishment of new even-aged stands. Mosaics tended to consist of larger even-aged patches than in EG B forests, and a single age class may occupy hundreds or even thousands of contiguous acres. Old-growth was moderately prevalent, and tended to exist in places that avoided major fires for about 200 years or more.

Because of the long fire intervals, fire suppression has had little influence on stand structures, but may have prevented stand-replacing fires that otherwise would have occurred. Partial cutting along with white pine blister rust, an introduced pathogen, has led to a substantial reduction in larch and white pine composition in some areas. Even-age harvest methods have simulated the primary role of fire in regenerating new stands, but have not maintained habitat features such as snags and surviving overstory trees that fires generally provided.

Ecological Group D

Lodgepole pine forests on cool to cold, dry to moist habitat types. EG D forests prevail in environments that favor nearly pure stands of lodgepole pine. These conditions are usually found at higher elevations, especially near and east of the Continental Divide, but are also found in some valley bottoms in Northwestern Montana. These forests are less common on state lands than some other ownerships, because state lands are primarily at lower elevations outside the National Forests.

The natural fire cycles in EG D forests led to low to moderate fire frequencies, which generally prevented forests from succeeding from relatively short-lived lodgepole pine to spruce and fir. Some areas tended to have periodic stand-replacing fires that produced even-age stands; large, contiguous patches of a single age class are common in these environments. Somewhat drier sites had more frequent ground fires that resulted in several age classes. Old-growth was rare in these forests.

Fire suppression has apparently lengthened the fire cycle in many areas, resulting in a much higher percentage of older stands than would have occurred naturally. This is resulting in increased levels of dwarf mistletoe infection and mountain pine beetle hazards. Fires in areas that previously experienced underburns would now be stand-replacing in many cases. Timber harvests have been predominantly clearcuts, in order to take advantage of the serotinous cones common in lodgepole pine and to minimize windthrow and snow damage.

Ecological Group E

Douglas-fir forests on warm to cool, dry to moderately moist habitat types. These forests occur on relatively cool but dry sites throughout the mountainous areas of the state, but are most common in Southwestern Montana, where ponderosa pine and western larch are absent. These are forests in which Douglas-fir is the primary or exclusive species at all stages of succession.

Natural wildfires occurred with moderate to high frequency and tended to be a mix of underburns and stand-replacement burns in small patches. The resulting stands tended to be patchy, with frequent openings. Entire old-growth stands appear to have been uncommon, but patches of large old trees occurred frequently.

Fire suppression has increased the overall density of these forests in many places, especially the stocking of younger trees. This has apparently led to intensification of root diseases, dwarf mistletoe and budworm outbreaks. Partial cutting has often maintained the patchy forest structure, but has eliminated the large tree component from many areas. Even-aged harvest methods have often been used in order to reduce insect and disease problems, but have changed stand mosaics in many cases and affected habitat values.

Ecological Group F

Spruce, spruce/fir and western redcedar/grand fir forests on warm to cold, moist habitat types. This is a diverse group of forest types that occur in wet environments with little or no history of fire for long periods. Consequently, these forests are usually uneven-aged and dominated by late-successional, shade-tolerant tree species. They are commonly found along stream courses and canyon bottoms, as well as in protected moist basins at high elevations. While fire has generally been absent for a long time; some stands, such as those with western redcedar, may have required fire for establishment.

Timber harvests have been largely partial cuts, but boundaries of adjacent even-aged cuts often extend into riparian stands. Clearcutting has also been used on upland, high-elevation EG F sites, often with poor regeneration success.

Other Forest Environments

These are forest lands which we could not classify by habitat types. They are primarily hardwood stands (predominately cottonwood and aspen forests) and forested scree (i.e., slopes covered with loose rock fragments, as per Pfister et al. 1977).

Hardwood sites are primarily cottonwood and aspen forests. Cottonwood forests occur primarily along stream bottoms. Cottonwoods are especially tolerant of siltation from periodic flooding because they can produce adventitious roots and new sprouts from stems buried by silt. Their seeds also require moist exposed soil for germination, and this condition is also associated with recent flooding. In the absence of flooding, cottonwood stands eventually mature and are replaced by conifers or shrub communities after 100 years or so (Hansen et al. 1995; Oliver 1990, pp. 110-111).

Aspen forests rely on fire for periodic rejuvenation. Aspen resprouts readily after fires, but will eventually be eliminated by competition with species such as Douglas-fir in the absence of fire. As a result, aspen forests are now gradually being replaced by coniferous forest types (Gruell 1983, Covington et al. 1994).

Forested scree encompasses a wide range of climatic conditions, but the lack of soil results in droughty conditions and poorly stocked stands. Scree sites are found primarily on very steep slopes (Pfister et al. 1977).

Nonforested Lands

Nearly 40,000 acres of classified state forest land are nonforested. Vegetation type data is not currently available for this acreage. It appears that most of this land is grassland, with lesser amounts of nonforested wetlands occupied by grasses or shrubs, alpine tundra, shrublands and juniper woodlands.

Grasslands were maintained naturally by frequent wildfires, which kept juniper and other conifers, and the more fire-susceptible shrub species such as sagebrush and mountain-mahogany, at low levels. Grazing pressure from native large herbivores was low. Fire suppression and domestic livestock grazing have both favored encroachment of shrubs and conifers into grasslands. Grazing has also altered the relative composition of grasslands. The more-palatable grass species have declined in abundance, while less-palatable grasses including exotics that are well-adapted to disturbance, have increased (Gruell 1983, Covington et al. 1994).

These ecological groups and their descriptions are generalizations. Many exceptions to the typical natural patterns do occur. Topography in particular will modify the changes caused by fire regimes; for example, steep uniform slopes may experience more frequent fires and have larger patch sizes than equivalent environments on flatter ground.

FORESTED LANDS BY ECOLOGICAL GROUP

After defining the ecological groups, we estimated the amount of forested land in each group using habitat type and forest type. These estimated amounts are shown by Land Office in Table III-V1.

Table III-V1
ACRES OF FORESTED TRUST LANDS
BY ECOLOGICAL GROUP

Ecological Group	NWLO	SWLO	CLO	NELO/ ELO/ SLO	Total	% of Total
A (Warm Dry - PP)	38,046	61,531	27,426	65,967	192,970	29%
B (Moderate - WL/DF/LPP)	91,574	32,596	0	0	124,170	19%
C (Moist - WL/DF/WWP)	87,823	1,741	0	0	89,564	14%
D (Cool Moderate - LPP)	10,683	8,643	481	8,830	28,637	4%
E (Cool Dry - DF)	25,455	39,440	47,263	369	112,527	17%
F (Cool Moist - S/GF/WRC)	19,393	0	8,003	0	27,396	4%
Other (Hardwood, Scree)	13,257	6,158	10,049	12,118	41,582	6%
Nonforested*	13,557	13,219	12,085	0	38,861	7%
TOTALS	299,788	163,328	105,307	87,284	655,707	100%

*Nonforested classified forest land, to which the State Forest Land Management Plan applies. Does not include nonforest land on other classifications.

[**Note**: In all tables, acreage totals may differ slightly from column and row sums, and percentages may not add up exactly to 100 percent, due to rounding.]

Once the ecological groups had been defined and their general condition evaluated, we were able to analyze the current condition of Montana's forested lands using the seven descriptors listed above. This analysis showed that the current status of forest vegetation in Montana, both on state lands and in general, is substantially different from conditions prior to European settlement. In general, the present forests differ from historic conditions in the following ways:

- Present forests are more densely stocked, especially in the drier environments represented by Ecological Groups A, B and E, but with smaller trees.
- Later-successional tree species, which generally are more shade-tolerant and less resistant to fire and other stresses than early-successional species, are much more prevalent now.
- Old-growth conditions are now rare where they were once abundant (especially EG A ponderosa pine sites), and relatively abundant where they were once rare (EG D lodgepole pine sites).
- Intermediate age classes with small sawtimber are now predominant, whereas young and old forests used to comprise most of the acreage.
- The extent of small and large patches has been reduced, and replaced in many areas by medium-sized patches.

TIMBER HARVEST METHODS

The choice of cutting method is a site-specific decision based on site characteristics, stand conditions, and treatment objectives. Depending on project issues and the nature of sites and stands chosen for harvest, the proportion of methods used may vary considerably over time. Data on cutting methods used in DNRC timber sales from Fiscal Year 1990 through 1994 is shown in Table III-V2.

Table III-V2
ACRES OF FORESTED STATE LANDS HARVESTED
BY CUTTING METHOD
FY90-FY94

Cutting Method	Total Acres	Percent of Total
Clearcut	1,897	9%
Seed Tree[1]	6,320	30%
Shelterwood	1,349	6%
Selection[2]	6,923	33%
Intermediate[3]	4,516	21%
TOTAL	21,005	

1 Includes seed tree removals.
2 Includes individual-tree and group selection.
3 Includes commercial thinning, improvement cutting, overstory removals, sanitation and salvage cutting.

ISSUE TIES

Vegetation is tied to nearly all of the issues of public concern delineated during our planning process. In the past, timber sales have provided more trust revenue than the other uses of state forested lands. Future timber management policies will affect trust revenues from timber sales, grazing, and recreation. Timber harvest practices influence watershed health, wildlife and plant habitats, fisheries, and noxious weed encroachment. Clearly, the chosen alternative will affect nearly every issue raised by citizens concerned about the future use of our forested lands.

PLANT SPECIES OF SPECIAL CONCERN

INTRODUCTION

Montana's state forest lands support a rich diversity of plant species. DNRC recognizes the importance of plant species of special concern which may be harmed as a result of land management activities that could lead to their listing as threatened or endangered. The USFWS is responsible for listings of Threatened and Endangered species that require protection under the federal Endangered Species Act of 1973. Currently there are no endangered plant species, and only two threatened plant species in Montana: 1) Howellia aquatilis, which occurs in wetlands in the Swan valley area, and possibly in the SWLO and CLO areas; and 2) Spiranthes divuvialis, a wetland plant discovered in Jefferson County 1994.

DNRC refers to the Montana Natural Heritage Program (MNHP) for current listings of plant species of special concern to consider for protection or mitigation measures as appropriate during MEPA analysis for project actions. The MNHP inventories and compiles data on plant species and plant communities that are known to be rare, endemic, disjunct or threatened throughout their range or in Montana. The MNHP recognizes 380 plant taxa of special concern in Montana and has ranked these plant species based on their global and statewide abundance, using a scale of 1 (critically imperiled) to 5 (demonstrably secure). Each species is assigned the appropriate combination of global and state ranks. The USFS has designated certain species as "sensitive" based on criteria that consider the plants' range of occurrence and biology. Some of these sensitive species are included in the MNHP listing. However, when we refer to "sensitive" plant species in this section, it is for convenience; we are not specifically referring to the USFS sensitive species designation.

As botanical surveys increase on all ownerships, we may discover other plant species of special concern or reduced populations of sensitive plants. We currently do not complete botanical surveys for projects unless species of special concern are identified in the area by our own personnel, the public, or a MNHP data base search. Without project-level surveys, sensitive plant species may be adversely affected by DNRC projects.

In the remainder of this section, we describe the current condition of the sensitive plant communities on state lands in terms of their distribution and numbers by Land Office and by general habitat type.

CURRENT CONDITIONS

We first considered the occurrence of plant species of special concern within DNRC land office boundaries. Using the comparison of geographic distribution and ranking of sensitivity shown in Table III-P1, we identified the number of species most likely to be affected in an area. The CLO Area has the greatest diversity and number of the Heritage Program's plant species of special concern. The NELO, SLO, and ELO Areas have the smallest number of rare species.

Table III-P1
OCCURRENCE OF PLANT SPECIES OF SPECIAL CONCERN WITHIN LAND OFFICE BOUNDARIES[11]

Special Status	NWLO	SWLO	CLO	NELO	SLO	ELO
Rare Throughout Their Worldwide Range	21	30	43	7	20	4
Rare Within Montana	83	123	156	28	67	30
Rare in Both Their Worldwide Range and in Montana	21	28	40	7	20	4
Rare and Documented to Occur on State Lands	8	10	3	2	3	2
Federally Listed as Threatened Under the ESA (Howellia aquatilis)	1	1	1	0	0	0
Possibly Appropriate for Federal Listing Under the ESA (C2)[12]	7	7	14	2	6	1
Stable in Population	4	10	9	2	4	2
Listed as Sensitive by USFS	28	53	49	4	13	1

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[11] Several plant species occur in multiple land office areas and categories.

[12] Please note that since the printing of the DEIS, the USFWS has eliminated C2 species from their listing process. C2 species were candidate species being considered for protection by the USFWS. Despite the elimination of this category, we have retained the information on C2 species in this EIS because we feel it provides useful information in assessing the impacts of management activities on sensitive and threatened species.

Table III-P2 shows the distribution of plant species of special concern by general habitat type. The habitat types most likely to be affected by DNRC management activities include forest, wetland, and riparian areas, which together contain a greater number of sensitive plant species than any other habitat type. Habitats that contain sensitive plants seem to be more concentrated in the western and middle parts of Montana, with fewer species of concern in the Northeastern, Southern, and Eastern Land Offices.

Table III-P2
OCCURRENCE OF MONTANA PLANT SPECIES OF SPECIAL CONCERN AND ACTIVITIES LIKELY TO AFFECT THEM BY GENERAL HABITAT AND LAND OFFICE

HABITAT TYPE	NWLO	SWLO	CLO	NELO	SLO	ELO	ACTIVITIES LIKELY TO AFFECT
Forest	24	24	18	4	2	1	Timber Management, Grazing
Wetlands Peatlands	34	33	40	11	11	4	Grazing
Riparian	7	6	3	1	2	1	Grazing, Road Crossings
Woodland	3	0	3	3	3	7	Timber Management, Grazing
Alpine	10	20	37	1	9	0	Recreation
Shrubland	0	12	11	0	6	1	Roads, Grazing, Recreation
Grassland	6	9	20	6	8	13	Roads, Grazing, Recreation
Grassland/ Shrubland	1	3	9	0	0	0	Grazing, Recreation
Other	9	10	9	2	8	2	Recreation, Grazing, Roads
Unknown	4	6	13	1	20	3	

ISSUE TIES

The preservation of plant species of special concern is tied to some issues raised by the public during our planning process. Native plants are important elements in the ecosystem integrity of state lands, as well as in the maintenance of biological diversity and wildlife habitats for species that may depend on particular plants for food or reproduction. The availability of sensitive plants for study and viewing is a recreational and scientific opportunity, and possibly also a future contributor to trust revenue. Laws designed to protect sensitive, threatened, and endangered species may affect the amount and type of timber harvest allowed on state lands, which could also impact trust revenue.

NOXIOUS WEEDS

INTRODUCTION

Introduced plants often colonize aggressively after native vegetation and soil are disturbed. When these plants conflict with, interfere with, or otherwise restrict land management they are commonly referred to as weeds. A plant that has been classified as a weed only attains a "noxious" status by an act of state legislation. Noxious weeds are classified in one of three categories:

Category 1 Noxious weeds that are currently established and generally widespread.

Category 2 Noxious weeds that have been recently introduced in the state and are rapidly spreading. These weeds currently infest relatively small tracts, except for sulphur cinquefoil, which is more widespread.

Category 3 Noxious weeds that have not yet been detected or are found only in scattered and localized infestations.

Noxious weeds degrade water quality and increase soil erosion compared to sites where native grasses dominate. Noxious weeds can also supplant and threaten native plant species of special concern. Spotted knapweed and leafy spurge are known to affect a number of rare plants in Montana.

Noxious weeds can adversely affect most recreational activity, but the effect is minimal and noticeable mostly to recreation users who are very aware of weeds. Some recreational users may be affected by herbicides used to control weeds. Humans, vehicles, and animals can introduce weeds to developed recreation sites.

The spread of these plants is most influenced by weed seed source, vegetation type, amount of ground disturbance and sun exposure. Droughty sites offer many noxious weeds a competitive advantage.

Seeds can be brought onto new sites by vehicle traffic, logging equipment, off-road vehicles, domestic livestock, wildlife, and people. Weeds spread along areas of disturbance and where climate conditions are favorable for their growth.

In the remainder of this section, we describe the most prevalent species of noxious weeds in Montana and estimate their current and potential infestation of state forested lands.

Table III-N1
CATEGORY 1 NOXIOUS WEEDS
Ranked by Extent of Infestation

Weed	Date of Introduction	Life Form	Habitat
Spotted Knapweed (Centaurea maculosa)	1920's--alfalfa & clover seed contaminant	Biennial/ Perennial Forb	Disturbed sites; pastures; rangelands; open forest
St. Johnswort (Hypericum perforatum)	Reported in Montana by 1910	Perennial Forb	Meadows; dry, sandy or gravelly soils; disturbed sites; rangeland; open forest
Leafy Spurge (Euphorbia esula)	Brought to U.S. in 1827. Intro. to Montana in 1917 as hay seed from North Dakota	Perennial Forb	Dry upland sites; moist areas; shallow rocky soils; open forest
Canada Thistle (Cirsium arvense)	Introduced to Canada late 19th Century; noted in Montana in 1901	Perennial Forb	Disturbed sites; pastures; meadows; dryland & irrigated cultivated crops; open forest
Russian Knapweed (Centaurea repends)	Introduced to North America 1898; reported in Montana in 1931	Perennial Forb	Irrigated and dryland pasture; range; hayland; cropland
Diffuse Knapweed (Centaurea diffusa)	Introduced with Spotted Knapweed	Annual/ Perennial/ Biennial Forb	Disturbed areas; rangeland; pastures; open forest
Dalmatian Toadflax (Linaraia damatica)	Reported in Montana in 1951	Perennial Forb	Disturbed areas; rangeland
Whitetop (Cardaria draba)	Reported in Montana in 1931	Perennial Forb	Common in irrigated crops, dryland grain, and rangeland
Field Bindweed (Convolvulus arvensis)	Noted in Montana in 1901 publication	Perennial Forb	Disturbed sites; cultivated fields
Sulfur Cinquefoil (Potentilla recta)	Ravalli County - 1948. Lake, Missoula Counties	Perennial Forb	Dry fields; open forest; pastures; meadows; rangeland

Table III-N2
CATEGORY 2 NOXIOUS WEEDS

Weed	Date of Introduction	Life Form	Habitat
Dyers Woad (Isatis tinctoria)	Introduced to U.S. as source of dyes; introduced to Utah in 1917; reported in Montana in 1958	Winter Annual/ Biennial Perennial Forb	Disturbed areas; rangelands
Purple Loosestrife (Lythrum salicaria & L. Viroatum)	Introduced to U.S. in early 1800s; first reported in Montana in 1937	Perennial Forb	Floodplains; marsh edges; river margins; seasonally flooded impoundments

Table III-N3
CATEGORY 3 NOXIOUS WEEDS

Weed	Date of Introduction	Life Form	Habitat
Yellow Starthistle (Centaurea solstitialis)	Ravalli County - 1958	Winter Annual/ Forb	Disturbed areas; rangeland; dryland and irrigated pastures
Common Crupina (Crupina vulgaris)	1969 - Idaho; found in Idaho, Oregon, Washington and California	Winter Annual/ Forb	Well-drained, rocky to silt loam soil
Rush Skeletonweed (Chondrilla juncea)	Currently in Idaho, Washington, Oregon, California, and Montana's Lincoln County	Perennial	Well-drained soils; disturbed areas; dryland and irrigated crops

CURRENT CONDITIONS

Currently 15 weeds classified as noxious inhabit Montana. Although nine of these weed species are well established, spotted knapweed and leafy spurge cause the greatest concern because of their extensive acreage, highly competitive nature and persistence. All other listed noxious weeds generally occur in localized areas or as spot infestations on forest sites. While these weeds do not present a significant threat to regeneration of trees, noxious weeds do threaten rangeland and forest plant communities. Where identified, spot occurrences of noxious weeds have the best potential for control or eradication.

Noxious weeds must be controlled and not allowed to seed as stipulated in the Montana Noxious Weed Act § 7-22-2101, Appendix A, MCA. To comply with the Montana Noxious Weed Act, DNRC has signed cooperative agreements with counties outlining revegetation and weed control efforts associated with forest management and land-disturbing activities. All lessees and licensees of state land and holders of recent right-of-way permits are required to control noxious weeds as a condition of their use.

NOXIOUS WEED TYPES AND INFESTATION AREA

Noxious weed occurrences are recorded during DNRC project development and as part of periodic range surveys, but no systematic inventories of weeds have been completed on state lands, and we do not know the extent of noxious weed infestation on DNRC forest lands. One approach to estimating the area of noxious weeds occurring on state lands is to use the acres of noxious weeds reported in National Forests within DNRC Area boundaries and assume that a similar percentage of state lands is infested (Table III-N4).

Table III-N4
ESTIMATED PERCENTAGE OF DNRC FORESTED LANDS INFESTED WITH PREDOMINANT FOREST LAND NOXIOUS WEEDS BY DNRC LAND OFFICE

Noxious Weed	NWLO	SWLO	CLO	SLO, NELO, ELO
Spotted	6.6%	25%	< 1%	< 1%
St. Johnswort	< 1%	< 1%	< 1%	< 1%
Leafy Spurge	< 1%	< 1%	< 1%	< 1%
Canada Thistle	< 1%	< 1%	< 1%	< 1%
Houndstongue	< 1%	< 1%	< 1%	< 1%

Based on field observations and estimates of area infested, knapweed is by far the most significant problem on state forest lands. Knapweed is widespread on roads and in drier forest types and is adapted to a broad range of elevations and aspects. Spotted knapweed prefers open habitats and does not spread rapidly into dense timber because shade inhibits its growth and reproduction. Willard (1988) found that knapweed success in all habitat types correlated with the amount of disturbance and moisture stress.

Knapweed monitoring and research in the Lolo, Bitterroot and Flathead National Forests indicate that while grassland communities are at high risk, a majority of the vegetative communities in the forests are resistant to weed invasion, even after logging and moderate cattle grazing (Losensky 1987). Knapweed populations in well-managed rangelands do not increase rapidly (Watson 1974). There are, however, a number of drier forest types at risk of weed invasion, where noxious weeds can dominate native vegetation. Knapweed can be effectively controlled with herbicides and has several biocontrol agents that have been released in Montana.

St. Johnswort (Goatweed) is a far-removed second in area of invasion and occurs as spot infestations or strips of plants along roads mainly in Western Montana. Goatweed can be a serious problem in grassland communities such as the Bison Range at Moiese, but its impact on forest lands is limited. Goatweed can be effectively controlled with herbicides and has several biocontrol agents that have been released in Montana.

Leafy spurge exhibits an exceptional ability to spread and thrive in a broad range of habitats. This weed has primarily been thought of as a range problem, but it also invades undisturbed land such as river banks, ditches, meadows, shallow droughty soils, and open canopy forest sites. Leafy spurge is a significant threat to open forests and rangelands, especially in light of how difficult it is to control with biological agents and herbicides. Leafy spurge requires yearly follow-up treatments with herbicides or any control agents.

Canada thistle and Houndstongue occur over broad areas, but typically at low levels of infestation, and rarely extensively on forest sites. Canada thistle and Houndstongue can be effectively controlled by prevention and herbicides.

Purple loosestrife and tansy are two weeds that grow on moist to wet sites such as ditches, meadows and riparian areas where they may form dense colonies. Purple loosestrife, a noxious weed, is a threat to riparian areas, but is currently limited to open wetlands, most notably the Ninepipes Wildlife Refuge and Lake County. Tansy, while not listed as noxious, is not inhibited by the shading of trees as are the other weeds. Weed spread through riparian areas has been slow due to their competitive plant communities.

The other Category I noxious weeds identified in Table III-N1 have not been detected on state forested lands or are found only in scattered and very localized infestations.

FOREST STAND TYPES AT HIGH RISK OF NOXIOUS WEED ESTABLISHMENT

Another method to estimate the area that could be severely infested with noxious weeds is to compare forest habitat types. Noxious weeds generally have a climatic range where they can thrive and out-compete other plants. Losensky (1990) studied the occurrence of noxious weeds on forest sites and found that grasslands and the warm, dry habitats of ponderosa pine and Douglas-fir have a high risk of weed establishment if a noxious weed source is present. Losensky rated the risk of weed establishment as high, moderate, or low, defined as follows:

High Risk Sites: Noxious weeds may frequently dominate forest vegetation on these sites. These stand types comprise about 192,970 acres, or 31.2 percent, of DNRC forest lands.

Moderate Risk Sites: Noxious weeds may dominate the interspaces of native vegetation, but these sites generally have a limiting factor which prevents full development of the weed. On forest types moister than the Douglas-fir group, weeds may spread along areas of disturbance, but generally not displace all native vegetation. These stand types comprise about 112,527 acres, or 18.2 percent, of DNRC forest lands.

Low Risk Sites: These sites generally have a limiting factor or factors which prevents or discourages development of weeds. These sites comprise about 311 thousand acres, or 51 percent of DNRC forest lands.

Only the habitat types or phases that Losensky rated as moderate or high risk for the nine primary species of noxious weeds are listed in Table III-N5. It does not include grasslands, which are high risk. The table shows that nearly 50 percent of state forested lands are at moderate or high risk for weed infestation.

Table III-N5
ACRES AND PERCENTAGE OF FORESTED LANDS AT RISK OF NOXIOUS WEED INVASION

	NWLO	SWLO	CLO	NELO, ELO, SLO	TOTAL
High Risk Habitats Group A Warm/Dry	38,046 (6.2%)	61,531 (9.9%)	24,426 (3.9%)	65,967 (10.7%)	192,970 (31.2%)
Moderate Risk Habitats Group E Cool/Dry	25,455 (4.1%)	39,440 (6.5%)	47,263 (7.6%)	369 (.05%)	112,527 (18.2%)
Low Risk Habitats	222,730	49,138	21,533	20,948	311,349
TOTAL	286,231	150,109	93,222	87,284	616,846

ISSUE TIES

Public concern over the spread of noxious weeds is tied to several other issues raised by citizens involved in the planning process. Noxious weeds can interfere with DNRC's ability to earn money for the school trust by displacing more palatable plants on grazing lands. Weed infestations reduce range productivity and plant cover, which increases erosion and reduces forage for domestic grazing and wildlife. Sensitive plants on forest lands can be displaced by weeds, compromising ecosystem integrity and possibly further endangering already threatened plant and animal species. The use of herbicides concerns the health and welfare of the public, and may reduce recreational opportunities as well.

WILDLIFE

INTRODUCTION

The wildlife resource embodies over 400 species of birds, mammals, reptiles and amphibians found in Montana, many of which rely on forested state lands for all or part of their habitat needs. We do not have reliable population distribution data for most of these species, and for many, we do not have widely accepted research data on the precise relationships between individual species and their habitat needs.

We decided to study the wildlife resource by first observing groups of species known to use particular habitat types, and then estimating the type and severity of impacts our management activities would have on those habitat types.[13] By observing how different components of the habitat are impacted, we can draw conclusions as to which wildlife species are likely to be adversely affected, and which are likely to be favorably affected. Table III-W4 shows the number of wildlife species that use each of nine general habitat types in each of our six DNRC land office areas.

In the remainder of this section, we describe the current condition of our wildlife resource in terms of the distribution, status, and trends of species across Montana. Most of our presentation is in terms of <u>numbers of species</u> in a particular category. For the most part, it will be necessary to study Appendix WLD to determine the names of species that are represented by the numbers in these tables. In this text, we include only a sample presentation of actual species names, partly to satisfy the reader that the numbers really do represent particular species, and partly to demonstrate the difficulty of naming each of the species represented by all the numbers in all the tables.

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[13] Marcot et. al. (1994) found this method suitable for use in forest planning over large areas. It is described in more detail, partly in Chapter IV, and in Appendix WLD.

CURRENT CONDITIONS

Our proposed Plan will influence the management of over a thousand square miles of land in large blocks and scattered parcels, distributed across the entire state of Montana. Approximately 519 terrestrial vertebrate species have been documented within the state. Ninety-nine of those are bird species that occur irregularly or accidentally. Excluding these accidentals from further analysis left us a total of 420 wildlife species that could occur on state lands affected by this Plan. Table III-W1 displays the distribution of species by taxonomic class.

Table III-W1
NUMBER OF WILDLIFE SPECIES THAT HAVE BEEN OBSERVED IN MONTANA SUMMARIZED BY TAXONOMIC CLASS[14]

Seasonal/ Migratory Status	Amphibians	Reptiles	Birds	Mammals	Total
Total	17	16	383	103	519
Seasonal or Year-long Residency	17	16	248	103	384
Migrates Through State	-	-	36	-	36
Accidental or Vagrant	-	-	99	-	99

The approximately 655 thousand acres of state land potentially affected by the proposed Plan represents less than three percent of Montana's 22.4 million forested acres. By comparison, the USFS manages about 62 percent of the state's forested lands, private industrial forests constitute about seven percent, and the BLM and the NPS manage forested acreage comparable to DNRC's three percent.

However, forested state school trust lands make a more important contribution to the habitat supporting Montana's 420 terrestrial wildlife species than their relatively small three percent share would suggest. Because these lands are scattered in small parcels across the entire state, species representatives of a wide spectrum of geography and habitat types could be affected. Species with habitat needs of 640 acres or less could be sustained or eliminated from large areas depending on the cumulative effects of management practices on scattered state parcels and on surrounding lands.

[14] As listed by the Montana Natural Heritage Program

State lands are important to wildlife for at least the following reasons unrelated to their relative size.

1) They provide habitat for a number of sensitive, threatened, or endangered wildlife species.

2) Small or isolated wildlife populations may be critical for maintenance of local or regional biological diversity.

3) Some DNRC lands have unique local importance to threatened, endangered, and other wildlife species.

4) Hunting and wildlife viewing make important contributions to Montana's economy, both locally and statewide.

SENSITIVE, THREATENED, OR ENDANGERED SPECIES

The Montana Natural Heritage Program lists 66 wildlife species as species of special concern. Listed species may be either very rare or locally abundant but occupying a very restricted range. In either case, they are especially vulnerable to extinction. Listed species are facing current or anticipated major declines in population or habitat capability which could be accelerated by land management activities. The MNHP list includes species designated by the USFWS as Threatened, Endangered, or candidates for Threatened status[15], under the Endangered Species Act, as well as most species on the USFS sensitive species list.[16]

Of Montana's 66 species of special concern, five are classified as Endangered, three are Threatened, and 17 may be appropriate for listing under the Endangered Species Act. Ten species in Montana are considered vulnerable to extinction throughout their entire global range. The Central Land Office has the most species of special concern, presumably because that administrative region includes all of the major habitat groups from both eastern and western portions of the state.

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[15] Please note that since the printing of the DEIS, the USFWS has eliminated C2 species from their listing process. C2 species were candidate species being considered for protection by the USFWS. Despite the elimination of this category, we have retained the information on C2 species in this EIS because we feel it provides useful information in assessing the impacts of management activities on sensitive and threatened species.

[16] Species designated as sensitive by the USFS are listed in USFS Manual 2670.22.

Table III-W2 displays the status and distribution of the Heritage Program's species of special concern by DNRC land office.

Table III-W2
STATUS AND DISTRIBUTION OF SPECIES OF SPECIAL CONCERN[17]

	DNRC LAND OFFICES						Statewide
	NWLO	SWLO	CLO	NELO	SLO	ELO	TOTAL
Rare Throughout Their Worldwide Range	8	8	8	7	6	7	10
Rare Within Montana	37	40	44	38	41	37	64
Federally Listed as Endangered Under the ESA	3	3	4	4	3	3	5
Federal Listed as Threatened Under the ESA	2	2	3	2	1	2	3
Possibly Appropriate for Federal Listing Under the ESA (C2) (see footnote 12 on previous page)	11	12	14	13	13	11	17
Listed as Sensitive by USFS Based on Evidence of Current or Predicted Downward Trends in Populations or Habitat capability Sufficient to Reduce Existing Distributions	15	15	13	8	13	7	18
Total Number of Species of Special Concern (All Categories) in Each Land Office	40	42	46	41	42	39	66

MAINTAINING BIOLOGICAL DIVERSITY

Maintaining biological diversity requires keeping common species common while simultaneously sustaining and increasing the abundance of rare species (Finch and Ruggiero 1993). Thus, the number of species in a given area is an important measure of overall biological diversity. However, Sampson and Knopf (1993) point out that maintaining high numbers of species may promote local but not regional diversity. Two or more separate areas, each with a smaller total number of species, may be necessary to maintain regional diversity if each area supports a different complement of species. This highlights the importance of maintaining viable populations of species of special concern as part of a diverse and stable landscape. Species that are rare, at the edge of their geographic range, or threatened with extinction may not be present in large numbers, even

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[17] A reminder from Section A: "Most of our presentation is in terms of numbers of species in a particular category. For the most part, it will be necessary to study Appendix WLD to determine the names of species that are represented by the numbers in these tables."

in optimum habitats, but they may represent an essential component of landscape-level biodiversity.

LOCALLY IMPORTANT HABITATS

DNRC also manages locally important blocks of wildlife habitat. For example, grizzly bear recovery in the Northern Continental Divide ecosystem is dependent upon maintenance of female grizzly bears producing cubs in each of 23 bear management units (USFWS). The Department manages 69 percent of the Stillwater Bear Management Unit. Grizzly bears could not be sustained in the Stillwater Unit without maintaining suitable habitat on these state forest lands.

Wildlife habitat on state forest lands may also be critical for populations that range over much larger areas. For example, the white-tailed deer herd in the Salish Mountains of Northwestern Montana summers on National Forest lands, but winters on approximately two thousand acres of state forest land west of Kalispell (Dusek 1994). The survival of this herd of 3,000 deer depends on suitable habitat being maintained on that parcel of state forest land. Similar situations occur across the state, where seasonally important habitats are typically restricted in distribution and abundance, yet disproportionately important to the survival of large populations.

ECONOMIC CONTRIBUTIONS

Wildlife on state lands also makes important contributions to the state's local and regional economy. Table III-W3 lists 67 Montana wildlife species that warrant special attention because they are hunted or trapped. Recreation opportunities associated with hunting and trapping these game and furbearer species represent a substantial annual economic contribution. Hunters spent $163.3 million in the state during 1992 and supported 4,100 full-time jobs and $9.7 million in state tax revenues (Brooks 1994).

Montana's diverse and abundant wildlife populations also attract large numbers of resident and nonresident visitors to wildlife-related activities. MDFWP estimates that $53.8 million were spent by people involved in viewing wildlife in Montana during 1992 (Brooks 1994). Viewing wildlife is projected to be the fastest growing wildlife-related activity in the United States, growing an average of 1.43% per year over the next 45 years (Walsh et al. 1989). This may prove a valuable economic resource to the school trust.

Table III-W3
NUMBER OF MONTANA GAME AND FURBEARER SPECIES IN EACH DNRC LAND OFFICE

State Designation	NWLO	SWLO	CLO	NELO	SLO	ELO	Statewide
Furbearers	10	10	10	10	9	7	11
Game Animals	8	9	11	9	10	5	12
Migratory Birds	33	33	33	33	33	32	34
Upland Birds	9	10	10	8	8	7	10
TOTAL	60	62	64	60	60	51	67

For all these reasons, the current condition of state lands and the potential effects on those lands from management activities need to be carefully evaluated. Guided by the assumptions outlined earlier, we again found the most workable course of action to be to highlight more specific habitat components that influence the composition of wildlife communities and evaluate their current condition and the trends and implications which that current condition suggests.

ISSUE TIES

ROAD MANAGEMENT AND MAINTENANCE

The extent of road development may affect wildlife security and is often used as a key element for defining effective habitat for various species. Restricting public use of the roads either seasonally or permanently can reduce impacts on wildlife. However, the existence of roads and trails, even if closed to motor vehicle use by barriers, increases access to an area and thereby reduces security. All of the plans include some increase in road development, but the extent and quantity of such development varies greatly.

HARVEST PRACTICES/CLEARCUTTING

Clearcutting, changes in stand composition, and other silvicultural practices make pronounced changes in forest habitats. The effects may be positive for some species and negative for others.

ECOSYSTEM INTEGRITY

There is considerable concern about the impacts of timber harvest and forest management on overall health of the ecosystem. Harvest of timber can alter the structure, function, and composition of forest ecosystems. This can harm biological diversity, not only in plant but also in animal species which suffer from the change in their habitat. Sensitive, threatened, and endangered species are especially vulnerable to changes in their environment.

RECREATIONAL OPPORTUNITIES

Protection of habitat is directly connected to the availability of recreational opportunities related to wildlife. Preservation of some habitats at the expense of others will cause some species to flourish, others to weaken. Hunters and anglers are interested in seeing game species increase, whereas those who wish to study, view, or photograph wildlife may be interested in other kinds of animals. Availability and development of recreational opportunities related to wildlife will vary widely depending on the choice of alternative.

FISHERIES

INTRODUCTION

In the simplest terms, the fishery resource is comprised of the physicochemical properties of water and the surrounding environment and the biological components that support the 86 recognized species of fish found in Montana. Most of our management activities affect fish populations only indirectly, through impacts on the aquatic environment in which they live. Consequently, our assessment will focus on the aquatic environment.

Montana's aquatic environments represent a wide range of conditions, from alpine lakes and snow-fed streams in the West to large, turbid rivers in the East. A correspondingly wide variety of fish species occupy this aquatic habitat. We do not have population inventories or research data to tell us all species that are present in all waters of the state, nor do we have full information on the habitat needs of every species. Therefore, we focus our assessment on certain species whose habitat needs are better known, and which we believe share habitat associations with many other fish species.

We divided the state into two broad habitats: those which support cold water species, and those which support warm water species. The warm water type includes transitional, or cool water species. Because the Mountain Whitefish is very abundant and requires cold, clear water in order to thrive, we assume that waters holding healthy, viable populations of Whitefish indicate the extent of cold water fisheries in the state. Headwaters areas are classified as coldwater if a viable population of mountain whitefish exist in the tailwaters of that river system. Figure III-F1 shows our assumed ranges of cold and warm water fisheries in the state.[18]

We chose bull trout and westslope cutthroat trout to represent the habitat needs of cold water species because these fish are very susceptible to human-induced environmental changes such as decreases in streamflow; increases in temperature, pollution, or siltation; and competition with introduced exotic species. In consultation with other fisheries biologists, we chose the goldeye and largemouth bass as representative of warm water species because their habitat requirements are thought to reflect the needs of many other warm water fish.

In the remainder of this section, we describe the current condition of our fisheries resource using our representative species as indicators. We discuss species in terms of their historical and current distribution in Montana lakes, rivers, and streams.

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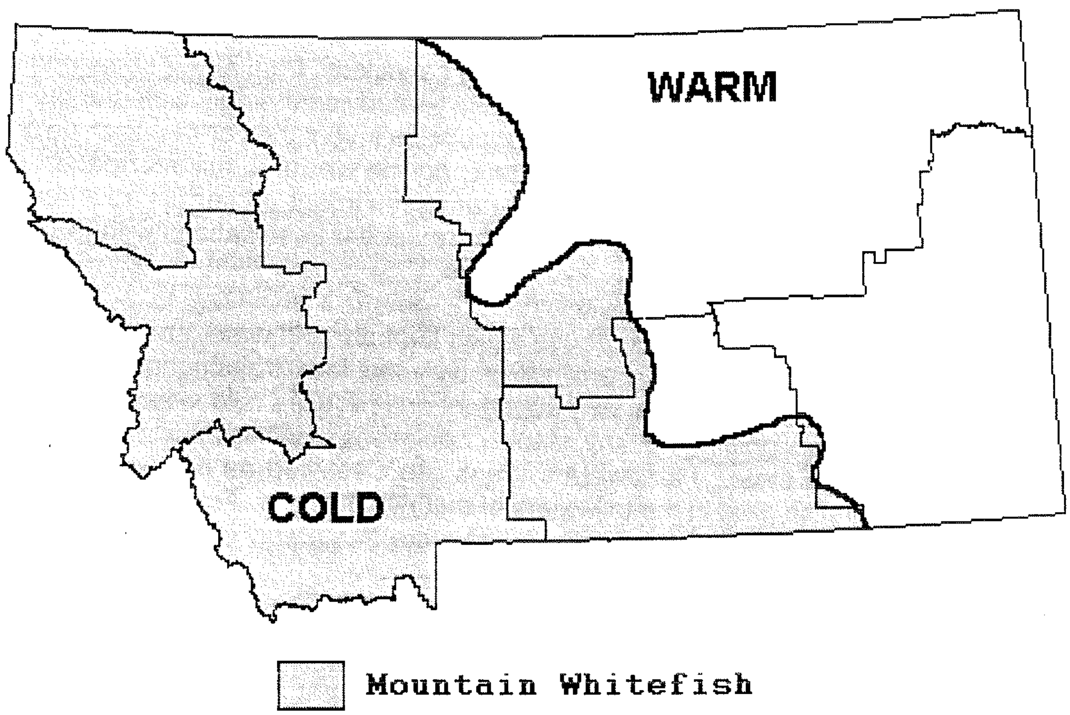
[18] Our choice to use distribution of the Mountain Whitefish as a means of mapping the extent of cold and warm water fisheries resulted from a personal conversation with Don Peters of the MDFWP.

Figure III-F1
ASSUMED RANGES OF COLD AND WARM WATER FISHERIES IN MONTANA



CURRENT CONDITIONS

Of the 86 species of fish found in Montana, 53 species are native, 30 are introduced, and another three are possibly native.[19] Some of these species are declining, with 15 presently listed as species of special concern. While the Pallid Sturgeon is the only fish listed as threatened or endangered in Montana, the USFWS is considering listing the white sturgeon and is reviewing petitions to list interior redband rainbow trout. The USFWS has determined that bull trout warrant

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[19] Native/non-native status is determined by MDFWP.

listing, but listing is precluded at this time because of manpower and budget constraints and the need to accommodate species considered to be at greater risk (USFWS 1994). The paddlefish, blue sucker, sturgeon chub, and sicklefin chub were previously classified as Category 2 fish,[20] which means that the listing of these species may be appropriate, but biological information is not available at this time to support immediate listing. The USFWS has also listed the fluvial population of the arctic grayling under the Endangered Species Act as warranted but precluded by listing actions on higher priority species. This determination reflects and was moderated by the USFWS' recognition of ongoing conservation actions by private, state, and federal agencies.

The wide dispersal of state lands throughout Montana, with the aquatic environment running through many different ownerships, makes describing the aquatic environment on state lands difficult. We do not have extensive, quantitative data for state lands alone; however, since fish habitat is intrinsically related to overall water quality, for the level of evaluation appropriate for a state-wide programmatic plan, we assume:

1) Fish habitat quality is directly correlated with water quality.

2) Water quality on state lands is directly correlated with water quality on adjoining lands.

Our rationale for accepting overall water quality conditions as representative of fish habitat quality on state land is as follows. The water quality assessment was based on "source" parameters such as agriculture, silviculture, resource extraction, and hydromodification; and "cause" parameters such as nutrients, siltation, thermal modification, and suspended solids. These same parameters directly affect fish habitat.

Also, the same authorities legally responsible for water quality protection promote fisheries habitat protection. Water quality standards stipulate that "water quality must be suitable for propagation of salmonid fishes and associated aquatic life" (ARM 16.20.618). "Reasonable land, soil, and water conservation practices" (ARM 16.20.603(19)) are applied through the application of Best Management Practices (BMPs) and contract requirements. The Streamside Management Zone Rules (ARM 26.6.601) limit disturbance in the streamside management zone and require retention of merchantable and sub-merchantable trees. These requirements promote fish habitat protection through reduction of sediment and recruitment of large organic debris.

WESTSLOPE CUTTHROAT TROUT

Westslope cutthroat trout are not as abundant as they once were, and many of those that remain are not genetically pure. The historic range of westslope cutthroat trout in Montana included all drainages west of the Continental Divide; those portions of the Missouri River drainage upstream from Fort Benton; and the headwaters of the Marias, Judith, Musselshell, and Milk Rivers. The distribution and abundance of westslope cutthroat trout has declined in the last 100 years (Liknes 1984). Genetically pure strains are estimated to exist on less than 5% and perhaps as low as 1-2% of the historic range (Van Eimeren and Shephard 1995). The MDFWP lists westslope cutthroat

[20] Please note that since the printing of the DEIS, the USFWS has eliminated C2 species from their listing process. C2 species were candidate species being considered for protection by the USFWS. Despite the elimination of this category, we have retained the information on C2 species in this EIS because we feel it provides useful information in assessing the impacts of management activities on sensitive and threatened species.

trout as a "species of special concern." They are also on the USFS Region One Sensitive Species list.

Westslope cutthroat trout prefer the cold temperatures typically found in headwaters areas. In large bodies of water their preferred habitat includes rocks, sandy or rocky shores, and deep waters. In small streams they favor rocky areas, riffles, deep pools, logs and overhanging banks (Everhart and Seaman, 1971; Sigler and Miller, 1963; Brown, 1971).

West of the Continental Divide, the upper Flathead River drainage basin contains the largest population of westslope cutthroat trout in Montana. The area currently occupied corresponds to about 85 percent of the historic range in that drainage, and about 58 percent of the known pure strains statewide are located there. The Clark Fork River drainage (below the mouth of the Bitterroot River) may have the second largest population. East of the Continental Divide, the Smith River drainage holds the largest population of native westslope cutthroat trout (Liknes, 1984).

Westslope cutthroat trout also populate Montana lakes. Liknes reported that 259 lakes actually do, or are thought to, contain westslope cutthroat trout populations. About six percent of the lakes are known to contain genetically pure strains. Roughly 94 percent of the lakes with pure strains are found within the confines of Glacier National Park. The remaining six percent are found on the Flathead Indian Reservation. Only four lakes or reservoirs east of the Continental Divide were reported to contain populations of westslope cutthroat trout.

BULL TROUT

Thomas (1992) estimated that bull trout currently occupy 42 percent of their native range in Montana. Rothschild and DiNardo (1987) concluded that species such as bull trout with specific requirements are likely to be more sensitive to habitat change and less able to persist in times of change. The adverse effects of land management practices on bull trout habitat and populations have been well documented throughout the species' range (USFWS, 1994).

The Montana Bull Trout Restoration Team has published Bull Trout Status Reports for the following drainages: Bitterroot River, Blackfoot River, Upper Clark Fork River, Flathead River, and South Fork Flathead River. Additionally, draft documents are available for the following watersheds: Middle Clark Fork, Lower Clark Fork, Upper Kootenai, Middle Kootenai, Lower Kootenai, Swan, and Oldman.

These reports include historic and current distribution, key watersheds, risks to survival, and a restoration goal specific to each watershed. In addition, the Restoration Team will put forth a unified restoration goal for the bull trout, statewide.

Rieman and McIntyre (1993) state that although bull trout are found throughout larger river systems, spawning and rearing fish are often found only in a small portion of the available stream reaches. Rearing and resident fish often use tributaries of larger river systems, while migratory fish use much more of the entire river drainage.

Bull trout are listed as a "species of special concern" by MDFWP and are on the USFS Region One Sensitive Species list. Several conservation groups have petitioned the USFWS to list the bull trout as endangered throughout most of its range. The USFWS responded to this petition by conducting a status review, and ruled on June 8, 1994 that listing bull trout as endangered was "warranted but precluded" for administrative reasons. With this ruling, bull trout were reclassified from a Category

2 Candidate species to a Category 1.[21] Bull trout are thus (with other candidate species) accorded no protection under the Endangered Species Act. The USFWS is required to reevaluate the "warranted but precluded" ruling within one year.

The report documenting the "warranted but precluded" status for bull trout (USFWS, 1994) contains the most current and comprehensive compilation of information on the status of the bull trout in Montana. The most extensive survey and inventory efforts have centered around the Upper Flathead River drainage and the Swan River drainage. Weaver (1992) reported that the number of redds in four tributaries of the North Fork Flathead River increased from about 117 in 1979 to a high of 406 in 1982, then fell to 61 redds in 1992. In four tributaries of the Middle Fork Flathead River, the number of redds changed over the same period from 71 to 184, then fell to 62. In contrast, in four tributaries of the Swan River the number of bull trout redds has steadily increased from 193 in 1982 to 375 in 1992. In response to declining bull trout numbers across Montana, in December 1992, MDFWP implemented an emergency closure of all bull trout fishing west of the Continental Divide.

Meehan (1991) gives a complete description of the habitat requirements of the above Salmonids. For an in-depth analysis of the correlation between land management activities and fisheries, see Meehan (1991) and Salo and Cundy (1988).

GOLDEYE AND LARGEMOUTH BASS

The distribution of the goldeye is limited to locations east of the Continental Divide. They normally prefer large river systems, but they are also found in large lakes (Paetz and Nelson,1970; Trautman, 1980; Brown, 1971). Goldeyes seem to prefer highly turbid waters and do not seem to invade colder water environments.

Largemouth bass are typically found in the southeastern portions of the state. Their preference for warmer water likely precludes movement westward. However, all but the deepest lakes are typically warm enough to support viable populations of largemouth bass.

Neither goldeye nor largemouth bass are considered threatened or sensitive. Their historical range has probably not diminished or changed in Montana.

ISSUE TIES

The fisheries resource is related directly or indirectly to several issues raised by citizens involved in our planning process. Water quality protection through proper watershed management is an important component of maintaining fish habitat. The amount and type of grazing and timber harvest are issues affecting watershed management and fish habitat. Healthy aquatic systems are important to ecosystem integrity and the fisheries resource. Wildlife is recognized as an important resource to many people, and fisheries are an important part of Montana's wildlife resource. Fisheries concerns relate to all these issues. The following are among the most important ways that human activities affect fisheries in Montana.

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[21] This change was made prior to the USFWS' elimination of Categroy 2 from their listing process. Category 1 is defined as "substantial biological information is on file to support the appropriateness of proposing to list as endangered or threatened."

1) Habitat Alteration: Aquatic habitat is adversely affected by a variety of land and water uses including timber harvest, mining, livestock grazing, road construction, subdivision development, and point sources of water pollution such as sewage treatment plants.

2) Water Management: Reservoir operations, downstream flow fluctuations, and de-watering have profound impacts on fish abundance and distribution.

3) Introduced Species: Introduced species have dramatic effects on native species due to hybridization, predation, and competition for forage, habitat and spawning sites.

4) Angler Demands: The estimated total angler use in Montana in 1992 was 2,300,000 angler days (MDFWP, 1994).

These human activities may affect habitat quality, wetlands and riparian areas, and fish populations.

CULTURAL AND AESTHETIC ENVIRONMENT

HISTORICAL AND ARCHAEOLOGICAL SITES

In considering the types of cultural resources one generally encounters in forested areas of Montana, it probably is best to separate forested lands on or adjoining the Rocky Mountain spine and the mountain isolates in Central Montana from the forested areas of Southeastern Montana. It is then most appropriate to separate prehistoric heritage properties from historic properties. Technically, the prehistoric period of Montana did not end until Lewis and Clark's voyage to the Missouri headwaters in 1805. Prehistoric heritage properties thus include paleontological (fossilized plant and animal) and cultural (human products of pre-European contact) resources. Forested lands in the mountain/foothill zones in Central and Western Montana typically contain more diverse (although generally quantitatively fewer) natural and cultural resources than do the adjoining open Plains.

In prehistoric times human groups frequented the foothill/mountain zones for numerous reasons including:

1) to collect plant resources (a) not available, (b) available to a lesser degree, or (c) available at different times than in the open plains;

2) to conduct vision quests;

3) to hunt or trap raptors and mountain-oriented game such as bighorn sheep, mountain goat, bear, and other fur-bearing animals;

4) to collect limber pine seeds;

5) to collect cambium from the inner bark of ponderosa pine;

6) to access and collect lithic raw materials suitable for chipped stone tool production; and

7) to access hunting or plant collecting areas adjoining the mountainous zones.

Providing the physical evidences of the previously outlined plant resources collecting activities (items 1, 4, and 5) have preserved, one could expect to find the following:

1) concentrations of old-growth ponderosa pine which exhibit prominent scars, similar in form, that do not appear to have been caused by natural agents such as lightning or one tree rubbing against another; and

2) The presence of apparent milling implements (manos and metates) in mid- to high-elevation settings may reflect previous processing of limber pine seeds.

The collection of other plant resources generally disturbed the ground too little to leave a permanent impression, and collecting activities were generally carried out using perishable tools such as digging sticks, antler tines, and hoes made of wood or bone.

Vision questing was typically carried out on prominent, isolated land forms such as mountain tops. The presence of small, isolated stone circles or semi-circles, or limbs and small logs arranged in a rectangular, semi-circular, or circular pattern on or near the tops of prominent topographic locales may reflect past vision questing activities. Alternatively, some small circular to rectangular stone structures in prominent locations may reflect hunting blinds used to procure mountain goat or mountain sheep, or eagle trapping structures. Although quite rare in forested areas, stone circles on ridge tops or relatively level terraces with inside diameters between 9 and 25 feet may reflect stones that once held down the ends of a tipi or similar domicile.

Cairns are another type of surface stone feature commonly encountered in the open plains, and less frequently encountered in forested areas. Historically, farmers and ranchers clearing fields would intentionally or inadvertently pile rocks along fencelines, in creek beds, or in coulees. Additionally, individuals clearing roadways occasionally piled stones along the travel route. Cairns were also constructed by prehistoric humans for a variety of purposes. Some cairns may have functioned as part of deadfall trap systems used to take small- to medium-size fur-bearing mammals. Travel by Native American groups through mountainous areas generally occurred along established trails. They often constructed cairns along the major travel routes in mountainous areas. In lower elevations and in forested lands in eastern Montana alignments of stone were used to herd bison and sometimes antelope into corral systems, steep-sided coulees, or over steep embankments of cliff faces. Alignments of cairns or individual stones in mountain parks or alpine meadows adjoining forested lands may reflect mountain sheep hunting systems similar to that described for bison. Originally, these stone alignments may have led to cribbed log structures into which mountain sheep were driven to be dispatched.

Another type of log structure, referred to as a wickiup, can occasionally be found in forested areas. A wickiup consists of small, generally straight logs which have been set on end and form a conical structure superficially resembling a tipi. Occasionally the skyward ends of the logs have been placed against and encompass a tree. Wickiups are believed to have functioned as temporary shelters probably used by a small number of hunters or by an entire group seeking short-term shelter while in a wooded environment. Historically, miners or trappers also constructed wickiups for use as short-term shelter or for elevating a supply of firewood from the damp or snow-covered ground.

The uplifted, volcanic, and/or intrusive nature of mountainous zones has exposed, formed, or deposited primary sources of lithic raw materials suitable for chipped stone tool production. Primary deposits of lithic raw materials include materials such as chert, basalt, silicified siltstones/sandstones, argillites, quartzites, and obsidian. The latter, however, has not been identified in Montana. Throughout Eastern Montana a fine-grained stone known as porcellanite is the dominant type of lithic raw material used in stone tool production. Although lithic raw materials suitable for stone tool manufacture were generally collected from surface exposures, they were also occasionally mined.

Massive rock outcrops common in mountainous settings and some of the forested lands in Eastern Montana also contain panels or cliff faces which exhibit rock art. In some of the mountainous settings of Western and Central Montana deposits of limestone bedrock have been exposed. The propensity of limestone to weather in a manner that forms caves and grottos provided an opportunity for prehistoric man to seek temporary shelter. In the forested lands of Eastern Montana especially, sandstone bedrock outcrops occasionally weathered in such a way that prominent depressions formed in the sandstone faces. Prehistoric inhabitants occasionally occupied these rock shelters for short durations. Evidence of human use of caves and rock shelters includes rock art, blackening of the walls and/or roof, chipped/ground stone tools and debitage, and/or firecracked rock.

Temporary settlement by nonrecent Native Americans can be identified by the presence of stone tools and waste flakes of lithic raw materials. Firecracked rock may be scattered across the ground or in concentrations. Firecracked rock is defined here as rock that exhibits reddening or blackening as a result of being heated, and that also exhibits spalling or a hackly fracture pattern attributable to heating/cooking activities. Firecracked rock exhibiting spalling can occur in forested areas as a result of past fires. Generally, however, rock will spall only after prolonged, intense heating. Lithic scatters are typically located on relatively level ground surfaces. Proximity to water and shelter seems to have been less of a consideration to prehistoric hunters and gatherers than was a relatively level place to set up camp. In some geographic settings susceptible to soil development or overburden deposition, the physical remains of a past group's activities have been buried and may be re-exposed as a result of stream downcutting, partial uprooting of trees, burrowing insect or mammal disturbances, or human disturbances to the ground. These open air campsites are the most common type of prehistoric human occupation in both forested lands and open prairie.

Historically, as people of European descent settled in the forested areas of Western and Central Montana, trapping, logging, and mining became the leading industries for those areas. Farming and sheep and cattle ranching also took place, but to a lesser extent. Evidence of historic trapping might be reflected in small, isolated log cabins or wickiup-type structures.

The remnants of mining camps can consist of tressels, rails, ore cars, cabins or other buildings, stamp mills, flumes, trash dumps, prospect holes, mine shafts, tailing dumps, sluice boxes, diversion ditches, and/or leach pads. Extraction of precious metals was the primary historic mining activity on forested lands in Western and Central Montana. In Eastern Montana coal mining was the primary type of mining operation taking place. Coal mining operations generally did not reach the same scale as metalliferous operations to the west. Other evidence of historic activities includes abandoned homestead/farmstead-era cabins or houses, outbuildings, irrigation ditches and associated structures, and possibly corrals. An obvious cultural resource that is often overlooked in forested lands and elsewhere are travel routes (railroads, automobile roads, and stagecoach/wagon roads) and their concomitants.

Fire lookouts can also be expected to occur in forested lands. Generally these sites consist of the remains of towers or platforms and possibly an associated cabin on prominent topographic locales.

Past logging activities can be identified by the remains of camps (cabins, outbuildings, and trash dumps), log decks, mill sites and associated features, log ramps and/or log chutes, and small railroads used for transporting logs to a mill site or major watercourse. Occasionally springboard stumps are found in previously logged areas.

Traditional cultural properties are locations or landmarks that contemporary and possibly past Native American groups consider to be sacred. Traditional cultural properties may be identified in a group's oral traditions, or may be places where rituals or prayers have been conducted for several generations. Traditional cultural properties can generally only be identified by a member of a specific tribal group and may not contain evidence of human occupation. When proposing activities within reservation boundaries it may be worthwhile to solicit comment from the tribal government concerning their knowledge of any traditional cultural properties in or adjoining the proposed project area.

Finally, if a site is thought to be older than fifty years, it should be considered a cultural resource.

VISUAL CONCERNS

Visual quality was not raised as a major issue, though it very likely is important locally to those persons directly affected by alteration of the landscape. Most of the concerns relating to visual quality on state lands were raised with regard to timber harvest, especially clearcutting, and associated road building.

We do not have an inventory of visual quality conditions. However, much of the information about current forest conditions presented in the Forest Vegetation sections of Chapters III and IV pertains to existing visual quality. See in particular the discussion of timber harvests in Chapter III, and the current conditions information for stand size classes, stand age distribution, old-growth, and patch sizes and shapes in Chapter IV.

FINANCIAL AND ADMINISTRATIVE ENVIRONMENT

ADMINISTRATIVE ORGANIZATION

INTRODUCTION

DNRC is charged with, among other responsibilities, the management of state school trust lands under the direction of the Board of Land Commissioners. School trust lands are managed to provide income for the support of education and the attainment of other worthy objects. Income from forested lands is primarily derived through the sale of forest products. Leasing various activities such as grazing, cabinsites, road use or other commercial uses provides additional income. The Department is funded by the Legislature through General Fund appropriations and timber sale receipts to conduct its income-generating activities.

The Department is organized into six administrative divisions:

- Central Management
- Trust Land Management
- Forestry
- Conservation and Resource Development
- Water Resources
- Oil and Gas Conservation

Trust Land Management Division: The headquarters for the Trust Land Management Division are located in Helena. The division is primarily a staff organization responsible for a variety of forest management-related functions on state trust lands. The Forest Management Bureau of the Trust Land Management Division is located in Missoula and is responsible for the forest management on all trust lands (classified Other, classified Grazing, and classified Forest) and for management of the surface resources on classified forest lands. A portion of the Trust Land Management Division budget is distributed to Field Operations to conduct their field-related activities.

Forestry Division: The Forestry Division is located in Missoula. It is primarily a staff organization responsible for a variety of service forestry and fire management functions on both state trust lands and private forest land. A portion of the Forestry Division budget is distributed to the Field Operations to conduct their field-related activities.

> Field Operations: Field Operations conducts the day-to-day field level activities in support of the Forestry and Trust Land Management Division Programs. They receive their funding from Forestry and Trust Land Management Divisions to accomplish their respective programmatic goals. The field staff serves as the Department's local representative within defined geographic areas.

Conservation and Resource Development Division: This division is the result of a reorganization effort in 1989 that combined the Water Development Bureau and Conservation Districts Division.

Water Resources: The Water Resources Division administers Montana's water right permitting system, assists the Water Court in adjudicating existing water rights, prepares the state water plan, oversees all state-owned water projects, participates in floodplain management, inspects and repairs dams and participates in interstate and international water allocation.

Oil and Gas Conservation Division: This division regulates oil and gas production in Montana to prevent waste and protect water supplies. Among its duties are well classification and inspection, issuing drilling permits, and engineering studies.

Figure III-AD1
DNRC - TRUST LAND MANAGEMENT DIVISION ORGANIZATION

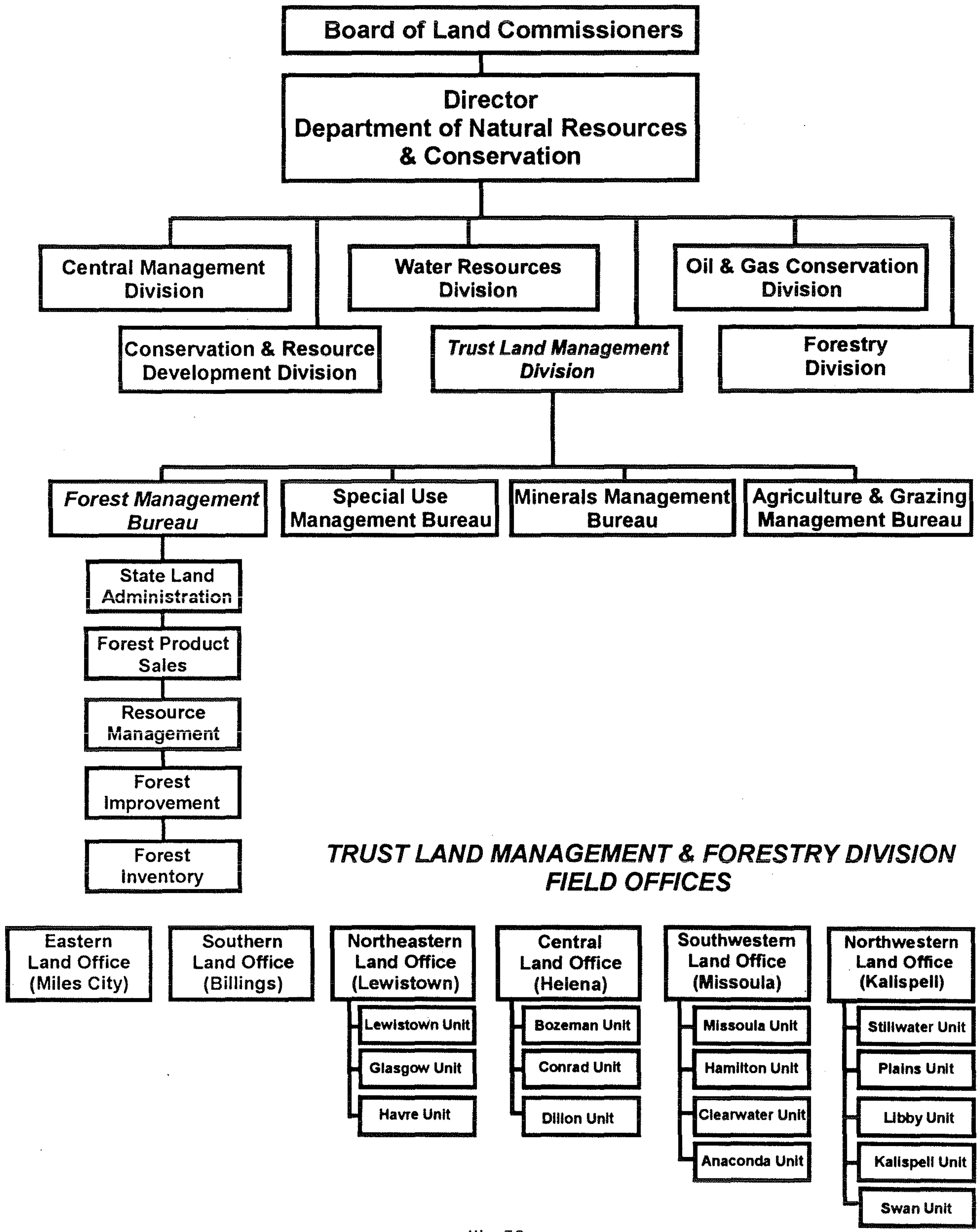
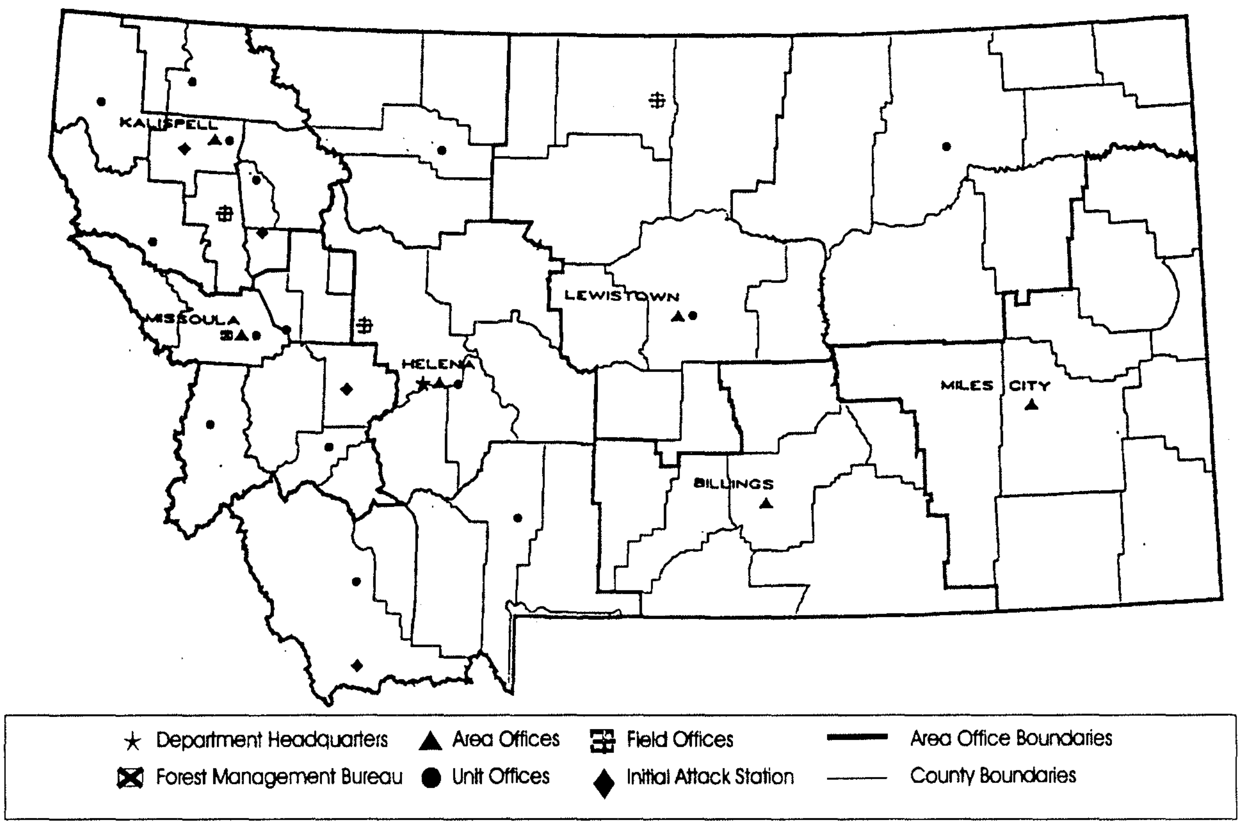


Figure III-AD2
LOCATION OF TRUST LAND MANAGEMENT AND AREA OFFICES



CURRENT CONDITIONS

DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION / TRUST LAND MANAGEMENT DIVISION ORGANIZATION AND STAFFING

The number of personnel and their distribution varies from year to year depending on legislative appropriations, budget cuts, workload, and staff vacancies. In Fiscal Years 1990-94 the Department of Natural Resources and Conservation (formerly DSL) was authorized an average of 360 full-time equivalents (FTE) annually. Approximately 29 percent were funded for programs directly associated with the management of school trust land. The remaining 71 percent were funded for programs not directly associated with trust land management such as Reclamation, Fire Management, Service Forestry or Central Management. Forest management programs were authorized approximately 77 FTE each year. Field Operations were allocated approximately 60 percent of the FTE authorized for forest management. The following tables (Tables III-AD1 and III-AD2) show the budgeted FTE by program and location for fiscal year 1994. These tables represent staff funding for trust management functions only. Additional personnel are funded in other programs at all locations.

Table III-AD1
FOREST MANAGEMENT AND LANDS PERSONNEL BY PROGRAM FOR FY 1994

	Field Operations FTE	Trust Land Management Division FTE
Forest Management Bureau		
Forest Product Sales	33.53	1.50
Resource Management		7.00
State Land Administration	10.64	2.50
Forest Improvement	17.44	1.75
Forest Inventory		3.00
Lands Administration	12.5	
Totals	74.11	15.75

Table III-AD2
DISTRIBUTION OF TRUST LAND MANAGEMENT AND FIELD OPERATIONS PERSONNEL BY LOCATION--FY94

	Forest Management FTE
Trust Land Management Division - Missoula (Forest Management Bureau)	15.75
Field Operations	
Northwestern Land Office	34.36
Southwestern Land Office	16.18
Central Land Office	10.93
Northeastern Land Office	7.79
Southern Land Office	1.85
Eastern Land Office	3.00
Totals	89.86

FOREST MANAGEMENT BUREAU

The management of forested trust lands is primarily conducted by personnel funded through the Forest Management Bureau of the Trust Land Management Division. The Forest Management Bureau manages the forested, state-owned trust lands to provide income to various school trusts. The primary income-producing program is the sale of forest products. Leases or licenses for other activities such as recreational use, camp grounds, grazing and cabinsites provide additional income. The forest land management function has five administrative programs to coordinate activities conducted on state forested lands.

Forest Product Sales Program

The goals of the Forest Product Sales Program are to:

- manage forest stands to improve productivity and health;
- provide a sustained flow of income to the school trust through the sale of forest products while meeting non-timber Resource Management Standards; and
- maintain a forest management program responsive to the concerns and issues of Montana's citizens.

The program consists of all activities required to grow, harvest, and sell forest products from state lands. The legal framework and statutory direction for forest product sales is provided in § 77-5-101--213, MCA. These statutes essentially:

- establish some lands as "state forest" reserved for forest production and watershed protection;
- direct the Department to conduct all field work in the selection, location, and appraisement of state timber land;
- provide the framework for selling, appraising, and collecting fees; and

- direct the Department to supervise all timber management activities before the timber is cut.

Program staff in Missoula allocate FTE and budgets to the field offices based on legislative authorization, timber inventories, tentative harvest plans submitted by the field offices, and agreed-upon annual work objectives. The staff ensures timber sales are prepared in compliance with the rules and regulations established by the Department and with the Montana Environmental Policy Act. Program staff also advertise all major timber sales (> 100 MBF), bills purchasers for volume harvested, and collects timber sale and related receipts.

Field personnel are responsible for all the on-the-ground activities associated with the sale of forest products. Field personnel use inventory data to identify and prioritize potential timber sale opportunities. They propose timber sales and submit them to resource management staff and any interested public citizens for comment and identification of issues or concerns. If necessary, they negotiate access to the sale area with adjacent landowners. Field personnel conduct the appropriate analysis for each sale proposal, write silvicultural prescriptions, mark harvest units, design roads, measure the trees harvested and administer the timber sale contracts.

When the harvest is completed, field personnel administer post-harvest treatments to reduce fire hazard, regenerate the stand, and maintain site productivity. Forest improvement funds collected during the timber sale are used by the Department for post-harvest treatments.

In fiscal years 90-94, the Forest Product Sales Program was authorized an average of 30.89 FTE and an average annual budget of $1,361,226. The amount of timber volume sold and the revenue generated from forest product sales fluctuates annually for a variety of reasons. Funding, harvest scheduling, complexity of sale proposals, environmental concerns, public interest, and unplanned workload conflicts such as fire suppression all affect the sales volume.

Annual income is affected by market conditions, harvest scheduling by purchasers, and volume sold by DNRC (formerly DSL) in previous years. Table III-AD3 shows the annual volume sold, volume harvested, trust revenue, and budgets of the Forest Product Sales Program over the 90-94 fiscal years.

Table III-AD3
DNRC Sales Volume, Harvest Volume, and Income
FY 1990-1994

FY	Volume Sold (MBF)	Volume Harvested (MBF)	Trust Revenue $
1990	30,086	42,333	6,789,160
1991	22,215	23,787	3,423,635
1992	14,892	33,614	6,347,461
1993	19,128	23,019	4,235,242
1994	28,224	17,001	5,587,167
5 Yr. Avg.	22,909	27,951	5,276,533

Land Administration Program

The goals of the State Land Administration Program are to:

- provide income to the school trust by leasing and licensing state forest lands for uses other than forest products sales;
- improve manageability of state forest lands by conducting land exchanges to consolidate ownership; and
- improve access to state lands by acquiring permanent and temporary rights-of-way on adjacent ownerships.

The primary income-producing activity in the Land Administration Program is the leasing of cabinsites. Other activities leased or licensed on state forest tracts include: agriculture licenses (primarily hay production), grazing licenses, special Recreational Use Licenses for outfitting, and other special leases such as campgrounds, rifle or archery ranges, Boy Scout camps, and commercial sites.

Field personnel funded in State Land Administration conduct evaluations of leases and licenses to ensure compliance with the terms of the agreement; evaluate land exchange proposals to determine if the exchange is in the best interests of the state; issue special Recreational Use Licenses; negotiate right-of-way easements for access to state tracts; and review right-of-way easement proposals across state lands. Staff personnel evaluate and process cabinsite sale requests, appraise licensed uses and easements, finalize right-of-way deeds, establish procedures for field personnel, evaluate land exchange proposals, and prepare billings. Over fiscal years 90-94, the State Land Administration Program was funded an average of 13.89 FTE with an average annual budget of $445,744.

Except for timber sales, a complete listing of all activities on forested state lands for fiscal years 90-94 is not readily available. However, the primary activities managed by the State Land Administration Program in FY 1994 and the revenue generated from classified Forest land are shown in Table III-AD4.

Table III-AD4
LEASES AND LICENSES ON CLASSIFIED FOREST LANDS - FY 1994

Lease Type	# Issued	Income
Agriculture	16	$2,023
Grazing	280	65,252
Cabinsite	626	326,423
Special leases	79	63,973
Total	1001	$457,671

In addition to lease and license administration, the program annually secures 15-20 permanent rights-of-way or temporary access licenses. The access provided generally is a critical element in an income-producing activity such as the sale of forest products, and often provides public use of state tracts. Personnel funded in the State Land Administration Program also contribute substantially to income-producing activities on non-forested grazing lands in the four land offices located east of the Continental Divide.

Forest Improvement Program

The goals of the Forest Improvement Program are to:

- manage the fire hazard created by treatment of state forest lands to comply with state laws, provide reasonable protection of residual forest stands, and to protect the property of surrounding landowners; and
- attain maximum reasonable growth and productivity from state forest stands.

The Forest Improvement Program provides for the collection of fees to complete brush disposal resulting from timber sales on state lands, site preparation for regeneration activities, planting, and thinning. It also manages seed orchard trees for improved seed and supports nursery operations for seedling production. The program staff collects fees on the volume of timber harvested from state lands and distributes them to the field offices for project work. The Forest Improvement Program is funded from fees associated with the sale of forest products, and the activities conducted under the program are designed to support the forest product sales program. Authorization for the collection and use of fees is provided in § 77-5-204, MCA, sale of timber-fee for forest improvement. The statute allows the Department to collect fees specifically for:

1) disposal of logging slash;
2) acquiring access and maintaining roads necessary for timber harvesting on state lands;
3) reforestation, thinning and otherwise improving the condition and income potential of forested state lands; and
4) complying with legal requirements for timber harvesting.

Program staff manage the Forest Improvement budget by evaluating project needs submitted by the field; monitoring harvest projections and calculating the fee rate required to accomplish program needs; monitoring effectiveness and prioritizing treatments on state tracts; and distributing the budget to field offices for project work. The staff also manages the improved seed orchard activities.

Field personnel plan, develop, and administer specific forest improvement projects such as brush disposal, tree planting or thinning contracts, and road maintenance activities. Many projects are closely related and conducted concurrently or soon after timber harvests. Other projects are a result of timber harvest activities conducted many years ago or of insect and disease agents and fire occurrences.

During fiscal years 1990 through 1994, the Forest Improvement Program was authorized an average of 19.3 FTE and an average annual budget of $1,053,246. However, expenditures and project accomplishments vary from year to year depending on the actual amount of timber harvested and associated fee collections.

Table III-AD5
FOREST IMPROVEMENT ACCOMPLISHMENTS FY 1990-1994

FY	Brush Piling (Acres)	Prescribed Burning (Acres)	Tree Planting (Acres)	Tree Planting (# Trees)	Precom-mercial Thinning (Acres)	Seed Collection (Bushels of Cones)
1990	2,958	466	1,357	524,384	924	266
1991	3,254	236	1,086	354,322	1,141	200
1992	4,593	16	1,062	367,435	241	217
1993	2,357	432	499	139,943	503	14
1994	1,134	17	1,056	348,276	465	181

In addition to the program accomplishments, a substantial number of Forest Improvement personnel contribute directly to forest product sales. An estimated five to six Forest Improvement FTE prepare and administer timber sales at the field offices.

Forest Inventory Program

The goals of the Forest Inventory Program are to:

- develop and maintain a resource information system for state forest lands that will improve the effectiveness and efficiency of field activities and planning; and
- maintain standards for measurement and evaluation of state forest lands that ensure accurate and cost-effective management.

The program is almost entirely a staff function, designed to collect and manipulate forest resource information on state lands to be used by land managers. The primary role is to support forest product sales; however, additional uses of the inventory data are evident. Forest management activities frequently require cumulative effects analysis and information on resources over large geographic areas, encompassing several ownerships. It is the responsibility of the Inventory Program to keep abreast of advancements in remote sensing technology, computer data base management, and geographic information systems (GIS). Inventory staff currently conduct stand level inventories in the field on state forested land. The stand level inventory consists of maps and records of forest resource information such as DBH, tree height, age, stocking, insect and disease presence, slope, aspect, road locations, and drainage information. The data is then digitized for GIS use in analyzing the impact of harvest activities, analyzing cumulative effects, and for mid- to long-range planning.

During fiscal years 1990 through 1994 the Inventory Program was authorized three FTE per year and a budget that averaged $101,596. The program accomplishments include an inventory of 20,000-30,000 acres annually, updating the data base on the 4,200 acres harvested annually, and digitizing the inventory data.

Resource Management Program

The goals of the Resource Management Program are to:

- use available technology to manage state forest lands in as economically efficient and environmentally sound a manner as possible;
- review, evaluate and monitor activities on forested state lands to maintain appropriate soil, water, wildlife, cultural, and economic values; and
- avoid unacceptable cumulative effects from state forest management activities.

The Resource Management Program consists of staff resource specialists who provide support to field personnel in their land management activities. Their primary role is to provide for the consideration and protection of various resources while conducting the Department's Forest Product Sales Program. Areas of expertise represented in the program include soils, hydrology, wildlife biology, economics, MEPA compliance and planning.

Program staff review harvest proposals submitted by field personnel, conduct direct and cumulative effects analyses of potential impacts resulting from the proposal, conduct site-specific review of proposals and recommend mitigation measures, participate on interdisciplinary teams that develop management proposals and MEPA documents, develop guidance for field use, and monitor the effectiveness of the mitigation measures by conducting post-sale reviews.

During fiscal years 1990 through 1994 the Resource Management Program was authorized an average of seven FTE annually and an average budget of $271,169. During that period, program personnel provided impact analysis or review, site-specific recommendations, and resource input on an average of 17-20 timber sales annually. Post-sale reviews for mitigation effectiveness were conducted on a minimum of 10-12 sales each year. Draft standards were prepared for Silvicultural Treatments, Watershed Management, Road Management, East-side Elk Winter Range, Whitetail Deer Winter Range, Timber Cruising, and Grizzly Bear Management. These standards will be superseded by the Resource Management Standards presented in this Plan for the chosen alternative.

ISSUE TIES

The points raised in this section deal mainly with our own internal concerns about possible changes in the size and composition of our workforce.

ECONOMICS

INTRODUCTION

Our assessment of economic impacts revolves around two main themes: the amount of revenue earned by the school trust under each alternative and the impacts that each alternative would have on regional jobs and incomes.

Trust revenue is important because we operate under a legal mandate to generate the "largest reasonable and legitimate advantage (monetary)" from management of state lands. Under the terms of Montana's constitution, money earned from management of state lands helps support public schools and state universities. Regional jobs and incomes are important because changes in our management affect the flow of basic economic inputs such as timber supply, grazing opportunities, and recreation opportunities. This, in turn, causes upward or downward pressure on the overall level of economic activity across Montana.

CURRENT CONDITIONS

In this section, we show the current contribution of forested lands to the school trust fund. We also examine the NPV of the DNRC forest asset.

PERCENT OF SCHOOL FUNDING FROM FORESTED TRUST LANDS

Revenues earned from state trust lands contribute only a portion of total public school funding and revenues earned from forested state trust lands account for only a portion of total trust land revenues. This subsection evaluates the share of total public school funding that comes from the management of forested trust lands under each alternative.

While there are other beneficiaries served by proceeds from school trust lands, the large majority of revenue (roughly 95 percent) is dedicated to support of the "common schools" administered by the Office of Public Instruction. The common schools are supported by the Public School Equalization Aid Account, often referred to as the Equalization Fund.

Annual contributions to the Equalization Fund come, in part, from income taxes, coal severance taxes, mineral royalties, property taxes, lottery revenues, and earnings from trust lands administered by DNRC. Collections in fiscal year 1994 totaled $411.7 million, of which DNRC contributed $40.9 million through the Common Schools Income and Interest account. For fiscal years 1992-1994, DNRC contributions averaged 10.35% of the annual Equalization Fund total.

Among the larger DNRC contributions to the Equalization Fund are revenue from nonforest land grazing, agricultural rentals, and revenue from timber sales and other forested lands activities. The total share of DNRC contributions from forested lands activities has averaged 27.0 percent over the fiscal period 1992-1994. The net effect is that forested land activities (activities affected by the proposed Plan) contribute roughly three percent of total annual payments for the support of public schools in Montana.[22] [23]

Table III-E1 shows the data we have used to arrive at these figures.

Table III-E1
FORESTED LANDS SHARE OF DNRC CONTRIBUTIONS TO SCHOOL TRUST FUNDS[24]

Distributable Revenue	3-Yr. Avg.	FY 92	FY 93	FY 94
Grazing (2.5%)[25]		108,538	104,451	106,601
Timber Sales (100%)		2,422,419	3,074,174	3,769,170
Other Revenues (50%)		267,601	390,188	440,009
Transaction Fees (50%)		67,893	85,213	89,154
T & L Interest (31.85%)		8,498,654	9,604,363	8,030,153
Forested Lands Total		11,365,015	13,258,389	12,435,087
Total All DNRC Lands		44,254,690	47,274,406	45,600,175
% From Forested Lands	27.00%	25.68%	28.05%	27.27%

Nondistributable Revenue (To T&L Permanent Fund)	3-Yr. Avg.	FY 92	FY 93	FY 94
Timber Sales (100%)		4,038,261	1,488,558	1,938,947
Rights-of-Way (50%)		50,532	48,001	43,511
Sand & Gravel (50%)		82,233	49,735	78,782
Miscellaneous (50%)		61,480	70,383	84,107
Forested Lands Total		4,232,326	1,656,677	2,145,347
Total All DNRC Lands (Less T&L Interest)		9,339,572	6,684,446	8,425,331
% of T&L Interest from Forested Lands	31.85%	45.32%	24.78%	25.46%

Equalization Fund	3-Yr. Avg.	FY 92	FY 93	FY 94
Common School I&I (DNRC)		39,616,168	41,673,746	40,943,551
Total Equal. Fund Rev.		360,023,259	413,173,333	411,682,300
Percent from DNRC	10.35%	11.00%	10.09%	9.95%

Average Forested Lands Contribution to Equalization Fund: 2.79% [27.00% X 10.35% = 27(.1035) = 2.79%]

22 That is, 27.00% of DNRC's total 10.35% contribution comes from forested land activities (.270 X 10.35 = 2.79%).

23 These figures represent the percentage of Equalization Fund revenue that comes from forested trust lands each year. The actual dollar amounts follow a more complex path. Certain legislatively determined revenue items are "nondistributable" which means that they are retained in a permanent "Trust and Legacy Account." Ninety-five percent of the annual interest earned by this permanent fund is paid to the Equalization Fund (The other five percent is reinvested). So, the "nondistributable" portion of revenue from forested land activities is a legitimate part of annual earnings, but in its passage through the Trust and Legacy Account, it becomes indistinguishable from earnings by other activities that are unrelated to forested trust lands.

24 The numbers in this table can be derived from data published in the DNRC Annual Report for fiscal year 1994, p. 32.

25 That is, we estimate that 2.5 percent of total grazing revenue comes from forested state lands.

NET PRESENT VALUE OF EXPECTED TRUST REVENUES

This represents the sum of money in hand today that, if invested at four percent interest, would exactly equal the result of subtracting all expected management costs over the next 25 years from all revenues we expect to earn over the same period.[26] By reducing each future income and cost stream to its present value equivalent, we are able to make meaningful comparisons of the earning potential of each alternative.

In fiscal year 1994, a year of unusually high stumpage prices, activities on DNRC forested lands (lands affected by the proposed plan) generated approximately 6.5 million dollars for the benefit of public schools[27]. If we continued to operate under the same management philosophy we do today, we would continue to contribute an average of 6.5 million dollars per year to the school trusts and the discounted present value equivalent of 25 years worth of contributions would be $101.5 million.

Present and Future Value of Timber Asset

The focus of our proposed Plan is management of forested lands. The inventory of timber on those forested lands is a saleable asset which represents potential benefit to the school trusts. At current DNRC stumpage prices, today's value of our timber asset would be approximately $485 million.

ISSUE TIES

Our economic assessment relates primarily to two of the issues listed in Chapter I: Trust Management Policy and Recreation Opportunities. NPVs and percentages of total school funding tell us the financial consequences of different interpretations of the trust mandate.

Considering we do not have a well-developed, existing recreation management program, we have made assumptions in order to construct plausible recreation scenarios that could become a point of beginning for a future recreation program.

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[26] Appendix ECN supports our choice of 4 percent as the discount rate.

[27] This value ($6.5 million) is derived from the FY 1994 column of Figure III-E1, as follows:

Total Distributable $ from Forested Lands:	$12,435,087
Less $ from T & L Interest:	8,030,153
Plus Non-distributable $ from Forested Lands:	2,145,347
Net Revenue Contributed in FY 1994	$ 6,550,281

CHAPTER IV

THE ENVIRONMENTAL CONSEQUENCES

This chapter provides the scientific and analytic basis for comparing the probable environmental effects of implementing each of the alternatives we are considering. Discussions of individual resources are presented in the same order as in Chapter III. Each resource discussion will include a brief introduction, an explanation of the methodology used, and presentation of the expected environmental effects in that particular area.

METHODOLOGY

In essence, we have assessed the effects that our high and low estimated grazing, recreation, timber harvest, and special use levels (presented in Appendix SCN) would have on wildlife, fisheries, watersheds, air quality, soils, vegetation, trust revenues, our budgets and staffing, and regional jobs and incomes.

We remind you that these high/low output estimates are not accomplishment targets. We developed what we think are plausible output scenarios under each alternative in order to have some specific basis for plausible programmatic level estimates of the environmental effects of implementing each alternative. It is likely that actual output levels would be someplace within the range bracketed by each set of high-low estimates; however, we are making no firm commitment to those levels. Actual outputs would be determined by following the intent of the selected alternative (see Chapter II), the intent of Resource Management Standards (RMS), and program budgeting direction given to us by the state legislature.

We have organized this analysis to portray the estimated effects on each of the above "resources" in a way that is both fairly specific; and responsive to the issues raised by members of the public during our scoping process. Each member of our planning team has identified Descriptors, which are characteristics that most appropriately measure the magnitude and importance of changes in a particular resource. In some cases, these Descriptors are precise numbers (Acres by Stand Size Class), and in some cases they are numeric abstractions (Proportionate Change in Sediment-Generating Activity Levels).

In each resource sub-section, we present Direct and Indirect Effects and Cumulative Effects. In most cases, this is done separately for each resource descriptor with an overall summary at the end of the section. A summary table of all expected environmental effects is presented in the Executive Summary.

The remainder of the chapter is organized as follows:

Physical and Biological Environment

1. Soils
2. Watershed
3. Air Quality
4. Vegetation:
   a. Forest Vegetation
   b. Plant Species of Special Concern
   c. Noxious Weeds
5. Wildlife
6. Fisheries

Cultural and Aesthetic Environment

1. Historical and Archaeological Sites
2. Visual Concerns

Financial and Administrative Environment

1. Administrative Organization
2. Economics

PHYSICAL AND BIOLOGICAL ENVIRONMENT

FOREST SOILS

INTRODUCTION

In this section, we predict the environmental effects of each alternative on forest soils. Timber harvest, site preparation, and vegetation control can alter factors that influence short-term and long-term site productivity. Road construction and recreational development also impact soil health.

METHODOLOGY

We predicted the impact of land management activities on forest soil properties, including physical properties, nutrient status, and hydrologic functions, by estimating the changes in the following descriptors:

Availability of Soil Nutrients
Accelerated Erosion/Slope Stability
Management-Induced Soil Compaction and Displacement

We used the management scenarios developed in the planning process and conducted an evaluation for each of the six DNRC Land Offices.

Changes in soil properties can indicate a reduced productive potential (Griffith 1990). The degree of impact or change is related to the area of land committed to roads or special uses and the area of land affected by forest management activities such as log skidding, slash treatment, and site preparation. Potential soil displacement, compaction, and erosion within an area depend on mechanical methods of harvest. Tractor yarding and piling are the harvest activities with the most potential for displacing and compacting soil. Heavy use skid trails can cause reduced soil productivity due to compaction, displacement, and erosion.

The harvest method chosen depends to a large extent on the slope of the area to be harvested. For this analysis, we assume that slopes of over 45 percent require cable yarding or helicopter harvest, which limits the area and degree of soil impacts and maintains soil productivity. Cable harvest has a low impact on soils because skidding corridors typically disturb only five to seven percent of a harvest area (Purser 1992, Miller 1986), compared to 17.5 percent of tractor-logged harvest areas.

Table IV-S1 below shows our estimates of state land areas by slope degree. We based our estimates of areas susceptible to soil impacts on estimates of tractor-operable ground, which depends on the slope degree of the area to be harvested. For purposes of this effects analysis, slopes of less than 45 percent are considered suitable for conventional ground-based tractor harvest. Other harvest methods are also appropriate in lieu of tractor harvest; for example, log forwarders or soft track skidders that are gentler on the land.

Table IV-S1
SLOPE CLASSES OF FOREST LAND COVERED BY THE PLAN

	NWLO DNRC Acreage %	SWLO DNRC Acreage %	CLO DNRC Acreage %	NELO, SLO, ELO DNRC Acreage %	TOTAL Total Acreage %
TOTAL COMMERCIAL FOREST LANDS BY LAND AREA OFFICE	286,231 Acres	150,110 Acres	93,223 Acres	93,104 Acres	622,668 Acres
ACRES/% of DNRC forest lands on 0-35% slopes, suitable for conventional tractor harvest and dozer piling	188,340 65.8%	94,870 63.2%	60,502 64.9%	60,145 64.6%	403,857 64.8%
ACRES/% of DNRC forest lands on 35-45% slopes, suitable for tractor harvest, and whole tree harvest, excavator or broadcast burn (slope range at risk of sever displacement - if tractor piled)	37,496 13.1%	25,819 17.2%	11,466 12.3%	13,220 14.2%	88,001 14.1%
ACRES/% of DNRC forest lands on 45-65% slopes suitable for cable harvest	43,793 15.3%	24,918 16.6%	17,992 19.3%	15,920 17.1%	102,623 16.4%
ACRES/% of DNRC forest lands on slope over 65%, including rock outcrops and slopes subject to potential slope instability and soil creep. Cable or helicopter harvest required. Most of these lands are deferred.	16,888 5.9%	4,503 3.0%	3,170 3.4%	3,817 4.1%	28,378 4.5%

We used the level of road building as another measure of soil impact. Roads and their associated disturbed sites reduce the area of long-term plant productivity and irreversibly change the land use to transportation. State lands currently average about two miles of road per section, equivalent to eight acres of land, or 1.25 percent of each section on lands identified with this plan.

We evaluated recreational uses for the effects of developed sites, trails and dispersed uses by considering area and degree of impacts. Recreational activities can cause ground disturbance and erosion of topsoil. Sedimentation, associated with trails and developed sites, can also be a problem, mainly on localized areas of heavy use.

Recreational opportunities, like harvest methods, are somewhat dependent on slope degree. Recreational opportunities and their associated impacts are greatest on slopes less than 45 percent. On 45 percent or steeper slopes, recreational activities are more localized and limited to hiking on trails, hunting, or development of ski areas. Ski areas, however, produce more dramatic impacts than most other recreational activities, similar to those of even-aged timber harvest with its associated service roads. Hiking trails are typically narrow and of various conditions, from cleared and well-used to overgrown and barely distinguishable on the ground. These trails generally have little effect on soil productivity, but heavy vehicle, human, or animal traffic can cause compaction and erosion (Cole 1991).

We assumed that snag density, availability of organic debris, and ground displacement by machinery would have an impact on soil nutrient availability (Zinke 1990). Snags and down logs provide a long-term source of large woody debris important for soil productivity. When snags fall, they weather and provide soil nutrients, improve moisture retention, and provide a medium for mycorrhizae fungi and root growth. Harvest type and whole tree skidding can result in fewer snags and downed woody debris than would occur with comparable natural disturbances.

ENVIRONMENTAL CONSEQUENCES FOR SOILS

In the following pages, we will outline the predicted effects of each alternative on individual descriptors. First, we will describe effects common to all alternatives, if there are such effects, and then effects specific to each alternative.

DIRECT AND INDIRECT EFFECTS

Availability of Soil Nutrients

The Descriptor Relationship

Breakdown of organic matter is the primary source of forest soil nutrients, supplemented by the slow weathering of soil parent materials. In Montana, most nitrogen fixing occurs in old logs, woody debris, and duff on the forest floor and on shrub roots. Harvey and others (1976) found up to 95 percent of active mycorrhizae fungi occur in decaying wood and humus in a mature Douglas-fir/western larch forest. Mycorrhizae fungi are associated with tree root systems and functionally improve tree growth by increasing the volume of soil from which nutrients and moisture can be extracted. Removal of forest cover and surface soil organic matter can affect fungi populations, availability of nutrients, and long-term soil productivity (Zinke 1990).

While ground displacement is considered detrimental to soil nutrients, scarification (defined as a deliberate, moderate disturbance of soil to remove or mix surface duff with less than 1" of surface mineral soil) can be beneficial for tree regeneration and reduction of competition. Scarification by prescribed burning or mechanical methods provides bare mineral soil that certain tree species need to regenerate. It also promotes oxidation of organic matter and speeds its breakdown into nutrients to enrich soil.

A significant impact on nutrient cycling is considered to occur when the nutrient removal associated with the activity exceeds the estimated natural rate of nutrient replenishment over time. Maintaining adequate distribution of surface duff and organic litter throughout timber harvest units can provide building material nutrients important to soil nutrient cycling. Soil nutrient losses to streams from harvest activities at low elevation sites are usually insignificant (Stark 1982). Harvey (1994) found that retaining 15 tons (in dry forest types) to 25 tons (in other forest types) of well-distributed large woody debris per acre after timber harvest can provide adequate organic matter for nutrient cycling and long-term soil productivity.

Expected Future Conditions

DESCRIPTOR: AVAILABILITY OF SOIL NUTRIENTS	
EFFECTS COMMON TO ALL ALTERNATIVES Activities that cause displacement of soil will continue under all alternatives, which means that management effects on soil nutrients will continue.	
EFFECTS OF ALPHA AND DELTA Alpha and Delta would have similar effects on the amount of organic debris available to nourish the soil. Snag numbers and woody debris would probably decrease over time, depending on slash management and on harvest, firewood cutting, and recreation development levels. Ground displacement levels would be similar to current levels.	EFFECTS OF BETA Beta would probably have the third lowest effect on the number of snags or amount of organic debris available. Woody debris would probably remain near present levels or decrease slightly, but any decrease would be less than under Alpha or Delta. Lower harvest levels than Alpha, Delta, or Epsilon would result in less ground displacement than under those alternatives.
EFFECTS OF GAMMA AND ZETA Gamma and Zeta would likely have the most beneficial effect on the availability of soil nutrients. Snags and woody debris of all sizes would increase, and the low harvest level estimates of these alternatives would cause the lowest level of direct impacts such as soil displacement of organic duff. The emphasis on road management under Zeta, however, may increase public access to large snags for firewood, making this alternative slightly less beneficial than Gamma.	EFFECTS OF EPSILON Epsilon would probably have the greatest cumulative areal impact on soil nutrient availability, because of the larger number of acres treated. We would expect Epsilon to reduce snag and woody debris density, and to have the highest ground displacement levels of any alternative. On certain higher productivity sites where it was economically feasible, fertilization would improve soil nutrients.

DESCRIPTOR: AVAILABILITY OF SOIL NUTRIENTS
EFFECTS OF OMEGA
Omega would likely have greater cumulative areal impact on soil nutrient availability than Gamma, Zeta or Beta because of the larger number of acres treated. Omega would implement mitigation measures that maintain near present levels or decrease slightly and have less impact than Epsilon, Alpha or Delta on a per acre basis. On some sites, nutrients may be supplemented to increase growth and productivity, were economically feasible.

Accelerated Erosion/Slope Stability

The Descriptor Relationship

Erosion impacts soil productivity by causing nutrient loss and contributing to unstable surface conditions. Erosion caused by road construction and logging on unstable slopes can also affect sediment production. The severity and duration of the erosive impact of management activities depends on several factors including soil type, terrain, intensity of management activities, mitigation measures applied, and unpredictable events such as severe storms. All soils are susceptible to some increase in erosion if they are disturbed by activities that remove the duff surface. Soils forming in granitics, volcanic ash, and fine textured material with low rock content have higher erosion potential.

Surface runoff is likely to occur in forested areas where there are moderate to high amounts of precipitation combined with extensive soil disturbance. Research indicates that increased soil disturbance and compaction associated with timber harvest can affect infiltration and produce more runoff and subsequent erosion than undisturbed sites (Johnson 1980). The increase of runoff and erosion will vary with soil type amount and type of harvest and mitigation measures implemented.

Roads have been the principal source of erosion caused by forest management. Skid trails, other disturbed areas such as gravel sources, and heavily grazed areas along stock driveways and trails are also significant sites of erosion. Within timber harvest units, most bared soil areas are exposed and subject to erosion for only a short time before they are revegetated. Exceptions are heavily trafficked areas such as skid trails or landings and very dry sites with sparse vegetation, which have a severe erosion potential, unless revegetated and provided with proper drainage.

Erosion on roads and driveways can be controlled with proper road location, drainage design, maintenance, and revegetation of disturbed soils. In general, however, a greater area committed to roads and driveways increases the potential for damaging effects due to erosion and slope instability. Sediment runoff associated with erosion from forest roads is addressed more fully in the Watershed sections of this chapter.

The risk of slope instability on state lands is small because the area subject to instability occurs on localized areas in less than six percent of all lands (see Table IV-S1). Table IV-S1 shows our estimate of the percentage of slopes greater than 65 percent by DNRC land office. (Accurate slope information is not currently available for the NELO, SLO, and ELO areas, but we assume it is within the range of slopes for other area offices noted in Table IV-S1.) For the purposes of this comparison, slopes over 65 percent are considered at highest risk of instability because 65 percent is the normal angle of repose and stability for most landscape materials. Slopes over 65 percent are mainly classified as deferred and include areas of bedrock that are stable.

Most of this area is deferred and only a very small percentage is considered available for timber harvest or development. However, potential future timber operations may occur in unstable areas more frequently as these areas are accessed. All roads, timber harvests, and site developments are designed to avoid and minimize risks on unstable slopes. DNRC conducts site-specific reviews to incorporate mitigation measures to reduce slumping problems on sites where potential slope instability is identified.

Studies in central Idaho (Clayton 1983) found that in those limited areas where instability associated with management activities occurred, roads were the principal source of instability on about 90 percent of sites. Since roads generally cross less than five percent of a harvest area and are the dominant cause of instability, we estimate the area of slopes at risk of instability due to road construction at considerably less than half a percent of all DNRC forested lands.

Expected Future Conditions

<table>
<tr><th colspan="2">DESCRIPTOR: ACCELERATED EROSION/SLOPE STABILITY</th></tr>
<tr><td colspan="2">EFFECTS COMMON TO ALL ALTERNATIVES

Best Management Practices (BMPs) and Resource Management Standards would apply under each alternative to help avoid or reduce the risks of causing accelerated erosion or slope instability. The acceptable level of risk would vary somewhat by alternative.</td></tr>
<tr><td>EFFECTS OF ALPHA

Alpha would probably be the alternative third most likely to increase soil erosion and minor localized risk of slope instability. Its projected road density and maximum harvest level estimates are third highest, after Epsilon and Delta.</td><td>EFFECTS OF BETA

Beta would probably be the third least likely to increase erosion and slope instability. Its projected level of road construction is the fourth highest, and an emphasis on selection as a harvest method should often result in less impact on harvest areas.</td></tr>
</table>

DESCRIPTOR: ACCELERATED EROSION/SLOPE STABILITY	
EFFECTS OF GAMMA We expect Gamma to cause very few if any erosion or slope instability problems because of its low projected road density and emphasis on closing and rehabilitating roads. Gamma also has very low projected harvest level estimates and associated disturbance. Gamma would have the least impact on erosion or slope instability.	EFFECTS OF DELTA Delta would have the second highest impact on erosion and slope stability. In addition to the impact of its relatively high projected road density and harvest level estimates, the increased development of recreation associated with Delta could result in a greater risk of erosion. Delta would also accept a higher level of risk of impacts than some of the other alternatives.
EFFECTS OF EPSILON Epsilon would probably have the greatest impact on erosion and localized risk of slope instability. Its road density and harvest level estimates are higher than any other alternative, and it would accept a higher level of risk in its watershed standards, as well, which implies acceptance of a higher level of erosion risk.	EFFECTS OF ZETA We expect Zeta to cause few erosion or slope instability problems because of its low road density and harvest level estimates. The increase in developed recreation and open road use associated with Zeta could result in a slightly greater risk of erosion than Gamma, making it the second least likely to increase erosion and slope instability.
EFFECTS OF OMEGA The effect of Omega to increased soil erosion and localized slope instability would be similar to Alpha, but more than Beta. The projected road density would be slightly less than Alpha. Omega would involve a higher degree of harvest and associated risks than Alpha, Beta, Delta, Gamma, or Zeta. Yet, Omega would provide a higher level of soil protection with conservation and mitigation measures than Epsilon, Alpha or Delta on a per acre basis.	

Management-Induced Soil Compaction and Displacement

The Descriptor Relationship

Soil compaction and displacement can reduce soil productivity by removing nutrients, reducing aeration, reducing water infiltration and retention, and causing difficulty in rooting. The area of disturbance is proportional to the method and amount of timber harvest or the size of the recreational development. Within a timber harvest area, the loss or damage of soil productive capacity as a result of physical or biological impacts that exceeds 15 percent of native soil condition is considered significant. Detrimental soil impacts of compaction and displacement are considered significant when they exceed 20 percent of an area (USDA, BC Forestry).

Compaction is a process in which soil density increases and large pore spaces decrease. Any kind of traffic--vehicle, human, or animal--can cause compaction. Harvey defines detrimental compaction as more than a 15 percent increase in bulk density, more than a 50 percent reduction in macropore space, or 15 percent or less macropore space (Froehlich 1985). Ample porosity and soil aeration are required for mycorrhizae, microbes, and plant roots to grow and perform their functions. Compaction causes increased surface runoff and a reduction of growth potential because it decreases water retention and infiltration rate. It reduces soil aeration, which in turn causes difficulty in rooting for plant regeneration and growth of seedlings. The extent of compaction is a function of the area of land affected by road or trail building and tractor skidding, and thus is closely tied to the level of timber harvest.

Soil displacement usually occurs as a result of mechanical removal of surface duff and topsoil during timber harvest operations. Mineral soil is exposed and the potential for runoff and erosion increases. Displacement can reduce the nutrients and water available for plants.

Ground-based log skidding and slash treatments have the greatest potential to cause soil displacement and compaction. Seventy-eight percent of DNRC forested lands are considered suitable for ground-based logging. Recently, 90 percent of logging on DNRC lands have been harvested with conventional ground-based systems. In the future, we expect a higher percentage of cable harvest. Ground-based tractor skidding typically disturbs 20 percent of surface soils. Dozer piling and site preparation disturb another 20 to 25 percent for a total disturbed area of roughly 40 percent, although most of that disturbance is considered to be slight. Areas of slight disturbance (scarification) have a negligible effect on soil productivity and encourage seedling establishment. We estimate that ground-based logging causes moderate compaction and displacement on about ten percent of the area logged, and severe compaction and displacement on about 7.5 percent, based on recent monitoring efforts and research (USDA, DNRC monitoring).

Expected Future Conditions

DESCRIPTOR: MANAGEMENT-INDUCED SOIL COMPACTION AND DISPLACEMENT	
EFFECTS OF ALPHA Alpha ranks third in terms of projected timber harvest and third in projected road density. We expect that from 21 to 42 percent of state lands would be subject to ground-based machinery activity under this alternative, which means that from 6.7 to 13.3 percent of forested state lands could face an increased risk of detrimental effects from compaction and displacement.	EFFECTS OF BETA Beta ranks fifth in projected timber harvest and fourth in road density. We project that between 18 and 41 percent of state lands would be subject to ground-based machinery under Beta, which means that from 5.0 to 11.6 percent of state lands could face an increased risk of detrimental effects from compaction and displacement.
EFFECTS OF GAMMA Gamma has the lowest harvest level and road density estimates, along with a program to close and rehabilitate road as often as possible. Under Gamma, we expect that between 5 and 11 percent of state lands would be affected by ground-based machinery activity, which means that from 1.7 to 3.3 percent of state lands could face an increased risk of detrimental effects from compaction and displacement.	EFFECTS OF DELTA The harvest level estimates for Delta are the third highest, while its road density estimate is second highest. We estimate the area at increased risk of detrimental effects from compaction and displacement due to ground based machinery activity at from 5.0 to 9.8 percent of state lands. However, the likelihood of greater recreational development under Delta could increase the area of compaction and displacement due to developments with intense use such as parking areas, ski trails, and so forth.
EFFECTS OF EPSILON Epsilon has the highest projected timber harvest and road density levels, and the highest potential to increase soil compaction. Under Epsilon, we expect that between 37 and 58 percent of state lands would be affected by ground based machinery activity, which means that from 11.6 to 18.5 percent of state lands would face an increased risk of detrimental effects from compaction and displacement.	EFFECTS OF ZETA The projected harvest and road density levels for Zeta are the second lowest of the alternatives. Area at an increased risk of detrimental effects from compaction and displacement from ground-based machinery activity is estimated to be from 3.4 to 6.7 percent of state lands. However, the greater recreational development that would occur under Zeta could increase the area of compaction and displacement due to development of hiking trails, parking areas, ski trails, and so forth.

DESCRIPTOR: MANAGEMENT-INDUCED SOIL COMPACTION AND DISPLACEMENT
EFFECTS OF OMEGA Omega has the second highest projected timber harvest and fourth in project road density. We expect that 31 to 53 percent of forested lands would be subject to ground-based machinery under Omega, which means that 9.9 to 16.7 percent of forested lands would be subject to short and long-term effects to productivity. On a per-acre basis, the area of detrimental soil effects would be less than Epsilon, Alpha or Delta.

CUMULATIVE EFFECTS

Effects of ALPHA, DELTA, and EPSILON

Implementing the Alpha, Epsilon, and to a lesser extent Delta, alternatives would have a greater total area of detrimental effects to soils because of their higher levels of timber harvest and road construction. They would maintain a level of snag retention and woody debris that would help maintain roughly 80 percent of soil nutrients and their associated productivity. The exception would be the detrimental effects of timber harvest and whole tree skidding on moderate to low productivity sites where adequate woody debris was not retained.

Effects of BETA

Beta would maintain soil productivity by implementing more intensive forest management and mitigation measures. We would maintain 80% of the productive capacity of soils, on average, by limiting the area of detrimental effects. The impact of Beta on soil nutrients, soil compaction and displacement, and erosion would be less than that of Alpha, Delta, Epsilon and Omega but more than Gamma and Zeta.

Effects of GAMMA and ZETA

The Gamma and Zeta alternatives would maintain long-term soil productivity because of their lower scale of harvest and land management than all the other alternatives. Gamma would provide the greatest soil protection by avoiding activities that would have a significant environmental impact. We would maintain 90 percent of soil productive capacity on average by limiting the degree of soil effects with special mitigation measures. Zeta would seek to increase the value of state lands as recreational sites, which in most cases would mean protecting soil value in order to promote healthy forest ecosystems.

Effects of OMEGA

Omega would maintain soil productivity by implementing more intensive forest management and mitigation measures than Alpha, Delta or Epsilon. We would maintain 80-90% of the productive capacity of the soils on projects by limiting the area of detrimental effects and retaining woody debris for long-term soil nutrients. Two exceptions would be on limited sites where: (1) detrimental effects of timber harvest and whole tree skidding occurred on low productivity sites where adequate woody debris was not retained; and (2) enhanced productivity on timber stands were economically feasible to fertilize.

SUMMARY

Under all alternatives, we would consider soil properties and limitations before undertaking projects to reduce the soil impacts associated with management activities. Under all alternatives, we would try to avoid activities expected to cause significant environmental impacts. Under some alternatives, however, a higher risk of impact on soils would be considered acceptable. Delta and Epsilon would accept a higher risk of impact and in some cases our activities under those alternatives might cause significant cumulative effects on forest soils.

Cumulative effects to soils may result from increasing the areal extent of soil impacts over time, so that alternatives with a higher level of management activity are more likely to impact soil productivity. Road building effects, erosion, and local slope instability permanently remove soil from vegetative production. Of all harvest activities, only ground-based operations have cumulative, long-term effects on soil productivity; cable and helicopter harvest have negligible effects on soils within a forested stand. Cumulative effects are most likely to occur with silvicultural treatments that require multiple entries, such as uneven-age timber management, where equipment enters a stand every 20 or 30 years. Development of recreational sites can impact soil productivity by increasing areas of compaction, displacement, and erosion.

Under all alternatives, we would monitor the effectiveness of mitigation measures and impacts to soils on a limited number of sites. We would use this information to evaluate needs to adjust mitigation measures and management practices to reduce soil impacts or apply rehabilitation measures where appropriate.

Table IV-S2 below summarizes our assumptions about the effects of each alternative on the factors that impact soils.

Table IV-S2
DETRIMENTAL EFFECTS TO SOILS BY ALTERNATIVE

	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
Estimated Harvest Level Range							
(MMBF per year)	20-40	15-35	5-10	15-45	35-55	10-20	35-50
Total Area of Land Managed over Life of Plan (25 Years)							
Acres (000)	148-290	111-253	37-74	111-216	253-401	74-148	216-364
Percentage of Total	24-47	18-41	6-12	18-35	41-65	12-24	35-59
Estimated Road Area							
(Mi/Mi^2)	2.5-3.0	2.3-2.8	2.0-2.1	2.4-3.2	2.9-3.3	2.2-2.5	2.6-2.9
Ground-based Harvest Area (90% of Land Managed)							
Acres (000)	133-260	100-228	33-67	100-194	228-361	67-133	194-328
% of DNRC Forest Land	21-42	16-37	5-11	16-31	37-58	11-21	31-53
Ground-based Harvest Area Protected by Special Mitigation Measures							
Acres (000)	34-65	25-57	8-17	25-49	57-90	17-33	49-82
Total Area of Long-term (Irreversible) Soil Effects[1]							
Harvest effects (000 ac)	14-28	11-24	4-7	11-21	25-39	7-14	21-35
Road Acres (000)	23-54	16-44	9-10	17-43	46-83	10-23	35-66
% of forested land[2]	2.7-5.4	2.0-4.7	.7-1.3	2.0-4.1	4.7-7.6	1.4-2.7	4.0-6.8
Area of Short- and Intermediate-term Soil Effects							
Acres (000)	25-49	19-42	6-12	19-36	42-67	12-24	36-61
% of Land Managed[3]	4.0-7.9	3.0-6.9	1.0-2.0	3.0-5.7	6.9-10.9	2.0-4.0	5.9-9.9

[1] Includes area committed to roads, skid trails, and landings which will not be returned to productive use.

[2] These are areas of reduced soil productivity estimated to last up to 50 years.

[3] Percent of all state forest land (i.e., no. of acres managed/616,846)

WATERSHED

INTRODUCTION

In this section we describe the environmental impacts of each alternative on our watershed resource, as well as the analysis methods utilized. It is important to note that this analysis is, by necessity, general in nature.

It is beyond our capabilities to precisely quantify the effects of different management scenarios at the programmatic level. For this reason, the following analysis is based on plausible management scenarios which are used to approximate the range of impacts. Certain aspects of each alternative are not explicitly reflected in the effects assessment. For example, the width of Streamside Management Zones (SMZs) prescribed in the Watershed RMS varies between alternatives. All alternatives meet legal requirements, but SMZs of greater width provide a lower degree of risk to watershed values. This relationship is not directly incorporated into the analysis, however, it is indirectly reflected through the volume of timber harvested. Another example of an implicit relationship in the analysis is that of riparian standards. Varying levels of riparian standards are proposed in the Grazing RMS. These will affect the magnitude of impacts to water quality. These impacts, however, are quantified in this effects analysis only to the extent that implementation of the RMS will alter the total number of animal unit months (AUMs) on State land.

There are limitations to this type of analysis. The results presented below should act as a guide to the general ranking of alternatives but there are other factors which can only be considered by understanding the general philosophy and specific RMS for each alternative. Care should be taken in applying the following results in isolation of the entire text of this document.

METHODOLOGY

Two broad measures were used describe the current condition of the state forested lands watershed resource. The first comes from a biennial report called the Montana §305(b) report, prepared by the Water Quality Division of the Montana Department of Environmental Quality (MDEQ).[4] The Montana §305(b) report details the impairment of stream and lake waterbodies throughout the state. This report classifies waterbodies as Fully Supporting, Threatened, Partially Supporting, or Not Fully Supporting. We assume that the lands affected by this plan are adequately depicted in the Montana §305(b) report. This may be a conservative assumption, because there is evidence that the State's management of its water resource on forested tracts is better than the average for all forest ownerships (Schultz 1990; Schultz 1992; Frank 1994).

The second broad measure of current conditions describes wetland and riparian areas. We delineate wetlands and riparian areas as either Functional, Functional-At Risk, or Non-Functional based on information from the Montana Riparian/Wetland Association (MRWA) (Hansen, personal communication).

Once again, we assume the MRWA assessment of the state of Montana's riparian and wetland resources adequately reflects the condition of these areas on state lands. Since no inventory of riparian condition exists for state land, the MRWA general assessment is the best available information.

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[4] Formerly the Water Quality Bureau of the Montana Department of Health and Environmental Sciences.

THE EFFECTS ASSESSMENT

Watershed processes are influenced by both natural and human activities and may affect watersheds separately or in combination. To determine the extent of management impacts upon an individual watershed, we would ideally quantify and understand the inherent variability of natural disturbances prior to any effects assessment, but in reality we can only qualify and interpret. The size and scope of this plan is such that quantifying potential impacts to individual watersheds statewide is not feasible, even if there were a protocol to perform such analyses. In order to assess the effects of management related activities on watershed processes, we developed a method which allowed specific changes unique to each alternative to be analyzed and compared. We performed the analysis for each DNRC land office and for the statewide total of land affected by the plan. This analysis is combined with a qualitative evaluation of the mitigation measures (RMS) that have been developed for each alternative. As stated above, the results of this analysis should be interpreted in light of the pertinent RMS.

We predicted the impact of land management activities on water resources by estimating the changes in the following descriptors:

Sediment Levels in Streams and Lakes
Nutrient Levels in Streams and Lakes

The watershed effects assessment considered management-induced changes to timber harvest level (million board feet, or MMBF), the percentage of timber harvests consisting of clearcut or seed tree methods, road density (mi/mi^2), number of AUMs grazed, and numbers of Group I recreation sites. We assumed that timber harvest and road building activities have the greatest potential impact on state lands watersheds. Road building was assumed to be primarily associated with timber harvest activities on state land. We used harvest level and road density estimates to predict changes in ground disturbance levels associated with timber management. Since sediment and nutrient loading are associated with ground disturbance levels, we assumed these parameters would allow for comparison of effects between alternatives.

The type of harvest treatment method was used to predict changes in vegetative crown removal. We assumed that greater percentages of land harvested with clearcut or seed tree methods would contribute greater amounts of sediment or nutrients available for delivery to streams and lakes.

We assumed that the number of AUMs grazed is related at least indirectly to the amount of sediment and nutrients introduced to streams. The number of livestock grazed in riparian or streamside areas would give a more direct index to streambank or vegetation impacts. However, those numbers are not available, so we used total AUMs as a comparative tool. Numbers of AUMs from grazing scenarios developed by DNRC personnel were used to reflect changes by alternative.

Group I recreation use includes all home and cabinsites, developed campgrounds, and other dispersed and concentrated uses. The number of these sites was assumed to correlate with direct, indirect, and cumulative impacts to waterbodies. The numbers used were taken from recreation scenarios developed by DNRC personnel to predict changes in Group I sites for each alternative. Since numbers and distribution of Group I sites are limited, we assumed the overall contribution of such sites to sediment and nutrient levels would be small in comparison to grazing and timber harvest activities.

We weighted the impacts associated with each category of disturbance in order to take into account the relative severity, importance, or complexity of each category. In our analysis, we assumed timber harvest activities accounted for 60 percent of the direct, indirect, and cumulative impacts generally seen at the watershed level. Grazing accounted for 30 percent and recreation for 10 percent of potential impacts. These numbers are only intended to reflect the relative impact of each category in order to perform a comparative effects assessment. We derived the factors using the following reasoning:

Timber Harvest: Most road construction and land disturbance on forested state-owned land is associated with timber harvest. The timber harvest portion of this plan applies to all forested state owned land.

Grazing: Grazing accounts for very little if any road construction. The grazing portion of this plan applies only to classified Forest lands.

Recreation: The area affected by recreation sites is smaller than that affected by timber and grazing. Only a small amount of road construction is generally associated with recreation sites.

We developed an effects assessment matrix to rate the contribution of each impact category and assigned an overall impact rating for each alternative. These ratings were then ranked. This process was conducted for each Land Office and Statewide, on both the high and low-level scenarios. The Statewide high scenario ranking is reported in Table IV-W1. The steps in deriving this rating are as follows:

1) We divided the predicted level of activity by the current levels. Current levels of timber harvest variables were based on an average of the last five years of DSL/DNRC timber sales. For grazing and recreation, we used current program levels as a base.

2) The resulting quotient was then assigned a rating based on the percent change from the existing levels. For instance, if the number of AUMs was estimated to decrease by 20% from existing levels the quotient would be 0.8. This would receive a rating of 1. The ratings were as follows: 0 percent change = 0, 1-25 percent change = 1, 26-50 percent change = 2, 51-75 percent change = 3, 76-100 percent change = 4, and >100 percent change = 5. Increased levels (i.e., quotients >1) were assigned negative ratings.

3) Each rating related to timber harvest (harvest level, % in clearcut and seedtree, and road density) was then multiplied by the weighting factor of 0.6. These products were then averaged. The grazing rating was multiplied by the weighting factor of 0.3. The recreation rating was multiplied by the weighting factor of 0.1. The figures obtained from each of these weightings were summed for each alternative to yield an overall impact rating.

4) Each alternative was then ranked based on the overall rating derived in Step 3. Lower numbers equate to lower potential impacts.

Table IV-W1
WATERSHED EFFECTS RANKING
BY ALTERNATIVE

	Alpha	Beta	Gamma	Delta	Epsilon	Zeta	Omega
Sediment and Nutrient Loading Risk (1=lowest risk)	7	3	1	4/5	6	2	4/5

ENVIRONMENTAL CONSEQUENCES FOR WATERSHED

In the following section we will outline the predicted effect on sediment and nutrient levels of each alternative. We will first explain effects common to all alternatives, and then effects specific to individual alternatives.

DIRECT AND INDIRECT EFFECTS

Sediment and Nutrient Levels

The Descriptor Relationship

State forest management activities will affect two important components of water quality: sediment and nutrient levels. Each alternative has the potential to change the amount of sediment and nutrients introduced to streams and lakes. However, the degree of change and its positive or negative impact will vary by alternative and Land Office.

Although we cannot quantify how the broad scale descriptors of watersheds will change as a result of State forest management activities, we can estimate the relative potential in each alternative for positive or negative effects on the water resource.

The variation in the level of impact on sediment and nutrient levels between alternatives is reduced by the fact that most of the watershed standards that apply to management activities do not vary between alternatives. Where the resource standards do vary, water quality standards must still be met. The variations in level of impact are, therefore related primarily to the level of disturbance. With BMPs applied at the current levels, we anticipate some minor level of impact. For example, even with full compliance with BMPs, a culvert installation may likely result in a minor amount of sediment being introduced to the stream. If all "reasonable land, soil, and water conservation practices" and permit requirements are applied, the activity complies with water quality standards.

Expected Future Conditions

DESCRIPTOR: SEDIMENT AND NUTRIENT LEVELS	
EFFECTS COMMON TO ALL ALTERNATIVES Timber harvest will continue under all alternatives. Some impacts, primarily short-term, are anticipated and are related to the amount and type of harvest. Roads are a primary source of sediment and associated nutrients. Overall road density will likely increase at least slightly under each alternative. We would expect sediment and nutrient loadings to increase in the years during and immediately following road construction, reconstruction, or significant maintenance. These increases would be expected to greatly diminish in years following the cessation of construction activity and with the stabilization of the road bed and revegetation of cut and fill slopes. We expect that the proper application of BMPs and DNRC road RMS will keep increases in sediment and nutrient loadings to streams and lakes to as low a level as is technologically feasible. No alternative is predicted to change the current trends in sediment and nutrient levels related to grazing east of the Continental Divide, since the stricter riparian grazing standards will not apply to these lands. The level of recreation development will affect sediment and nutrient loading, and all alternatives will see some development of recreational uses. Numerous laws, regulations and standards will guide this development. If low management levels are used, sediment and nutrients would be expected to decrease statewide under all alternatives, although each alternative would likely still result in increases in specific Land Office areas.	
EFFECTS OF ALPHA Alpha is generally rated as the highest impact alternative primarily because Alpha does not include riparian standards for grazing. Alpha would increase the sedimentation and nutrient levels in all land offices if high management levels were used, and it may increase them more than any other alternative. At low management levels, we would expect sediment and nutrients to decrease in all areas except the ELO, where they could increase.	EFFECTS OF BETA Beta would increase the sedimentation and nutrient levels in all land offices if the high management levels were used, but not as much as under Alpha, Delta, Epsilon or Omega. At low management levels, Beta would probably decrease sediment and nutrient levels in all areas. We expect Beta to be the third lowest impact alternative under all scenarios.

<table>
<tr><th colspan="2">DESCRIPTOR: SEDIMENT AND NUTRIENT LEVELS</th></tr>
<tr><td>EFFECTS OF GAMMA

Gamma has the lowest anticipated impact for all Land Offices and statewide, due to its low levels of timber harvest, grazing, and recreation. Gamma would lead to expected sediment and nutrient loadings ranging from amounts somewhat to significantly lower than existing conditions. This interpretation is based upon lower projected amounts of timber harvested, fewer clearcut and seed tree harvest treatments, fewer AUMs grazed, and a higher degree of direct DNRC riparian area management.</td><td>EFFECTS OF DELTA

Delta would probably increase the sedimentation and nutrient levels in all land office areas if high management levels were used. We expect impact on sediment and nutrient levels under Delta to be third highest, tied with Omega and after Alpha and Epsilon. At low management levels, Delta would probably decrease sediment and nutrient levels in all areas except the ELO, where we expect it would have no effect.</td></tr>
<tr><td>EFFECTS OF EPSILON

Epsilon has the second highest level of impact due primarily to its expected large timber harvest. Under high management levels, Epsilon would probably increase the sedimentation and nutrient levels in all land office areas, while under low management levels we expect it to cause little or no change.</td><td>EFFECTS OF ZETA

Zeta would have the second lowest level of impact, due primarily to its low timber harvest level estimates. Zeta would lead to expected sediment and nutrient loadings ranging from amounts essentially similar to existing conditions to amounts somewhat lower. This interpretation is based upon lower projected amounts of timber harvested, fewer clearcut and seed tree harvest treatments, fewer AUMs grazed, and a higher degree of direct DNRC riparian area management.</td></tr>
<tr><td colspan="2">EFFECTS OF OMEGA

From a Statewide perspective, Omega is anticipated to have the third largest impact (tied with Delta and after Alpha and Epsilon) on sediment and nutrient levels at high management levels and the second largest impact (after Epsilon) at low management levels. The relatively high harvest and roading levels in Omega are offset somewhat by the RMS regarding roads and riparian management. In addition, riparian grazing standards are reflected in this analysis indirectly through the number of anticipated AUMs and will lower sediment and nutrient delivery from existing levels.</td></tr>
</table>

CUMULATIVE EFFECTS

Changes in predicted sediment and nutrient loadings are the result of the cumulative nature of management activities. The effects assessment is driven primarily by timber harvest levels and associated road construction. If timber harvest levels are reduced, the effect may be a lowering of sedimentation and nutrient levels. If timber harvest levels are increased, the effect may be an increase in sedimentation and nutrient levels. Watershed restoration efforts will reduce the level of impact. Other land uses, such as recreation, may also result in impacts to watersheds. The effects of adjoining landowners' management activities in watersheds of co-ownership are a concern and can impact activities undertaken on state lands. In other words, effects from increases in one management activity may be offset by reductions in another activity. Cumulatively, these effects may compound or diminish sediment and nutrient concentrations.

The generally scattered distribution of DNRC land parcels makes the assessment of expected impacts complicated on a programmatic level. We will continue to utilize project level risk assessment no matter which alternative is selected. Professional judgment, watershed modeling, and field assessment of watershed condition are required to determine risk at the project level. Due to the scattered nature and relatively small acreage of DNRC's land base and the fact that all alternatives meet or exceed water quality standards, we anticipate that implementing any of the alternatives will have no measurable detrimental impact on future statewide assessments of impaired streams completed by the Water Quality Division. However, there is the potential that watershed restoration work may result in removing a stream from the impaired list.

AIR QUALITY

INTRODUCTION

In this section we describe the environmental impact on air quality of each alternative, and the methodology we use to estimate those impacts. In the Executive Summary, we presented a summary table of the environmental consequences of each alternative management plan.

METHODOLOGY

Our method of measuring air quality is based on expected changes in the following two descriptors:

Particulate from Wildfires
Particulate from Prescribed Burning

We predict changes in wildfire particulate from expected changes in vegetative conditions, which should influence the acreage and intensity of wildfires. We use the estimated timber harvest levels under each alternative to predict changes in particulate from prescribed burning.

Both wildfires and prescribed fires burn in a variety of fuels and atmospheric conditions, resulting in a large variation in the amount of smoke produced per acre burned or volume of fuel. However, we assume that these variables can be averaged over a period of time in a given region. Consequently, we assume that both the amount of particulate produced and the impact on air quality are approximately proportional to the acreage burned in wildfires.

With prescribed burns, we assume that these effects are proportional to the volume of timber harvested. While the amount of burning needed per thousand board feet of harvest can vary greatly, we believe that these variations can be reasonably averaged over a period of time.

ANALYSIS PROCEDURE FOR PARTICULATE FROM WILDFIRE

We expect the amount of particulate emissions from wildfires to continue to be roughly proportional to the acreage burned in wildfires. Particulate amounts will also be influenced by changes in the amount of available fuels per acre.

We estimate changes in the future acreage and intensity of wildfire under each alternative from predicted changes in vegetative conditions, as described in the vegetation analysis. Specifically, changes in forest type and stocking levels are likely to influence the size and intensity of wildfires. They have a direct influence by changing the amount of live fuels available to crown fires. They also have an indirect effect through their influence on insect and disease levels, which create additional dead fuels.

Changes in vegetative conditions on adjacent ownerships as well as those on state lands would have some influence on wildfire levels. Fires starting on one ownership and escaping control can spread to other lands.

ANALYSIS PROCEDURE FOR PARTICULATE FROM PRESCRIBED BURNING

We use estimated changes in timber harvest levels under each alternative to estimate the changes in air quality from prescribed burning. We assume that the amount of slash to be burned and the average resulting particulate emissions per thousand board feet harvested will remain similar to current rates for all alternatives. There could be differences between alternatives in slash disposal and site preparation methods, and in typical fuels and dispersion conditions at the time of burning, but we see no clear basis for predicting different average rates of particulate emissions.

ENVIRONMENTAL CONSEQUENCES FOR AIR QUALITY

In the following section, we will outline predicted effects of both descriptors. We will first describe effects common to all alternatives, if there are such effects, and then effects specific to individual alternatives.

DIRECT AND INDIRECT EFFECTS

Particulate from Wildfires

The Descriptor Relationship

The intensity and size of wildfires is already increasing throughout the Inland West because of past and current fire suppression and timber harvest practices. This increases the difficulty of fire control and leads to larger burn acreages (Covington et al. 1994). We also expect increases in fuel loadings to result in more particulate emissions per acre burned. Fires in heavy fuels tend to smolder longer, which increases the amount of smoke produced per ton of fuel burned (Prescribed Fire and Fire Effects Working Team 1985). These factors will increase the likelihood of air quality impacts from wildfires.

Forest management practices involving timber harvests, often in combination with prescribed burning, can be used to reduce stocking and lower fuel levels, helping to reduce the chances for intense wildfires and associated air quality impacts. Prescribed burning may also be useful by itself in areas where harvesting is excluded or infeasible. (Arno and Brown 1989, Habeck 1990, Mutch et al. 1993).

Expected Future Conditions

DESCRIPTOR: PARTICULATE FROM WILDFIRE	
EFFECTS OF ALPHA, BETA, DELTA, EPSILON & OMEGA	EFFECTS OF GAMMA AND ZETA
Based on the vegetation analysis, it appears that these alternatives have some potential to reduce the level of wildfire intensity on state lands. At the high harvest level estimates, reductions in overall stocking levels and shifts toward early-successional forest types would reduce the likelihood of wildfire impacts on air quality. However, at the low harvest level estimates for these alternatives, the trend toward greater fire intensities and associated particulate production can be expected to continue.	The Gamma and Zeta alternatives can be expected to continue the trend toward higher fire intensities and associated particulate production because of lower harvest levels and subsequent build-up in fuel loading levels.

Particulate from Prescribed Burning

The Descriptor Relationship

State forest land management activities produce smoke particulate in prescribed burns for slash disposal and forest site preparation.

Expected Future Conditions

The relative changes we predict in particulate emissions from prescribed burning on state lands from 1982-91 levels are shown in Table IV-A1. These percentages are based on the ratio of harvest volume estimates in each alternative to the average harvest volume during the 1982-91 period.

Table IV-A1
PREDICTED CHANGES IN PARTICULATE EMISSIONS FROM PRESCRIBED BURNING ON STATE FOREST LANDS

(1982-91 level = 100%)

Alternative	High Harvest Level Estimate	Low Harvest Level Estimate
Alpha	120%	60%
Beta	105%	45%
Gamma	30%	15%
Delta	135%	45%
Epsilon	165%	105%
Zeta	60%	30%
Omega	150%	90%

DESCRIPTOR: PARTICULATE FROM PRESCRIBED BURNING	
EFFECTS COMMON TO ALL ALTERNATIVES Timber harvest across ownerships is most likely to decline between now and 2010, according to Flowers et al. (1993). As a result, we expect total particulate from prescribed burning to decline correspondingly. An increase in prescribed burning not related to timber harvest, such as burning for wildlife habitat improvement or ecosystem restoration, could prevent this decline.	
EFFECTS OF ALPHA, BETA, DELTA, EPSILON AND OMEGA	EFFECTS OF GAMMA AND ZETA
Predicted particulate emission levels from state lands would increase at least slightly under the Epsilon, and under the high harvest level estimates for the Alpha, Beta, Delta and Omega alternatives. Predicted levels would decrease under the low harvest level estimates for Alpha, Beta, Delta and Omega.	Predicted particulate emission levels from state lands would decrease under these alternatives.

CUMULATIVE EFFECTS

In the following section we will combine the effects of the descriptors and the impact of past and present actions to determine the overall impact on air quality of each proposed alternative. The contribution of state forests to overall air quality is small, as state forests only comprise about three percent of all forested land in Montana.

The high wildfire frequency in pre-settlement forests probably resulted in frequent episodes of poor air quality in the Inland West (Mutch et al. 1993). Fire exclusion has reduced the extent of these episodes, but has also resulted in forest conditions conducive to larger, more intense wildfires. Consequently, the opportunity for future episodes of poor air quality related to wildfires is increasing (Covington et al. 1994).

State forests may contribute toward reduction of these trends at the high harvest level estimates under the Alpha, Beta, Delta and Epsilon alternatives. Under other scenarios, state lands would contribute toward increased likelihood of poor air quality related to wildfires. Omega, with its harvest levels higher than Beta, and its emphasis on restoring historic vegetation conditions, may reduce the likelihood of intense wildfires within the harvest range proposed.

On state lands, the alternatives that would produce the highest level of particulate from prescribed burning (Epsilon, Alpha, Delta, Omega, and Beta at the high harvest level estimates) are those that would tend toward reduced likelihood of particulate from wildfire. Thus, prescribed burning may tend to counteract contributions to improved air quality from reduced wildfire extent. Similarly, the predicted overall increase in the size and severity of wildfires may tend to counteract the reduced particulate from harvest-related burning under Gamma, Zeta, and the low harvest level estimates of Beta and Delta.

The timing of prescribed burning impacts would be different from wildfire-related impacts and will determine whether an alternative reduces or increases particulate levels. Wildfires and associated air quality impacts occur most often in late summer, while prescribed burning is usually done in the fall and spring. Fall burning is more likely to result in air quality impacts because dispersion tends to be poorer than in the spring and summer. However, air quality impacts of prescribed fall burning are minimized through compliance with state air quality regulations. Prescribed burning is regulated through the Montana-Idaho Smoke Management Group (described in Chapter III), which forecasts conditions and issues restrictions when poor dispersion is expected.

SUMMARY

Prescribed burning is sometimes implicated for its adverse effects on air quality, especially in the fall. However, recent evaluations suggest that substantial amounts of prescribed burning, in conjunction with appropriate types of timber harvest, may be necessary to avoid even greater deterioration of air quality in the summer months due to increased wildfire severity (Mutch et al. 1993, Covington et al. 1994).

FOREST VEGETATION

INTRODUCTION

In this section, we predict trends in the forest vegetative environment for seven descriptors under the management philosophy of each alternative and summarize our analysis in terms of forest health. Forest health has been defined by O'Laughlin et al. (1993) as "a condition for forest ecosystems that sustains their complexity while providing for human needs." Defined as such, forest health refers to the integrity of forest ecosystems as well as our ability to meet management objectives. In terms of ecological integrity, a healthy forest is one that maintains all of its natural functions. A forest can be considered unhealthy if levels of stress, insects, pathogens, or wildfire threaten the values people place on the forest. These values include both commodities such as timber, as well as concerns such as water quality, aesthetics, and wildlife habitat (Monnig and Byler 1992, O'Laughlin et al. 1993).

METHODOLOGY

DESCRIPTORS

We characterized the forest environment in terms of the seven ecological groups and seven descriptors:

Stand Size Classes
Stand Age Distribution
Forest Types
Stocking Levels
Old-growth
Snag Abundance
Patch Sizes and Shapes

HISTORICAL AND CURRENT CONDITIONS

Once we had defined descriptors that could serve as indicators of forest condition we were able to delineate the current condition of state forested lands, using quantitative inventory data to describe the condition where feasible. Where useful quantitative data was not available, we outlined general trends and conditions. In addition, we included information on the existing condition of Montana forest lands in general to ensure that state lands were described in terms of their overall setting.

In order to fully understand existing conditions, however, we found it necessary to compare them to historical conditions, which helped us identify how human activities have already changed natural conditions and processes. In this way, we could develop a truer picture of the cumulative effects of human activities. These comparisons also provided us with some information on the sustainability of past timber harvest levels and other forest uses.

Our primary source of information on historical conditions was a comprehensive statewide forest inventory conducted in the 1930s and 1940s (Hutchison and Kemp 1952). We also used other sources of historical information and ecological studies where appropriate to describe past conditions and trends.

To derive current quantitative information, we drew upon late-1980s statewide inventory data compiled in a report by Conner and O'Brien (1993). We also included more detailed data from the 1980s statewide inventory contained in DNRC Trust Land Management Division files. In addition, Flowers et al. (1993) provided us with a summary of information from various statewide forest inventories, including adjustments for different measurement standards used in earlier inventories.

Through these sources we were able to examine the condition of state forested lands according to the data provided on our seven descriptors, considering both their current condition, as well as changes from the historic condition caused by human activities.

THE EFFECTS ASSESSMENT

Timber harvests, along with continued fire suppression, are likely to have the strongest impacts on development of vegetative communities. Therefore, we used the range of possible harvest levels as the starting point in predicting changes in forest conditions. The types of timber harvest, and where and when harvests are done, will also be important influences and are evaluated. To protect public safety and property, we are required by law to suppress wildfire on state lands, so we have assumed that fire suppression will continue to affect forest conditions. Other factors we considered include grazing practices and road management.

We developed estimates of sustainable annual cut levels using projections from forest inventory data including growth rates. We based these calculations on the assumption that all non-deferred state forest lands (excluding Eastside Land Offices) would be completely harvested over a period of years. "Deferred" forest lands are primarily areas that are inoperable or inaccessible due to steep slopes or high water tables, and areas with other land uses that preclude timber harvest.

Estimated sustainable annual cut levels range from 65 million board feet (MMBF) per year for an 80-year rotation, to 55 MMBF per year for a 120-year rotation (see Table IV-V1). For the purposes of this analysis, we used an annual cut level of 55 MMBF per year, which appears to be a prudently conservative (but not risk-free) level.

This annual cut level represents an estimate of the annual volume that could be harvested from all non-deferred forest lands, in balance with long-term tree growth. In other words, it is the amount of timber we believe we would want to harvest annually if our only goal were to maintain long-term timber growth at the highest feasible level. It does not include any allowance for "space and time" constraints that prevent harvest in a given area at a particular time. These constraints include such items as cumulative watershed effects and meeting standards for wildlife cover in a particular area. Such constraints may prevent harvesting at the 55 MMBF per year level, even under an alternative such as Epsilon, which is designed to harvest the volume at the "high" level indicated in the timber scenarios (see Appendix SCN). The anticipated effect of space and time constraints is part of the rationale for the range of possible harvest levels we have estimated for each alternative.

Table IV-V1
ESTIMATED SUSTAINABLE ANNUAL CUT LEVELS BY LAND OFFICE

Land Office	Percent Land Area (Volume) Deferred	MMBF/Yr: Annual Cut by Rotation Period 80 Yr.	100 Yr.	120 Yr.
NWLO	22% (25%)	44.0	39.8	37.0
SWLO	16% (17%)	19.3	17.2	15.8
CLO	76% (84%)	1.8	1.7	1.7
NELO/ELO/SLO*	76% (N/A)	0.0	0.0	0.0
TOTALS	35% (N/A)	65.1	58.7	54.5

* Deferred lands were not mapped for the Eastside Land Offices, so CLO area deferral estimates were used. No annual cut determination was made for Eastside Land Offices.

The high and low annual cut estimates for each alternative can be compared to the 55 MMBF per year high harvest level estimate, to determine what proportion of the non-deferred forest land area would need be managed for timber production to achieve this level. For example, we would have to manage an estimated 64 percent of the non-deferred land area for timber production to sustain a level of 35 MMBF (35/55) per year. Forests on the remaining 36 percent of the non-deferred forest land, as well as all of the deferred land, could remain untreated indefinitely. The proportion of the area treated between now and the year 2020 would most likely be somewhat less.

The proportions of forest land managed for timber production, as shown in Table IV-V1, should be understood as an index of treatment level only. "Untreated" areas could range in size from individual trees or patches within stands, to entire parcels. Their locations could also change over time, resulting in longer rotations or cutting cycles on some or all lands. In any case, however, these areas represent the proportion of the forest that would be allowed to grow progressively older and more heavily stocked, with reduced growth rates and increased mortality of trees eventually limiting further stand development.

The predicted effects of different treatment levels could occur with either even-age or uneven-age management. Under uneven-age management, harvested areas would consist of patches within stands, sometimes as small as the area occupied by individual mature trees, rather than entire stands. Predictions of future stand size classes and age classes must be understood in this context.

Specific approaches to silvicultural treatment and trends in stand development would depend somewhat on the management approach and standards described for each alternative. We used provisions within each alternative to describe what kinds of stands would be harvested at various times, and how these harvests would be done. We used these harvest method predictions, in turn, to project future characteristics of the forest. We also considered the influences of management practices other than timber harvest for their influences on vegetation.

Under all alternatives, our choice of cutting method would continue to be a site-specific decision based on site characteristics, stand conditions, and treatment objectives. However, the management approach within each alternative would have a substantial effect on how we would make these decisions. Our predicted distribution of harvested acres by cutting method under each alternative is summarized in Table IV-V2. For a more detailed explanation of how we made these estimates, see Appendix SCN.

Table IV-V2
PREDICTED DISTRIBUTION OF HARVEST ACREAGE BY CUTTING METHOD FOR EACH ALTERNATIVE

	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
Clearcut	10%	10%	0%	10%	10%	5%	10%
Seed Tree[1]	30%	25%	5%	25%	30%	15%	25%
Shelterwood	5%	5%	10%	5%	10%	5%	5%
Selection[2]	35%	40%	55%	35%	30%	50%	40%
Intermediate[3]	20%	20%	30%	25%	20%	25%	20%

[1] Includes seed tree removals.
[2] Includes individual-tree and group selection.
[3] Includes commercial thinning, improvement cutting, overstory removals, sanitation and salvage cutting.

We used our understanding of the existing conditions and natural processes within the different Ecological Groups to predict the environmental effects with and without timber management. In this way we developed estimates for the future condition of each descriptor. These estimates may consist of absolute numbers (e.g. acres by stand age class in the year 2020), or of trend predictions (e.g. a net increase or decrease in the number of large forest patches).

Table IV-V3
HARVEST LEVELS (MMBF/YR.) AND PROPORTION OF AREA MANAGED FOR TIMBER BY ALTERNATIVE

	HIGH ESTIMATE			LOW ESTIMATE		
		Percent Land Managed for Timber Production				
Alternative	Volume (MMBF/Yr.)	Non-deferred	All	Volume (MMBF/Yr.)	Non-deferred	All
Alpha	40	73%	47%	20	36%	24%
Beta	35	64%	41%	15	27%	18%
Gamma	10	18%	12%	5	9%	6%
Delta	45	82%	53%	15	27%	18%
Epsilon	55	100%	65%	35	64%	41%
Zeta	20	36%	24%	10	18%	12%
Omega	50	91%	59%	30	55%	35%

ENVIRONMENTAL CONSEQUENCES FOR VEGETATION

In the following section, we will outline the predicted effects of each alternative on the individual descriptors. Included in this section is a definition of each descriptor, an explanation of its value in determining forest conditions, and discussion of its current status in Montana and on State trust lands. At the end of this section we look at the cumulative effects of each alternative by combining the effects on each descriptor to develop a portrait of state lands' forest health under each alternative's management philosophy.

DIRECT AND INDIRECT EFFECTS

Stand Size Classes

The Descriptor Relationship

This descriptor represents the acreage of forest lands by stand size class. We classify stands as nonstocked; seedling/sapling stands (dominated by trees < 5" DBH); pole stands (5-9" DBH); and sawtimber stands (> 9" DBH). For some purposes, it is useful to further classify sawtimber stands as young or immature (less than 80 to 100 years old), mature (non-old-growth stands more than 80 to 100 years old), and old-growth. These subdivisions can be made using a combination of data from Tables IV-V4, IV-V5, and IV-V6 below (Thomas et al. 1979, Losensky 1993).

Stand size class is one descriptor of structural development stages that is readily available from inventories. The structural development stage of forest stands is important from ecological, forest health, and management standpoints. These include:

- amount of harvestable timber, now and in the future;
- availability of habitat for animals that use various structural stages; and
- likelihood of insect and disease episodes or other disturbances associated in part with stands of different tree sizes.

The specific methods for grouping stands into these classes vary among inventories; however, the various methods appear to be alike enough to allow meaningful comparisons.

Current Conditions

The existing cover type distribution is shown in Table IV-V4. We show data for forested state trust lands by Land Office, and for Montana forest lands on all ownerships combined.

Table IV-V4
ACRES BY STAND SIZE CLASS
FORESTED TRUST LANDS

Stand Class Size	NWLO	SWLO	CLO	NELO/ ELO/SLO	Total	% of Total	All Montana Forest Lands
Sawtimber	203,919	117,839	65,149	50,320	437,227	71	13,069,184
Poletimber	41,242	19,354	17,163	20,616	98,375	16	2,145,689
Seedling/ Sapling	39,423	12,319	9,544	4,562	65,848	11	2,321,512
Nonstocked	1,647	597	1,365	11,786	15,396	2	1,445,338
TOTALS	286,231	150,109	93,222	87,284	616,846	100	18,981,723

Trends: Table IV-V5 shows trends in the percentage of forest land occupied by the various stand size classes over the last half century, on state lands and on all ownerships combined. Note that while the nominal date for the earlier inventory is 1949, most of the field work was conducted in the 1930s; consequently it is more accurate to see these as 50-year rather than 40-year trends.

Data for the two time periods are not entirely comparable. Differences in inventory methods, stand size class definitions and forest acreage may slightly inflate estimates of 1989 sawtimber acreage relative to 1949 estimates. However, substantial changes most likely reflect real trends.

Table IV-V5
STAND SIZE CLASS TRENDS
Percent of Forest Lands by Stand Size Class

	State-Owned Forest Lands		All Forest Lands	
Stand Size Class	1989	1949	1989	1949
Sawtimber	71%	41%	69%	36%
Poletimber	16%	34%	11%	40%
Seedling/Sapling	11%	15%	12%	15%
Nonstocked	2%	10%	8%	8%

The major trend over the past several decades appears to be major shifts in poletimber and sawtimber acreage, both on state land and on all ownerships. In both cases, reported sawtimber acreage has nearly doubled, and poletimber acreage is less than half its previous level.

While some of the changes may be due to different size class definitions, real changes are probably reflected as well. Heavy logging of substantial areas of Western Montana, related to the arrival of the railroads and mining activity, took place in the late 1800s and early 1900s (Losensky 1993). These areas would have been primarily poletimber in the 1930s and 1940s, but are mostly sawtimber now.

Fire suppression may be an even more important factor. Historically, frequent wildfire in much of Montana kept forests predominantly open in character (Arno 1976, Freedman and Habeck 1984, Arno et al. 1987, Habeck 1990). Stands and patches of younger trees were most susceptible to elimination by the frequent fires. After active fire suppression began in the early 1900s, these trees were able to survive and develop into dense stands. The trends in poletimber and sawtimber stocking probably reflect the development of many of these stands over the past century.

The acreage of seedling/sapling stands and nonstocked areas on all forest lands appears to have been relatively stable over the past half century. However, the percentage of nonstocked and seedling/sapling stands on state forested lands has declined substantially. Most of the current openings and young stands are the result of timber harvest. It appears that the rate of harvest has not exceeded the rate of development of previously-existing young stands into larger size classes, either on state lands or in Montana forests in general.

<u>Implications</u>: The development of young poletimber stands into immature and mature sawtimber classes has increased the likelihood of insect and disease outbreaks and wildfire in many areas. Ponderosa and lodgepole pine stands have reached prime sizes for mountain pine beetle outbreaks over large areas; the fuel buildup from these outbreaks leads in turn to increasing the hazard of intense wildfires (Monnig and Byler 1992).

Expected Future Conditions

We developed relationships between existing stand size classes and stand age distributions for each Land Office. With the assumption that these relationships will remain relatively constant over time, we estimated stand size classes for the year 2020 for each alternative from predicted stand age distributions (see subsequent discussion of stand age distribution).

The procedure used to estimate stand age distributions assumes all harvests would temporarily create a nonstocked patch, and does not make any predictions for non-harvest disturbances such as wildfire. Some harvest methods will merely reduce the stocking of existing patches rather than create nonstocked openings. Consequently, the future acreage in nonstocked and seedling/sapling stands may be overestimated unless stand-replacing wildfires burn a substantial acreage.

Table IV-V6 shows predicted stand size class distributions for forested state lands. We made separate projections for the high and low harvest level estimates for each alternative. We include current figures for comparison.

Table IV-V6
PREDICTED STAND SIZE CLASS DISTRIBUTION ON STATE LANDS IN 2020
(Percent of forest acreage)

NWLO:	CUR-RENT	ALPHA		BETA		GAMMA		DELTA		EPSILON		ZETA		OMEGA	
		HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO
NONSTCKD.	0.6	3.1	1.6	2.7	1.2	0.8	0.4	3.5	1.2	4.3	2.7	1.6	0.8	3.9	2.4
SEED./SAP.	13.8	22.3	14.6	20.3	12.7	10.8	8.9	24.2	12.7	28.1	20.3	14.6	10.8	26.2	18.4
POLETIMBER	14.4	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
SAWTIMBER	71.2	69.9	79.1	72.3	81.4	83.7	86.0	67.6	81.4	62.9	72.3	79.1	83.7	65.2	74.5
SWLO:	CUR-RENT	ALPHA		BETA		GAMMA		DELTA		EPSILON		ZETA		OMEGA	
		HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO
NONSTCKD.	0.4	4.0	2.0	3.5	1.5	1.0	0.5	4.4	1.5	5.4	3.5	2.0	1.0	4.9	3.0
SEED./SAP.	8.2	24.3	13.8	23.6	11.2	8.5	6.0	26.9	11.2	32.5	23.6	13.8	8.5	29.7	19.0
POLETIMBER	12.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
SAWTIMBER	78.5	67.8	80.3	69.0	83.4	86.6	89.6	64.8	83.4	58.2	69.0	80.3	86.6	61.5	74.0
CLO:	CUR-RENT	ALPHA		BETA		GAMMA		DELTA		EPSILON		ZETA		OMEGA	
		HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO
NONSTCKD.	1.5	0.7	0.4	0.7	0.3	0.2	0.1	0.8	0.3	1.0	0.7	0.4	0.2	0.9	0.5
SEED./SAP.	10.2	10.3	8.2	9.8	7.8	7.3	6.8	10.7	7.8	11.7	9.8	8.2	7.3	11.2	9.2
POLETIMBER	18.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
SAWTIMBER	69.9	83.6	86.0	84.1	86.5	87.1	87.7	83.1	86.5	81.9	84.1	86.0	87.1	82.5	84.8
NELO/ ELO/SLO:	CUR-RENT	ALPHA		BETA		GAMMA		DELTA		EPSILON		ZETA		OMEGA	
		HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO
NONSTCKD.	13.5	0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.1	0.1
SEED./SAP.	5.2	0.3	0.2	0.3	0.1	0.1	0.0	0.3	0.1	0.4	0.3	0.2	0.1	0.4	0.2
POLETIMBER	23.6	20.7	20.6	20.6	20.6	20.6	20.5	20.7	20.6	20.7	20.6	20.6	20.6	20.7	20.7
SAWTIMBER	57.7	78.9	79.2	79.0	79.3	79.3	79.5	78.9	79.3	78.8	79.0	79.2	79.3	78.8	79.1
TOTALS:	CUR-RENT	ALPHA		BETA		GAMMA		DELTA		EPSILON		ZETA		OMEGA	
		HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO
NONSTCKD.	2.5	2.5	1.3	2.2	1.0	0.6	0.3	2.8	1.0	3.5	2.2	1.3	0.6	3.2	1.9
SEED./SAP.	10.7	17.8	11.4	16.7	9.8	8.2	6.6	19.4	9.8	22.8	16.7	11.4	8.2	21.1	14.6
POLETIMBER	15.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9
SAWTIMBER	70.9	72.7	80.5	74.2	82.4	84.3	86.2	70.9	82.4	66.9	74.2	80.5	84.3	68.9	76.6

DESCRIPTOR: STAND SIZE CLASSES	
EFFECTS COMMON TO ALL ALTERNATIVES The predicted proportion of forest area in poletimber stands is the same for all alternatives and harvest levels because we assume that future poletimber stands would develop entirely from existing seedling/sapling and poletimber stands, and that essentially all harvests would be done in sawtimber stands. We anticipate poletimber acreage in 2020 to be substantially less than the current amount. Current acreage of seedling/sapling stands are low, and inventory data indicates that stands currently are only staying in the poletimber class for about 20 years. This translates into a low predicted acreage of poletimber in the future.	
EFFECTS OF ALPHA We predict slight increases both in seedling/sapling and sawtimber classes. Sawtimber increases would be primarily on the Central and Eastside Land Office areas, given the range of possible harvest levels.	EFFECTS OF BETA We predict increases in sawtimber acreage at both harvest levels for all Land Offices, except for SWLO at the high harvest level. Trends for nonstocked and seedling/sapling stands vary by Land Office and harvest level.
EFFECTS OF GAMMA We expect sawtimber acreage to increase at both harvest levels for all Land Offices. We predict seedling/sapling acreage would decline at all Land Offices, except for at the high harvest level at SWLO.	EFFECTS OF DELTA We anticipate sawtimber acreage would remain constant or increase slightly overall, with some variation between Land Offices depending on harvest level. Seedling/sapling acreage would remain relatively constant or increase slightly at NWLO and SWLO, and remain constant or decline at CLO.
EFFECTS OF EPSILON Overall sawtimber acreage would remain roughly at current levels, with substantial declines at SWLO and increases at CLO. We predict seedling/sapling acreage would increase somewhat at NWLO and SWLO.	EFFECTS OF ZETA The proportion of sawtimber would increase at all harvest levels at all Land Offices. Seedling/sapling area could either increase or decrease depending on Land Office and harvest level.

DESCRIPTOR: STAND SIZE CLASSES
EFFECTS OF OMEGA
Overall, sawtimber acreage would slightly decrease at the high harvest level and increase at the low harvest level. Non-stocked would either increase at high levels or decrease at the low level. CLO and NE/E/SLO sawtimber acres would increase, SWLO acres would decrease and increases or decreases in NWLO acres would depend on harvest level.

Other ownerships: Industry-owned lands will probably have relatively low percentages of sawtimber stands because of their short rotations. Trends on National Forest lands will depend somewhat on the level of timber harvest or other disturbances. Ecosystem management practices would tend to restore historic levels of smaller stand size classes, but harvest levels may need to be increased in some areas to achieve this result. Recent projections indicate a declining harvest on National Forest lands (Flowers et al. 1993), so sawtimber acreage will probably increase over time, barring major wildfires.

Cumulative Effects on Stand Size Classes

We expect the declines in poletimber acreage over the past half century to continue on state lands, while the increased sawtimber acreage would remain or continue to grow. Much of this is a result of fire suppression and timber harvest over the past century, and management practices appear unlikely to influence these trends in the near term.

Over a longer period, alternatives with higher harvest level estimates, such as Epsilon or Omega or the high harvest estimate under Delta, have the greatest potential to restore more of a balance in stand size classes. However, the character of stands in each class may be substantially different from that in the past even under these alternatives. In particular, future sawtimber stands will probably be relatively young and well-stocked, in contrast with those in pre-settlement forests which tended to be open-canopied with large trees (Arno 1976, Habeck 1988, 1990, Covington et al. 1994).

Stand Age Distribution

The Descriptor Relationship

Stand age refers to the predominant age of trees in a stand or patch. Where stands are uneven-aged, the different ages are averaged, or the age of the best-represented age class may be used. In these cases, the reported stand age may be substantially younger than the number of years since stand origin, so stand age may not be an effective criterion for identifying potential old-growth stands.

As with stand size class, stand age helps describe structural development stages of stands. In particular, it may give a more complete picture of sawtimber acreage, which includes stands as small as nine inches average diameter up through old-growth stands. Trends in stand age are relatively easy to predict over time, based on planned harvest levels and criteria for selecting stands for harvest.

Current Conditions

Table IV-V7 shows stand age distribution on forested state lands. Comparable data is not available for combined forest ownerships.

Table IV-V7
FORESTED TRUST LAND ACREAGE
BY STAND AGE

Stand Age Class	NWLO	SWLO	CLO	NELO/ ELO SLO	TOTAL	%
Unclassified	1,394	556	1,363	11,785	15,098	2.5
1-20	19,400	3,860	8,873	4,193	36,326	5.9
21-40	9,919	4,648	672	8,461	23,700	3.8
41-60	17,810	6,267	687	739	25,503	4.1
61-80	65,771	21,609	2,092	20,043	109,515	17.8
81-100	51,049	41,510	41,642	30,111	164,312	26.6
101-120	43,202	28,989	15,408	10,308	97,907	15.9
121-140	38,218	15,228	7,501	739	61,686	10.0
141-160	11,341	9,824	7,553	536	29,254	4.7
161-180	9,259	14,906	33	369	24,567	4.0
181-200	8,731	2,712	7,397	0	18,840	3.1
201-300+	10,137	0	0	0	10,137	1.6
TOTALS	286,231	150,109	93,221	87,284	616,845	100

Table IV-V7 shows that state forest lands are heavily weighted toward 60-140 year-old stands. Some of this is due to averaging of tree ages on uneven-aged, one-acre inventory plots. However, much of the age distribution is related to the heavy timber harvests in the late 1800s and early 1900s, and to the advent of fire suppression at roughly the same time. Trees that were established after these timber harvests and after the last wildfires have been able to survive and eventually dominate stands over large areas.

Trends: Only limited stand age information is available from the 1949 inventory, and this is for forest lands across all ownerships. Methods of determining stand ages in the two inventories may not be entirely comparable. Nonetheless, the stand age comparison shown in Table IV-V8 is informative, and undoubtedly reflects real declines in the amount of older forest to a large degree. Based on narrative information presented by Conner and O'Brien (1993), the decline across all ownerships in stands 100 years and older is even more drastic than the figures shown for state lands. (Trends in board-foot volumes by tree size presented in a later section reflect the same trend.)

Table IV-V8
STAND AGE CLASS TRENDS
Percent of Forest Acres by Stand Age Class

Age Class	1989 State Lands	1949 All Ownerships
Nonstocked	2%	4%
1-40	10%	21%
41-80	22%	20%
81-120	43%	10%
121-160	15%	10%
161+	9%	35%

Gains in the middle age classes, rather than in young and overstocked stands, have compensated for the loss in older age classes. This is likely due to the selective removal of older trees from mixed stands, which has left residual stands in middle age classes.

The rate of even-aged harvests (clearcuts, seed tree, and shelterwood cuts) appears not even to have kept pace with the aging of young stands from the time of the earlier inventory. Previously, frequent fires kept a high proportion of the landscape in an early development stage in many areas. Regeneration was often slow after less frequent, high-intensity fires as well (Antos and Habeck 1981, Franklin et al. 1986, Oliver and Larson 1990), lengthening the time stands would spend in nonstocked and young age classes.

In contrast, achieving prompt regeneration is often a goal of timber harvest, and fire suppression has likewise reduced the proportion of land area in young and nonstocked classes.

Implications: The increase in area occupied by medium-aged stands raises the likelihood of insect outbreaks such as mountain pine beetle epidemics (see discussion above under Stand Size Classes). The reduction in area occupied by both young and old stands may be causing habitat losses for species associated with both early- and late-successional stages; both situations may be ecologically significant (Franklin et al. 1986, Oliver et al. 1994).

Expected Future Conditions

We projected existing stand age distributions ahead to the year 2020 for unharvested forest area. We assumed that harvest areas would become nonstocked for a five-year regeneration period, and then enter the 1-to-20 year age class. We also assumed that harvests would come from the oldest age classes first, but only on the percentage of the forest area that would need to be managed to produce the harvest levels we estimated under each alternative.

This procedure may overestimate the future acreage in young age classes, as most stands or patches harvested with intermediate cutting or selection systems would not revert to a non-stocked condition. However, we also made no allowances for stand-replacing wildfires, which would cause additional nonstocked and young stands. Accordingly, these errors will tend to compensate for each other to a degree, depending on future wildfire acreage.

Table IV-V9 shows the predicted stand age distributions on forested state lands, in comparison with existing distributions. Because of the assumptions used to generate these tables, undue importance should not be attached to individual items of data.[1] The overall trends are more likely to illustrate probable environmental effects.

Table IV-V9
PREDICTED STAND AGE DISTRIBUTION ON FORESTED STATE LANDS IN 2020
(Percent of Forest Acres by Stand Age Class)

LO/AGE CLASS	CURRENT	ALPHA		BETA		GAMMA		DELTA		EPSILON		ZETA		OMEGA	
NWLO:		HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO
Nonstocked	0.5	3.1	1.6	2.7	1.2	0.8	0.4	3.5	1.2	4.3	2.7	1.6	0.8	3.9	2.3
1-20	6.9	12.6	6.3	11.0	4.7	3.2	1.6	14.2	4.7	17.4	11.0	6.3	3.2	15.8	9.5
21-40	3.5	6.7	5.3	6.3	5.0	4.6	4.3	7.0	5.0	7.7	6.3	5.3	4.6	7.3	6.0
41-60	6.3	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
61-80	22.6	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
81-100	17.4	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5
101-120	15.3	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
121-140	13.5	14.5	15.4	14.7	15.6	15.9	16.1	14.2	15.6	13.7	14.7	15.4	15.9	14.0	14.9
141-160	4.0	8.9	11.6	9.6	12.3	13.0	13.7	8.2	12.3	6.8	9.6	11.6	13.0	7.5	10.3
161-180	3.3	4.1	6.4	4.7	7.0	7.6	8.2	3.5	7.0	2.3	4.7	6.4	7.6	2.9	5.3
181-200	3.1	1.7	2.7	1.9	2.9	3.2	3.4	1.5	2.9	1.0	1.9	2.7	3.2	1.2	2.2
201+	3.6	3.9	6.1	4.4	6.6	7.2	7.8	3.3	6.6	2.2	4.4	6.1	7.2	2.8	5.0
	CURRENT	ALPHA		BETA		GAMMA		DELTA		EPSILON		ZETA		OMEGA	
SWLO:		HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO
Nonstocked	0.4	4.0	2.0	3.5	1.5	1.0	0.5	4.4	1.5	5.4	3.5	2.0	1.0	4.9	3.0
1-20	2.6	17.0	8.5	14.9	6.4	4.2	2.1	19.1	6.4	23.4	14.9	8.5	4.2	21.2	12.7
21-40	3.1	5.6	3.6	5.1	3.1	2.6	2.2	6.1	3.1	7.1	5.1	3.6	2.6	6.6	4.6
41-60	4.2	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
61-80	14.4	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
81-100	27.7	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
101-120	19.3	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0
121-140	10.1	19.5	21.5	20.0	22.0	22.5	23.0	19.0	22.0	18.1	20.0	21.5	22.5	18.6	20.5
141-160	6.5	7.7	11.2	8.6	12.1	13.0	13.9	6.9	12.1	5.1	8.6	11.2	13.0	6.0	9.5
161-180	9.9	3.4	5.9	4.0	6.5	7.1	7.7	2.7	6.5	1.5	4.0	5.9	7.1	2.1	4.6
181-200	1.8	3.3	5.8	3.9	6.4	7.0	7.6	2.7	6.4	1.5	3.9	5.8	7.0	2.1	4.5
201+	0.0	2.7	4.8	3.2	5.3	5.8	6.3	2.2	5.3	1.2	3.2	4.8	5.8	1.7	3.7

1 Note in particular that all harvests scenarios are treated identically in the analysis, despite the fact that we project differing properties of harvest type (e.g., clearcut, selection) by alternative.

CLO:	CURRENT	ALPHA		BETA		GAMMA		DELTA		EPSILON		ZETA		OMEGA	
		HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO
Nonstocked	1.5	0.7	0.4	0.7	0.3	0.2	0.1	0.8	0.3	1.0	0.7	0.4	0.2	0.9	0.6
1-20	9.7	3.3	1.6	2.9	1.2	0.8	0.4	3.7	1.2	4.5	2.9	1.6	0.8	4.1	2.4
21-40	0.2	7.0	6.6	6.9	6.6	6.5	6.4	7.0	6.6	7.2	6.9	6.6	6.5	7.1	6.8
41-60	0.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
61-80	1.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
81-100	45.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
101-120	16.9	23.3	23.4	23.3	23.4	23.4	23.5	23.3	23.4	23.3	23.3	23.4	23.4	23.3	23.4
121-140	8.2	30.2	30.7	30.3	30.9	31.0	31.1	30.1	30.9	29.8	30.3	30.7	31.0	30.0	30.5
141-160	8.3	11.2	11.9	11.4	12.1	12.2	12.4	11.1	12.1	10.8	11.4	11.9	12.2	10.9	11.6
161-180	0.0	7.4	7.8	7.5	7.9	8.0	8.1	7.3	7.9	7.1	7.5	7.8	8.0	7.2	7.6
181-200	8.1	3.7	3.9	3.8	4.0	4.1	4.1	3.7	4.0	3.6	3.8	3.9	4.1	3.6	3.8
201+	0.0	7.3	7.7	7.4	7.8	7.9	8.0	7.2	7.8	7.0	7.4	7.7	7.9	7.1	7.5

NELO/ELO/ SLO:	CURRENT	ALPHA		BETA		GAMMA		DELTA		EPSILON		ZETA		OMEGA	
		HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO
Nonstocked	15.0	0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.1	0.1
1-20	5.5	0.3	0.2	0.3	0.1	0.1	0.0	0.3	0.1	0.4	0.3	0.2	0.1	0.4	0.2
21-40	0.0	17.9	17.8	17.8	17.8	17.8	17.7	17.9	17.8	17.9	17.8	17.8	17.7	17.9	17.8
41-60	0.5	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
61-80	25.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
81-100	38.5	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9
101-120	13.5	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9
121-140	0.5	25.8	25.9	25.8	25.9	26.0	26.0	25.8	25.9	25.7	25.8	25.9	26.0	25.7	25.8
141-160	0.7	6.8	6.9	6.8	6.9	7.0	7.0	6.8	6.9	6.7	6.8	6.9	7.0	6.7	6.8
161-180	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
181-200	0.0	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
201+	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

TOTALS:	CURRENT	ALPHA		BETA		GAMMA		DELTA		EPSILON		ZETA		OMEGA	
		HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO
Nonstocked	2.4	2.6	1.3	2.3	1.0	0.6	0.3	2.9	1.0	3.5	2.3	1.3	0.6	3.2	1.9
1-20	6.1	10.7	5.3	9.4	4.0	2.7	1.3	12.1	4.0	14.8	9.4	5.3	2.7	13.4	8.0
21-40	2.5	7.9	6.7	7.6	6.4	6.1	5.8	8.2	6.4	8.8	7.6	6.7	6.1	8.5	7.3
41-60	4.1	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
61-80	17.7	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
81-100	26.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9
101-120	16.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3
121-140	10.2	19.6	20.6	19.8	20.9	21.1	21.4	19.3	20.9	18.8	19.8	20.6	21.1	19.0	20.1
141-160	4.9	8.7	11.0	9.3	11.6	12.1	12.7	8.1	11.6	7.0	9.3	11.0	12.1	7.6	9.8
161-180	4.1	4.0	5.8	4.4	6.2	6.6	7.1	3.5	6.2	2.6	4.4	5.8	6.6	3.1	4.9
181-200	3.1	2.3	3.4	2.5	3.7	3.9	4.2	2.0	3.7	1.4	2.5	3.4	3.9	1.7	2.8
201+	1.7	3.6	5.3	4.0	5.7	6.1	6.5	3.2	5.7	2.4	4.0	5.3	6.1	2.8	4.5

DESCRIPTOR: STAND AGE DISTRIBUTION

EFFECTS COMMON TO ALL ALTERNATIVES

We predict that the area in stands 41-120 years old will be almost identical, regardless of alternative and harvest level, because we expect harvests to come from older stands, and new stands resulting from harvests would be younger than 40 years old in the year 2020. In reality, some stands younger than 120 years old are likely to be harvested, but these harvests would probably be mostly intermediate treatments or selection cuts that would not change stand ages appreciably.

With all alternatives, we expect the acreage in immature age classes (61-100 years) to decline substantially. We predict a corresponding increase in mature forest (101-140 years). This is due to the maturing of existing immature stands, which are currently the most common age classes. The extent of this shift may be less than shown in Table IV-V9, as some of this acreage will presumably have selection harvests which would tend to maintain the current age structure.

EFFECTS OF ALPHA	EFFECTS OF BETA
Under Alpha, we expect moderate increases in the amount of older forest (141 years-plus). At the Land Office level, the only exception to this trend would be in the Southwestern Land Office area, where we project a slight decline in older forest at the high statewide harvest level of 40 MMBF/yr. We also predict substantial increases in the young (0-40) age class, although this may only occur if substantial areas were also burned in stand-replacing fires or lost to other major disturbances, as discussed above. Older age classes would be found primarily in areas deferred from management, streamside areas, locations with poor road access, and in areas with resource concerns such as cumulative watershed effects, big game winter range, other wildlife concerns, and high visibility. Younger age classes would be primarily on accessible upland sites with few resource issues.	The amount of older forest would approximately double under the range of possible harvest levels for this alternative. We project increases in the amount of older forest for the entire range of harvest levels at all Land Offices. As maintaining representation of older forests is a particular goal in this alternative, they would tend to occur in a variety of environments in relatively large patches. A larger proportion of the harvest would probably come from the 81-140 year age classes, much of it from thinning and selection cuts. With its emphasis on promoting a greater balance of stand conditions, the Beta alternative would favor a greater concentration of harvest in the intermediate age classes, much of it through thinning and selection cutting.

<table>
<tr><th colspan="2">DESCRIPTOR: STAND AGE DISTRIBUTION</th></tr>
<tr><td>EFFECTS OF GAMMA

With the lowest range of possible harvest levels of any alternative, Gamma would show the greatest overall increase in forest age. In contrast with the other alternatives, the amount of young forest would show definite declines over the next 25 years, comprising less than ten percent of the forest land area. Creation of openings with younger age classes would be limited to wildfire areas or areas with few resource concerns.</td><td>EFFECTS OF DELTA

We predict a moderate to substantial increase in the amount of older forest, depending on harvest level. Older forests would occur primarily in lower-value stands and in areas where resources other than timber were the primary trust revenue sources. Young age classes would predominate on sites that currently have high-value timber or high rates of mortality, and on productive sites where timber is the primary revenue source.</td></tr>
<tr><td>EFFECTS OF EPSILON

Even though the high harvest level estimate for Epsilon involves managing for timber production on all non-deferred forest lands, we only predict a slight decrease in older forest. This is largely because about 35 percent of the forest land is deferred. At the low harvest level, the proportion of older stands would increase moderately. Remaining older forest is likely to be concentrated in relatively healthy stands, along streams, on inoperable steep or wet sites, and at higher elevations.

At the high harvest levels, the predicted area of young stands would increase to amounts comparable to 1949 levels (see Table IV-V8). These would generally be in areas that currently have high volumes of timber or high mortality rates.</td><td>EFFECTS OF ZETA

We predict little change from current levels of young forest, while the proportion of older forest would approximately double. Younger forests would be primarily in areas with low value for recreation or wildlife habitat.</td></tr>
<tr><td colspan="2">EFFECTS OF OMEGA

The amount of forest older than 201 would increase significantly. Non-stocked acres would increase or decrease depending on harvest level. Stands 61 to 100 would decrease substantially as these stands age and few replacements exist. Stands 121-160 would likely increase substantially although much of our future harvest may occur in these stands. The magnitude of the forecast changes would depend on our ability to focus our harvesting in mid-age stands.</td></tr>
</table>

Other ownerships: An overall shift toward older age classes is likely, as much of the federal land base is not managed for timber, and harvest levels are declining on National Forests. However, there may be a trend toward younger age classes on industrial land where short rotations will probably be used, and on small private ownerships where harvest pressures have been increasing (see Flowers et al. 1993).

Cumulative Effects on Stand Age Classes

The predicted stand age class distributions provide considerable information for evaluating the sustainability of harvest levels under each alternative. The overall increases in older age classes suggest that all alternatives can sustain a substantial percentage of older forests as well as maintain the range of possible timber harvest levels. At the high harvest level estimates under the Delta and Epsilon alternatives, the older age classes would probably be limited in the long term primarily to inoperable sites and along streams. Although the high harvest level under Omega is intermediate between Delta and Epsilon, the specific goal of restoring historic age class distributions would result in older stands being distributed on operable and inoperable sites. Under other scenarios, the percent of forest land managed for timber would be too small to eliminate all older stands even on efficiently operable sites.

We cannot take it for granted that old-growth characteristics will develop as stands become older. Many of today's immature to mature stands (61-140 years old) are densely stocked and may not develop large trees unless they are thinned. As these forests age, they will tend to become more susceptible to diseases, insect outbreaks, and intense wildfires (Covington et al. 1994).

Compared with historic conditions, older forest in particular would tend to be concentrated in less accessible and less operable sites. This effect would be greatest under the Delta and Epsilon alternatives, where harvest locations are based predominantly on timber values in existing stands. Harvest locations under the Beta, Gamma, and Zeta alternatives are based on broader ecological criteria at least in part, which would result in a shift toward historic age class distributions. Omega would probably have the greatest effect on restoring historic stand age class representation across the landscape, especially at the higher harvest level.

Forest Types

The Descriptor Relationship

Each stand's forest type is based on its most prevalent tree species, or in a few cases on a combination of tree species. The presence and relative abundance of various tree species on a site are a product of the site's vegetative potential, stand development, and disturbance history. Changes in tree species composition can affect a stand's susceptibility to environmental stresses, insect and disease outbreaks, and wildfire. They can also result in changes in wildlife habitat values.

Current Conditions

The current forest type distribution for state trust lands and across all ownerships is shown in Table IV-V10. Overall species composition by cubic foot volume is shown in Table IV-V11.

On state trust lands, the most common forest type is Douglas-fir, followed in order by ponderosa pine, lodgepole pine and spruce-fir. The greatest cubic foot volume exists in the Douglas-fir, ponderosa pine, western larch and lodgepole pine forest types.

Across all ownerships, Douglas-fir remains the most abundant forest type, followed in order by lodgepole pine, ponderosa pine and spruce-fir. Lodgepole pine slightly exceeds Douglas-fir in cubic foot volume, followed by ponderosa pine and western larch. The major difference between state lands and other ownerships is the relative lack of lodgepole pine on state lands, due primarily to the higher concentration of state forest lands in Northwestern Montana and at lower elevations, compared to Montana's forest lands in general.

Table IV-V10
ACREAGE BY FOREST TYPE
STATE FOREST LANDS

Forest Type	NWLO	SWLO	CLO	NELO/ ELO/SLO	TOTAL	All Montana Forested Lands
Douglas-Fir	128,245	100,426	62,910	369	291,950	6,388,827
Western Hemlock	0	0	0	0	0	30,171
Ponderosa Pine	7,934	25,576	19,657	67,037	120,204	3,010,635
W. White Pine	0	0	0	0	0	32,039
Lodgepole Pine	34,999	17,372	481	8,830	61,682	4,146,775
Western Larch	46,004	1,886	0	0	47,890	945,633
W. Redcedar	4,702	0	0	0	4,702	121,885
Limber Pine	0	0	28	0	28	145,541
Grand Fir	11,152	0	0	0	11,152	224,534
Spruce-Fir	41,442	2,714	8,004	0	52,160	1,554,595
Spruce	8,307	2,065	0	0	10,372	667,722
Other Softwoods	0	0	0	0	0	1,243,605
Aspen	0	53	942	1,108	2,103	217,957
Cottonwood	3,446	17	1,200	9,939	14,602	251,804
Nonforested Classified Forest	13,557	13,219	12,085	0	38,861	N/A
TOTAL	299,788	163,328	105,307	87,283	655,706	18,981,723

Table IV-V11
CUBIC FOOT VOLUME BY SPECIES
THOUSAND CUBIC FEET

Species	Forested Trust Lands	All Montana Forested Lands
Douglas-fir	390,409	8,752,100
Ponderosa Pine	157,442	3,011,100
Western White Pine	4,725	225,600
Lodgepole Pine	108,165	8,988,000
Whitebark Pine[1]	2,914	72,300
Limber Pine[1]	2,164	52,700
Western Larch	125,249	2,217,400
Grand Fir	33,481	1,656,400
Subalpine Fir	73,558	366,900
Engelmann Spruce	63,279	1,793,700
Western Hemlock	601	211,400
Western Redcedar[1]	10,607	52,900
Other Softwoods	0	759,700
Hardwoods	16,619	498,600
TOTAL	989,213	28,658,800

[1] These species are included under "other softwoods" in data from National Forest lands.

Trends: Tables IV-V12 and IV-V13 show forest type and species abundance trends, respectively, between 1949 and 1989. Data by ownership is not available from 1949; however, a rough picture of historic forest type acreage on state lands can be obtained from the ecological group information presented at the beginning of the vegetation description and in Table III-V1. Relative trends for state lands appear to have been similar to those on all ownerships.

The forest type trends show a major shift away from sites dominated by early-successional species such as ponderosa pine, western larch, and lodgepole pine and toward dominance of later-successional species such as Douglas-fir and spruce-fir types. The decline of the western larch forest type, which was the fourth most common type in Western Montana in 1949, is particularly noteworthy.

On state lands, only 60 percent of the acreage in Ecological Group A is the ponderosa pine forest type; historically, EG A would have been overwhelmingly composed of ponderosa pine stands. Likewise, historically the western larch type would have composed a high percentage of EG B and C sites; if this was the case, the western larch type has declined substantially on state lands.

Table IV-V12
FOREST TYPE TRENDS
(Percentage of Forest Lands by Forest Type)

	State-Owned Forest Lands	All Forest Lands	
Forest Type	1989	1989	1949
Douglas-fir	47%	34%	18%
Ponderosa Pine	19%	16%	22%
Western White Pine	--	--	2%
Lodgepole Pine	10%	22%	29%
Western Larch	8%	5%	16%
Western Redcedar	1%	1%	--
Limber Pine	--	1%	1%
Grand Fir	2%	1%	--
Spruce and Spruce-fir	10%	12%	4%
Other Softwood Types	--	7%	6%
Hardwood Types	2%	2%	3%

Table IV-V13
SPECIES ABUNDANCE TRENDS
(Percentage of Cubic-Foot Volume by Species)

	State-Owned Forest Lands	All Forest Lands	
Forest Type	1989	1989	1949
Douglas-fir	39%	31%	29%
Ponderosa Pine	16%	11%	14%
Western White Pine	--	1%	1%
Lodgepole Pine	11%	31%	25%
Whitebark/Limber Pines[1]	1%	-	2%
Western Larch	13%	8%	15%
Grand Fir	3%	6%	1%
Subalpine Fir	7%	1%	2%
Engelmann Spruce	6%	6%	9%
Western Hemlock	--	1%	--
Western Redcedar[1]	1%	--	1%
Other Softwoods	--	3%	--
Hardwoods	2%	2%	2%

[1] The 1989 data includes these species under "other softwoods" for National Forest lands.

These shifts in forest type have been widely noted throughout the Inland West, and are due to a combination of fire suppression and "selective" logging of ponderosa pine, western larch and western white pine from mixed-species stands (Arno 1976, Schmidt et al. 1976, Habeck 1990, Johnson et al. 1991, Monnig and Byler 1992, Mutch et al. 1993, Covington et al. 1994). In addition, the western white pine type, of limited distribution in Western Montana, has been affected by the white pine blister rust, an introduced pathogen.

Similarly, trends in relative species abundance show the same shift from dominance by early-successional species towards dominance of later-successional species, but to a lesser degree; this would be expected, because a small change in relative abundance of species can change the forest type over a substantial area. The exceptions are lodgepole pine, which has increased in relative volume while declining as a forest type, and spruce and subalpine fir, which show the opposite trend. The increase in lodgepole pine may be related to the aging of stands and the associated increase in per-acre volume; lodgepole stands were overwhelmingly poletimber in 1949, but were predominantly sawtimber by 1989 (see also Monnig and Byler 1992). The spruce-fir trends are not as easily explained. They may be due to changes in how forest types are defined, succession of aging lodgepole pine stands to dominance by small-diameter spruce and fir, improved sampling in higher-elevation areas, and to spruce beetle outbreaks in the 1950s, 1960s, and 1980s.

While clear trends are not apparent from the data in Tables IV-V12 and IV-V13, fire suppression is allowing aspen stands to mature and be replaced over time by conifers (Gruell 1983, Covington et al. 1994). Cottonwood stands were harvested for steamboat fuel in the 1800s, and in this century have been extensively cleared for hay and crop production. Heavy livestock grazing and trampling can reduce cottonwood establishment (Hansen et al. 1988). In addition, flood control and channelization from road and railroad construction reduce flooding and siltation, and consequently opportunities for rejuvenation of cottonwood communities.

Nonforested classified Forest lands have probably experienced some shifts from grassland toward dominance by juniper, sagebrush, and other shrubs. Both fire suppression and livestock grazing have tended to promote these shifts (Gruell 1983, Covington et al. 1994).

Implications: The susceptibility of stands to wildfire and some insects and pathogens has increased due to cover type and species abundance changes. Wildfires tended to maintain forests of fire-resistant western larch and ponderosa pine, and to favor regeneration of western larch, lodgepole pine, and western white pine. Shifts in composition toward more shade-tolerant and less fire-adapted species will likely increase the intensity and severity of wildfires that do occur. The susceptibility of forests to spruce budworm, Douglas-fir dwarf mistletoe, and root diseases has also increased because of these changes (Arno 1976, Habeck 1990, Johnson et al. 1991, Monnig and Byler 1992, Mutch et al. 1993, Covington et al. 1994).

While earlier inventory data specific to state lands is not available, the history of state lands with regard to fire suppression and partial cutting is similar to that of other ownerships. Consequently, we assume the same relative trends and their implications to occur on state lands as on the wider environments in which they occur.

Expected Future Conditions

DESCRIPTOR: FOREST TYPES

EFFECTS COMMON TO ALL ALTERNATIVES

Given the current legal requirements and practical considerations, we assume that active fire suppression will continue on virtually all forested state lands. Little if any state land is in wilderness areas or National Parks covered by fire management plans that allow some natural wildfires to burn. Consequently, trends toward stands dominated by shade-tolerant, less fire-resistant tree species will continue in areas where timber harvest does not take place.

While the use of prescribed burning may vary somewhat by alternative, prescribed burning will probably not be a major means of changing tree species composition under any alternative, except in conjunction with silvicultural treatments as a means of enhancing future revenue potential.

Western white pine and whitebark pine forests will continue to be affected by white pine blister rust. Trends in western white pine abundance will depend largely on harvest levels and associated planting of rust-resistant stock. Maintaining whitebark pine may additionally require substantial amounts of prescribed burning, which currently appears unlikely under any alternative.

Trends in hardwood composition should be relatively similar for all alternatives. These trends will be related in part to fire suppression and regulation of streamflow. Fire suppression will reduce the extent of aspen forests, which rely on fire for rejuvenation and elimination of conifer competition (Gruell 1983, Covington et al. 1994). In most cases, conifers such as Douglas-fir will eventually replace aspen forests unless active efforts are made to regenerate aspen stands.

In areas where highway construction or flood control projects have reduced riparian flooding, cottonwood stands will likewise decline. Without flooding and fresh silt deposition, cottonwood stands will eventually mature, die, and be replaced by conifers or shrubs in most cases (Hansen et al. 1988).

Fire suppression and grazing will continue to affect nonforest grasslands on classified Forest land (Gruell 1983, Covington et al. 1994). Continued trends toward shrub or conifer dominance are likely under all alternatives.

EFFECTS COMMON TO ALL ALTERNATIVES EXCEPT ALPHA

Increased protection of riparian areas on classified Forest lands from grazing impacts may result in slightly better representation of cottonwood and riparian shrub communities than under Alpha. The predicted reduction in classified Forest grazing under all alternatives other than Alpha may slightly reduce the rate at which brush and conifer cover encroaches on grasslands.

DESCRIPTOR: FOREST TYPES	
EFFECTS OF ALPHA	EFFECTS OF BETA
Many sites in ecological groups A and B, where shifts toward late-successional tree species have been most pronounced, are also big game winter range. In these situations, we may actively promote an abundance of Douglas-fir and other shade-tolerant species because of the cover they provide. In areas where maintaining big game cover is considered less important, we expect that recent efforts to thin immature stands and favor ponderosa pine and western larch will continue. Regeneration cuts in older stands, planting, and thinning of young stands will also tend to favor early-successional tree species. However, only harvest levels near the upper end of the possible range for this alternative appear sufficient to have an effect on a large proportion of the forest lands.	The Beta alternative would place considerable emphasis on restoring the composition of early-successional tree species. Even the high harvest level for this alternative would not provide for management of a large proportion of the forest land, but more use of thinning and selection cutting would allow these management efforts to be spread over a larger area. Consequently, at least some reversal of the trend toward shade-tolerant species appears likely if harvest levels approach the high estimate.

DESCRIPTOR: FOREST TYPES	
EFFECTS OF GAMMA	EFFECTS OF DELTA
Harvests under the Gamma alternative would emphasize restoring more natural conditions, which would include greater abundance of early-successional tree species. However, the range of possible harvest levels would be insufficient to reverse the trends toward shade-tolerant species. An emphasis on prescribed burning to restore early-successional species would be consistent with this alternative. However, the virtual necessity of using silvicultural treatments in conjunction with prescribed burning for effective restoration (Habeck 1990, Mutch et al. 1993) would prevent prescribed fire from being an effective tool in this alternative. Financial justification for such practices would also be more difficult than under other alternatives, unless non-timber revenue sources are anticipated as a basis for making these investments.	There would be less emphasis here than under the Alpha alternative on maintaining big game cover on most sites. The relatively high level of timber harvest at the upper end of the possible range would provide substantial opportunity to restore early-successional tree species. However, this is not a particular emphasis within this alternative.
EFFECTS OF EPSILON	EFFECTS OF ZETA
Restoring early-successional forest types is not an overt goal under this alternative. Nevertheless, the high level of timber harvest and emphasis on optimizing long-term timber production would lead to a shift toward early-successional tree species. These species are usually favored by timber-efficient even-aged management systems, and are also generally the most preferred for timber management.	As with the Gamma alternative, harvest levels under Zeta would be insufficient to lead to a net restoration of early-successional tree species. In addition, the emphasis on maintaining big game habitat would lead to favoring late-successional species in many areas.

DESCRIPTOR: FOREST TYPES
EFFECTS OF OMEGA With its emphasis on restoring historic conditions to the landscape, Omega would go the farthest towards increasing the representation of early successional species, especially at the high harvest level. Thinning in stands where shade tolerant species are encroaching would help restore vigor and historic conditions to many stands. Special emphasis would be placed on reversing the trend of increased levels of true firs and other tolerant species cover types. It is expected that Omega would also increase representation of ponderosa pine, western white pine, lodgepole pine and western larch cover types.

We predicted relative trends for each alternative by forest type. We compared these predictions to ecological group descriptions and past conditions from the 1949 inventory in order to evaluate cumulative effects.

The primary factors in each alternative that may influence forest type trends are: the level of timber harvest; silvicultural treatment methods; where and when harvests are done; the level of silvicultural investment including prescribed burning practices; and fire suppression. The predicted relative trends in forest type acreage and overall tree species composition are shown in Table IV-V14.

Table IV-V14
PREDICTED TRENDS IN FOREST TYPE ACREAGE ON FORESTED STATE TRUST LANDS

```
ALPHA:                              Predicted trend  (X = historic level)
                                  from present levels  (<--> = predicted
       Forest type:             <-decrease | increase->         range)
                                           |
       Douglas-fir               X      <-|->
       Western hemlock           X        |<->
       Ponderosa pine                   <-|->      X
       Western white pine                 |<>       X
       Lodgepole pine                    <|>  X
       Western larch                   <--|>           X
       Western redcedar                  <|>  X
       Limber pine                       <X>
       Grand fir                     X    |<->
       Spruce/subalpine fir     X         |<-->
       Hardwoods                       <->|   X
```

```
BETA:                            Predicted trend  (X = historic level)
                               from present levels   (<--> = predicted
       Forest type           <-decrease | increase->          range)
                                        |
       Douglas-fir             X     <--|>
       Western hemlock         X        |<->
       Ponderosa pine                  <|-->    X
       Western white pine               |<>      X
       Lodgepole pine                  <|>  X
       Western larch                  <-|->         X
       Western redcedar                <|>  X
       Limber pine                     <X>
       Grand fir                   X    |<->
       Spruce/subalpine fir   X         |<-->
       Hardwoods                     <->|   X

GAMMA:                           Predicted trend  (X = historic level)
                               from present levels   (<--> = predicted
       Forest type           <-decrease | increase->          range)
                                        |
       Douglas-fir             X        | <-->
       Western hemlock         X        |<->
       Ponderosa pine                <-->|       X
       Western white pine            <->|        X
       Lodgepole pine                <->|   X
       Western larch               <--> |           X
       Western redcedar                <|>  X
       Limber pine                     <X>
       Grand fir                   X    | <->
       Spruce/subalpine fir   X         | <-->
       Hardwoods                     <->|   X

DELTA:                           Predicted trend  (X = historic level)
                               from present levels   (<--> = predicted
       Forest type           <-decrease | increase->          range)
                                        |
       Douglas-fir             X      <-|>
       Western hemlock         X        |<->
       Ponderosa pine                  <|-->    X
       Western white pine               |<>      X
       Lodgepole pine                  <|>  X
       Western larch                  <-|->         X
       Western redcedar                <|>  X
       Limber pine                     <X>
       Grand fir                   X   <|-->
       Spruce/subalpine fir   X        <|-->
       Hardwoods                     <->|   X
```

```
EPSILON:                         Predicted trend   (X = historic level)
                                from present levels  (<--> = predicted
       Forest type            <-decrease | increase->         range)
                                         |
       Douglas-fir              X    <-->|
       Western hemlock          X       <|>
       Ponderosa pine                    |<-->   X
       Western white pine                | <>    X
       Lodgepole pine                    |<->X
       Western larch                     |<->        X
       Western redcedar                 <|>  X
       Limber pine                      <X>
       Grand fir                    X  <-|>
       Spruce/subalpine fir        X       <-|>
       Hardwoods                      <->|   X
```

```
ZETA:                            Predicted trend   (X = historic level)
                                from present levels  (<--> = predicted
       Forest type            <-decrease | increase->         range)
                                         |
       Douglas-fir              X        | <-->
       Western hemlock          X        |<->
       Ponderosa pine                <-->|       X
       Western white pine             <->|        X
       Lodgepole pine                 <->|   X
       Western larch                 <-->|           X
       Western redcedar                 <|>  X
       Limber pine                      <X>
       Grand fir                    X    | <->
       Spruce/subalpine fir        X         | <-->
       Hardwoods                      <->|   X
```

```
OMEGA:                            Predicted trend   (X = historic level)
                                from present levels  (<--> = predicted
       Forest type            <-decrease | increase->         range)
                                         |
       Douglas-fir              X  <->   |
       Western hemlock          X  <->   |
       Ponderosa pine                    |   <-> X
       Western white pine                |   <->  X
       Lodgepole pine                    |<->X
       Western larch                     |   <->     X
       Western redcedar                  |<->X
       Limber pine                      <X>
       Grand fir                    X<-> |
       Spruce/subalpine fir        X  <->    |
       Hardwoods                        <|>  X
```

Other ownerships: The adoption of ecosystem management on National Forest lands will probably result in an emphasis on restoring historical tree species composition. Achieving this will depend on extensive use of silvicultural treatments and prescribed fire, and adequate funding to carry out these projects (Mutch et al. 1993).

Trends on other land ownerships are likely to vary widely. Use of even-age silvicultural methods or other techniques that simulate the role of fire to a large degree will generally favor early-successional species. Reliance on more traditional "selective" logging methods, or on advance regeneration to initiate new stands will hasten succession toward late-successional species.

Cumulative Effects on Forest Types

A continuation of the trend toward increasing abundance of late-successional forest types is likely under most alternative/harvest level combinations. We would expect this trend to result in higher levels of insect outbreaks, root diseases and Douglas-fir dwarf mistletoe. Stand-replacing wildfires will be more common on sites that typically had lower-intensity fires in the past (Arno 1976, Habeck 1990, Mutch et al. 1993, Covington et al. 1994). These trends would be most pronounced under low harvest levels (Gamma, Zeta, and the low harvest estimates for Alpha, Beta and Delta), and where management goals favor late-successional species in some circumstances (Alpha and Zeta).

Opportunities to restore early-successional forest types will depend on harvest levels high enough to treat a large portion of the forest lands (Epsilon, Omega and the high harvest estimates for Alpha, Beta and Delta). This will be most effective if partial cutting to favor these species takes place, rather than regeneration harvests on more limited acreage. Some of these treatments would be carried out under each of these alternatives, but are only emphasized under Beta and Omega.

Early-successional forest types are not immune to damaging agents. Mountain pine beetle primarily affects early-successional pine species, especially if stands are overstocked and in small sawtimber size classes. Maintaining natural disturbances at natural rather than elevated levels will depend on reducing stocking levels and maintaining appropriate tree age and size distributions, as well as regulation of species composition.

Trends on other ownerships will influence the forest health results of activity on state lands. Wildfires that start or insect populations that build up on lands dominated by late-successional species may spread to other ownerships regardless of conditions in the latter areas.

Stocking levels

The Descriptor Relationship

Stocking level is the extent to which the growing space in a stand or patch is occupied by trees. Stocking can be described in terms of percentage of canopy coverage, basal area per acre, or a number of other measures that have been developed.

Stocking level has important implications, both from an ecological and management standpoint.

- It is strongly related to stress levels, and consequently the likelihood of insect and disease episodes.

- It is related to the amount of fuel available to a wildfire, and thus to the hazard of intense fires.

- It influences availability of habitat for animal species associated with open- or closed-canopy forests.

- High stocking levels reduce the rate of tree growth and stand development. These in turn reduce the rate at which merchantable timber and different forms of wildlife habitat are produced.

- Low stocking levels, on the other hand, result in poor occupancy of the site, reducing the rate of timber production and delaying the development of closed-canopy habitat conditions.

- Trends in stocking are an indicator of the sustainability of past harvest levels.

Stocking levels are influenced by a stand's disturbance and development history. Timber harvest and fire suppression have been major factors affecting stand stocking levels. Stocking level trends and their implications may vary substantially by forest type.

Current Conditions

Table IV-V15 shows current stocking, expressed as canopy coverage, for forested state lands. We derived the information from DNRC's stand-level inventory. Not all state forest lands have been inventoried in the stand-level inventory, so we extrapolated data from inventoried areas to uninventoried areas. The nonstocked acreage derived in this way is different from that obtained from the statewide inventory. Comparable information is not available across other ownerships.

Table IV-V15
STATE FOREST LAND ACREAGE BY STOCKING LEVEL

Stocking Level	NWLO	SWLO	CLO	NELO/ ELO/SLO	TOTAL	%
Nonstocked	4,226	1,995	224	0	6,445	1
Poorly Stocked (< 40%)	26,868	14,783	14,544	28,938	85,133	14
Medium Stocked (40-69%)	60,708	68,066	33,208	26,537	188,519	31
Well Stocked (> 70%)	194,428	65,265	45,246	31,809	336,748	54
TOTALS	286,230	150,109	93,222	87,284	616,845	100

Trends: The best available information for evaluating trends in stocking level is for cubic-foot and board-foot tree volumes. Volume trends will not entirely correspond to changes in canopy coverage, because a stand with large-diameter trees will have more volume than a stand of smaller-diameter trees with comparable canopy coverage. However, this can be addressed by comparing volumes by diameter class, to the extent this information is available.

Table IV-V16 shows changes in cubic-foot and board-foot volumes by major owner groups between 1949 and 1989. These figures come from Flowers et al. (1993), and reflect adjustments for different merchantability standards. Information specific to state lands is not available in this report; state land is included in the "other" category. A direct comparison of unadjusted 1949 and 1989 inventory data indicates that trends for state lands were similar to those of the "Other" owner group as a whole. We have included figures specific to state lands in 1989 for reference.

Table IV-V16
TRENDS IN CUBIC-FOOT AND BOARD-FOOT VOLUME ON FOREST LAND
Volumes Per Acre of Forest Land

Measure and Owner Group	1989	1949
Cubic Feet Growing Stock[1]		
All Owners	1,663	1,634
U.S. Forest Service	1,935	1,668
Forest Industry	1,349	2,920
Non-Industrial Private	1,073	1,268
Other (Includes State)	1,505	1,375
State Trust (Operable)	1,759	N/A
Board Feet (Int'l ¼ in.):[2]		
All Owners	5,516	6,297
U.S. Forest Service	6,166	6,138
Forest Industry	4,780	14,274
Non-Industrial Private	3,772	4,808
Other (Includes State)	5,674	5,384
State Trust (Operable)	5,927	N/A

[1] Cubic foot volume in trees 5.0" diameter and larger, to a 4.0" top.
[2] Board foot volume in trees 9.0" diameter and larger.

These trends show little change in overall cubic foot volumes over the past half century. However, volumes have increased somewhat on Forest Service lands and in the "Other" category that includes state lands. By contrast, volumes have declined substantially on industrial lands.

Board-foot volumes, on the other hand, show overall decreases. The only exceptions are Forest Service lands, which show little change, and lands in the "Other" category, including state lands, which have a slight increase. As board-foot volumes include only trees 9 inches and larger in diameter, this suggests a decline in the average size of trees.

Further indication of the reduction in tree size is shown in Table IV-V17. Information for 1949 was taken directly from Hutchison and Kemp (1952), so trends may partially reflect differences in how measurements were derived. Board-foot volume for trees smaller than 11 inches diameter was subtracted from the 1989 volumes, to make the data more comparable to the merchantability standards used in the 1949 inventory. Data for 1949 is not available by owner; we include figures for forested state lands in 1989 for reference.

Table IV-V17
TRENDS IN VOLUME DISTRIBUTION BY DIAMETER CLASS
Percent of Volume in Diameter Class

	State-Owned Forest Lands[1]	All Forest Lands	
Measure and Diameter Class	1989	1989	1949
Cubic Feet Growing Stock:			
5.0-10.9"	38%	45%	44%
11.0"+	62%	55%	56%
Board Feet (Int'l ¼ in.):			
11.0-20.9"	74%	77%	53%
21.0-28.9"[2]	21%	17%	36%
29.0"+[2]	5%	6%	11%

1 State-owned forest lands are operable trust lands for 1989 cubic-foot volume, and all state lands, including non-trust lands, for 1989 board-foot volume.

2 The diameter break between these classes is 31" rather than 29" in the 1949 data.

These data indicate a substantial shift of the volume toward smaller trees. As volume estimates of stocking are biased in favor of larger trees, and average volumes per acre have changed little over the past half century, this probably indicates an overall increase in stocking in terms of canopy coverage.

Increases in stocking levels and a shift toward smaller-diameter trees have been widely discussed in the literature. These trends are interpreted as due to "selective" logging of large-diameter trees out of large areas of forest, combined with fire suppression over most of the past century (Habeck 1990, Johnson et al. 1991, Monnig and Byler 1992, Mutch et al. 1993, Covington et al. 1994). These changes are also related to the shifts in species composition and cover types described previously. They have undoubtedly been most pronounced on Ecological Group A, B, and E sites, which were maintained in open conditions to varying degrees by relatively frequent, low intensity fires.

While stocking levels on state lands appear to have increased at least slightly since 1949, adjoining lands have had the opposite trend in many locations, primarily where state lands are intermingled with industrial lands. Where state lands are mixed with Forest Service ownership, on the other hand, it appears that the trend has been toward much denser stands.

Implications: Increases in stocking level associated with fire suppression have major ramifications in drier forests such as EGs A, B and E, which were naturally maintained in open conditions by frequent wildfires. The denser stocking produces higher forest stress levels because of increased competition for light, moisture and nutrients. This results in greater susceptibility to insects and diseases. These disturbances, while natural, are now likely to operate at unnatural levels.

Increases in closed canopy forests along with accumulation of dead fuels will also lead to higher-intensity fires than would have occurred naturally. Such fires are likely to be stand-replacing in areas that previously would have experienced primarily low-intensity underburns (Arno 1976, Habeck 1990, Johnson et al. 1991, Monnig and Byler 1992, Mutch et al. 1993, Covington et al. 1994).

On the other hand, decreases in stocking of larger-diameter trees represents a reduction in old-growth features. Habitats associated with old-growth as well as those connected with more open forests have been reduced substantially in extent over the past half century. Furthermore, the dense stocking of smaller trees results in slower diameter growth, reducing the likelihood that these trees will attain large sizes in the future.

While volume trends on state lands can only be interpreted indirectly from the available data, it appears likely that merchantable volumes have increased since 1949. Regeneration, tree growth, and stand density increases have apparently exceeded rates of harvest and other disturbances on state lands. The average harvest per year from state lands during this period has been 39.8 million board feet. However, future harvests will have to come from smaller trees, which have increased in volume while the representation of larger trees has declined.

Expected Future Conditions

DESCRIPTOR: STOCKING LEVELS	
EFFECTS COMMON TO ALL ALTERNATIVES Fire suppression will continue to promote stand structures with densely-stocked understories. These will eventually develop into dense poletimber and small sawtimber stands as they have in the past unless silvicultural treatments, possibly in combination with prescribed fire, are used to reduce these stocking levels.	
EFFECTS OF ALPHA	EFFECTS OF BETA
An emphasis on maintaining cover in big game winter ranges would limit stocking reduction on Ecological Group A sites, which typically were open-canopied historically. With the range of possible harvest levels, the acreage of poor to medium stocking would probably decline at least slightly.	Although the range of possible harvest levels is slightly lower than with Alpha, there is an increased emphasis on stocking reduction treatments in the drier ecological groups. This may result in more acreage with medium stocking, but less acreage with poor stocking, than under Alpha.

<table>
<tr><th colspan="2">DESCRIPTOR: STOCKING LEVELS</th></tr>
<tr><td>EFFECTS OF GAMMA

An emphasis on partial cutting methods would result in stocking reduction on more acres relative to harvest levels. Because annual harvests would be minimal, however, we expect a substantial net increase over current stocking levels. The acreage of poor to medium stocking would decline substantially.</td><td>EFFECTS OF DELTA

At the high harvest level, harvests may be large enough to increase at least slightly the acreage of poor to medium stocking. The opposite would occur at the low harvest level, or if a high percentage of the harvest were salvage to capture values currently at risk.</td></tr>
<tr><td>EFFECTS OF EPSILON

The percentage of land with poor to medium stocking may either increase or decrease slightly, depending on harvest levels and prescriptions. Placing increased emphasis on even-age cutting methods to increase stand-level timber production efficiency would probably result in a greater degree of stocking reduction on fewer acres, relative to harvest level.</td><td>EFFECTS OF ZETA

Because of the low harvest levels, the acreage of poor to medium stocking would decline substantially. This would especially be the case on ecological group A sites that historically had low stocking levels, because of an emphasis on maintaining big game winter range cover. Elsewhere, a greater emphasis on partial cutting would reduce stocking less over a larger acreage, relative to the harvest level.</td></tr>
<tr><td colspan="2">EFFECTS OF OMEGA

Trends should be towards slight decreases in well stocked stands through thinning of encroaching shade tolerant species. Non-stocked and medium stocked areas will slightly increase while poorly stocked areas should decrease. Medium stocked areas should remain roughly the same. The higher harvest levels than in Beta result in the anticipated differences between these two alternatives.</td></tr>
</table>

We predicted relative effects for each alternative, using historic conditions as a baseline for evaluating cumulative trends. The primary factors expected to influence stocking trends are level of timber harvest, silvicultural treatment methods, and fire suppression. Locations and timing of timber harvests, and level of silvicultural investment may have some effect also.

It is difficult to quantify estimates of future stocking level distributions. However it is reasonable to assume that the amount of area with low to medium stocking levels would be largely proportional to timber harvest levels. Since harvest levels for the past several decades on state land have averaged 40 MMBF per year, and growing stock volumes appear to have increased if anything over this period, any harvest level less than 40 MMBF per year should result in a net increase in stocking levels.

A given harvest level will reduce stocking on more acreage, but to a lesser extent and for a shorter duration, where intermediate or selection cutting is done. Emphasizing stocking reduction treatments in forest environments that typically had open forest structures (e.g. ecological group A) will do proportionately more to restore historic conditions than would similar treatments in environments that typically supported denser forests. Predicted relative levels of change are shown in Table IV-18.

Table IV-V18
PREDICTED TRENDS IN ACREAGE BY STOCKING LEVEL ON FORESTED STATE TRUST LANDS

```
ALPHA:                          Predicted trend    (<--> = predicted
                               from present levels          range)
         Stocking level       <-decrease | increase->
                                         |
         Nonstocked                     <|>
         Poorly stocked               <->|
         Medium stocked               <->|
         Well stocked                    |<->

BETA:                           Predicted trend
                               from present levels
         Stocking level       <-decrease | increase->
                                         |
         Nonstocked                     <|>
         Poorly stocked              <-> |
         Medium stocked                <-|>
         Well stocked                   <|-->

GAMMA:                          Predicted trend
                               from present levels
         Stocking level       <-decrease | increase->
                                         |
         Nonstocked                   <->|
         Poorly stocked             <->  |
         Medium stocked               <->|
         Well stocked                    |  <->

DELTA:                          Predicted trend
                               from present levels
         Stocking level       <-decrease | increase->
                                         |
         Nonstocked                     <|->
         Poorly stocked                <-|>
         Medium stocked                <-|>
         Well stocked                   <|-->
```

```
EPSILON:                          Predicted trend
                                from present levels
       Stocking level          <-decrease | increase->
                                          |
       Nonstocked                         |<->
       Poorly stocked                    <|->
       Medium stocked                    <|>
       Well stocked                     <-|>

ZETA:                             Predicted trend
                                from present levels
       Stocking level          <-decrease | increase->
                                          |
       Nonstocked                      <->|
       Poorly stocked                 <-> |
       Medium stocked                  <->|
       Well stocked                       | <->


OMEGA:                            Predicted trend
                                from present levels
       Stocking level          <-decrease | increase->
                                          |
       Nonstocked                         |<->
       Poorly stocked                 <-> |
       Medium stocked                    <|>
       Well stocked                      <|>
```

Other ownerships: Trends on other ownerships will vary considerably, depending on their current condition and future management goals. Adoption of an ecosystem management approach on National Forest lands should result in a net reduction in the amount of densely-stocked forest, depending on the level at which stocking reduction and prescribed burning practices are actually carried out. Further declines in volume per acre have been predicted for industrial lands (Flowers et al. 1993), which would suggest a continuing trend toward more open forests.

Cumulative Effects on Stocking Levels

Arresting long-term trends toward densely-stocked stands on state lands will probably require harvest levels of more than 40 MMBF per year. Lower harvest levels may accomplish this to some degree only if we emphasize intermediate treatments with stocking reduction as an overt goal.

The Delta and Epsilon alternatives would probably reduce the percentage of well-stocked stands toward historic levels if harvests are in the upper range of the estimates. Because Beta would specifically target out-of-balance conditions for treatment, it may also reduce the proportion of dense stands at least slightly at the high harvest estimate. Omega also targets out of balance stands but with the higher harvest levels would reduce the well stocked stands more than Beta. All other alternatives and harvest levels would almost certainly lead to continued stocking level increases.

Maintaining or increasing current high stocking levels on dry to moderately moist sites (especially EGs A, B and E) is likely to lead to increasingly severe insect outbreaks, root disease activity, and stand-replacing wildfires. If these effects do occur, stocking will ultimately be reduced, but to levels even lower than historic conditions over large areas. This has already begun to occur elsewhere in the Inland West where environments are similar (Johnson et al. 1991, Monnig and Byler 1992, Mutch et al. 1993, Covington et al. 1994).

Old-Growth

The Descriptor Relationship

Old-growth represents the later stages of natural development of forest stands. These are frequently not climax forests, but rather are subclimax conditions related in part to the natural role of wildfire in the Inland Northwest (Habeck 1988, 1990). Old-growth stands are generally understood to be dominated by relatively large old trees, contain wide variation in tree sizes, exhibit some degree of multi-storied structure, show signs of decadence such as rot and spike-topped trees, and contain standing large snags and large down logs (USDA Forest Service 1989).

Old-growth provides important habitat for some animal species, and may be ecologically important for other reasons (Habeck 1988). Old-growth stands also tend to provide the largest volume of high-quality timber, and thus are especially vulnerable to human impacts. Efficient timber management involves much shorter rotations than the time required to develop old-growth qualities.

Old-growth must be understood in its context of stand development and disturbance processes, which vary greatly by ecological group and topographic position. Fire is essential for maintaining old-growth ponderosa pine forests (Ecological Group A). By contrast, the prolonged absence of fire is necessary for the development of old-growth in moister EG C forests (Habeck 1988, 1990). Some evidence suggests that under natural conditions some forest types typically had much more old-growth than others (Losensky 1993).

Current Conditions

Estimated amounts of old-growth on state lands are shown in Table IV-V19. The estimates in Table IV-V17 were developed from DNRC Stand-Level Inventory information, with adjustments based on limited field verification, and extrapolated into unsampled areas. Stand-Level Inventory information for this procedure was available only for Northwestern and Southwestern Land Offices, so we extrapolated to other land offices by using comparative stand age data. While this procedure is imprecise, it represents the best available option at the present time; however, these estimates should be used with caution. Comprehensive information across forest ownerships is not available.

Table IV-V19
ESTIMATED OLD-GROWTH AMOUNTS ON FORESTED STATE LANDS

Item	NWLO	SWLO	CLO	NELO/ ELO/SLO	Total
Total Forest Acres	286,231	150,109	93,222	87,284	616,846
Estimated Old-Growth Acres	52,923	21,439	14,983	905	90,250
Estimated Percent Old-Growth	18.5%	14.3%	16.1%	1.0%	14.6%

Trends: Historic information on old-growth amounts is limited. Losensky (1993) has made some estimates of "potential" old-growth amounts by forest type on National Forest lands in 1900. These estimates are based on 1930s inventory data, with adjustments for stand age increases, fire, and timber harvest between 1900 and the 1930s. Losensky's estimates for Western Montana are shown in Table IV-V20. These estimates are based strictly on stand age criteria without screening for other criteria; consequently they may overestimate the amount of old-growth.

Table IV-V20
ESTIMATED NATIONAL FOREST OLD-GROWTH PERCENTAGES IN 1900
WESTERN MONTANA
(from Losensky [1993])

Forest Type	Percent Potential Old-Growth
Western White Pine	20.8%
Ponderosa Pine	54.4%
Larch/Douglas-fir	31.3%
Hemlock/White Fir	37.7%
Douglas-fir	6.9%
Engelmann Spruce	45.1%
Lodgepole Pine	2.7%
Western Redcedar	61.8%
Cedar/White Fir	29.5%
WEIGHTED AVERAGE	23.4%

Direct forest-type comparisons between Losensky's figures and current old-growth estimates for state lands are not currently feasible. Forest type definitions are different from those used in the statewide inventory publications, forest types have shifted markedly since the 1930s, and estimates of current old-growth amounts are too preliminary to be further subdivided by forest type. Nevertheless, some trends can be identified with relative confidence.

Overall amounts of old-growth may not have declined greatly since 1900. In addition to the estimates shown above for state lands, the Flathead National Forest (1992) administration has recently estimated that 20 percent of its forest land is currently old-growth. On the other hand, the data in Table IV-V16 indicate that the amount of old-growth on forest industry land has probably declined substantially.

Old-growth amounts in some forest types do appear to have changed substantially. Over the past century, harvest has greatly reduced amounts of old-growth ponderosa pine, western larch, and white pine forests. These forest types tend to occur in lower-elevation, relatively accessible areas, and have been heavily harvested for more than a century in some cases. In many cases, the greater hazard of intense wildfire resulting from increases in stand density and species composition changes threatens remaining old-growth ponderosa pine and larch forests (Habeck 1990, Covington et al. 1994).

Some forest types such as lodgepole pine show the opposite trend. Lodgepole pine forests tend to be in higher-elevation, less accessible areas, and until recently were less desirable as timber. Fire suppression has allowed lodgepole pine stands in many areas to age beyond their normal lifespan (Monnig and Byler 1992), increasing the previously small amounts of mature and old-growth lodgepole pine forest.

Trends on state lands are probably typical of those described above. A large proportion of state lands forests have been partially cut on one or more occasions, removing primarily large, high-value ponderosa pine and western larch from stands. However, substantial areas of low- and mid-elevation old- growth larch and spruce forests remain on the Swan, Stillwater and Coal Creek State Forests on Ecological Group C and F sites. Much of the public increasingly sees these forests as a unique resource that warrants protection from harvest.

Analysis procedure: We can quantitatively predict future old-growth amounts only in an indirect manner from stand age distributions. Existing estimates of old-growth acreage correspond to the acreage in stands older than 140 years on the average for NWLO and SWLO lands. Therefore, relative trends in acreage in stands older than 140 years may correspond at least roughly to future old-growth acreage. (NOTE: Because recorded stand ages may not reflect the oldest age classes in uneven-aged stands, they may be younger than the length of time since stand origin. Thus, recorded stand ages of old-growth stands may legitimately be much younger than the 200 years or so generally required for development of old-growth conditions.)

The proportion of older forest that will actually be old-growth in 2020 will depend in part on the development of stands that are currently between 115 and 140 years old, as well as on how much current old-growth would be left. Most of these stands are currently well-stocked. Densely-stocked stands will not develop large trees and old-growth structure for many decades if ever, and may be lost to natural disturbances without ever attaining old-growth qualities. Stocking levels of the current young to mature stands will be an important determinant of future old-growth amounts (Franklin et al. 1981, Oliver and Larson 1990). For this reason, we also use the expected level of intermediate or selection cuts in such stands to predict long-term old-growth development.

Implications: The amount and quality of old-growth in Montana and elsewhere have been substantially reduced, especially at lower elevations, because of timber harvest and to some degree fire suppression. Further reductions appear likely given continued timber harvest and management, potentially jeopardizing the viability of some species that use old-growth habitat. The smaller area and increased isolation of remaining old-growth may have further reduced its usefulness as habitat for many associated species (Harris 1984).

The importance of existing old-growth on state lands depends largely on the condition of intermingled lands. The remaining old-growth may be especially important in areas where surrounding lands have been heavily harvested, provided that patches are large enough or are adequately interconnected (Habeck 1988). On the other hand, large areas of old-growth with relatively little human disturbance may be particularly critical for maintaining overall ecosystem integrity (Noss 1993).

Expected Future Consequences

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The distribution of future old-growth, spatially and by forest types or ecological groups, will depend to a large degree on how harvest locations are chosen. We used the harvest location and timing scenarios for each alternative to predict the future distribution of old-growth. Our predictions for future old-growth amounts are shown in Tables IV-V21 and IV-V22.

The estimated percent of forested land that would still be occupied by current old-growth stands in 2020 is shown in Table IV-V21. These numbers are subject to the errors involved in estimating the current acreage of old-growth, as described in above. They also do not take into account provisions of some alternatives designed specifically to maintain certain amounts of old-growth; consequently, the percentages shown for the Beta, Gamma, Zeta and Omega alternatives are probably conservative. In general, these figures represent the lower limit of the amount of old-growth likely to be present in 2020.

Table IV-V21
PERCENT OF FORESTED ACRES ON STATE LANDS PREDICTED TO CONSIST OF EXISTING OLD-GROWTH IN 2020

	Harvest Level	NWLO	SWLO	CLO	NELO/ ELO/SLO	Average
CURRENT		18.5%	14.3%	16.1%	1.0%	14.6%
ALPHA	high	9.0	5.7	14.7	1.0	8.1
	low	14.2	10.0	15.6	1.0	11.7
BETA	high	10.3	6.8	14.9	1.0	9.0
	low	15.5	11.0	15.8	1.0	12.6
GAMMA	high	16.8	12.1	16.0	1.0	13.5
	low	18.1	13.1	16.2	1.0	14.4
DELTA	high	7.7	4.6	14.5	1.0	7.2
	low	15.5	11.0	15.8	1.0	12.6
EPSILON	high	5.2	2.5	14.1	0.9	5.3
	low	10.3	6.8	14.9	1.0	9.0
ZETA	high	14.2	10.0	15.6	1.0	11.7
	low	16.8	12.1	16.0	1.0	13.5
OMEGA	high	7.8	4.6	14.5	1.0	7.2
	low	7.6	7.8	15.2	1.0	9.9

Predicted amounts and characteristics of older forest in 2020 are shown in Table IV-V22. Unlike Table IV-V21, these numbers take into account the aging of younger stands into the 141 year-plus age classes. They also do not take into account provisions of some alternatives designed specifically to maintain certain amounts of old-growth; consequently, the percentages shown for the Beta, Gamma, Zeta and Omega alternatives are probably conservative. These figures represent an upper limit of the potential amount of old-growth in 2020, and probably overestimate these amounts substantially.

Table IV-V22
PREDICTED FUTURE AMOUNTS OF OLDER FOREST (>140 YEARS) ON STATE LANDS AND POTENTIAL FOR OLD-GROWTH DEVELOPMENT FROM YOUNGER FOREST

		Predicted percentages of older forest in 2020					
	Harvest Level	NWLO	SWLO	CLO	NELO/ ELO/SLO	Average	Potential for old-growth from younger forest
CURRENT		13.8%	18.3%	16.1%	1.0%	13.4%	
ALPHA	high	18.6	17.1	29.6	8.2	18.6	moderate
	low	26.8	27.7	31.3	8.3	25.5	low-moderate
BETA	high	20.6	19.7	30.1	8.2	20.2	moderate-high
	low	28.8	30.3	31.8	8.3	27.2	moderate
GAMMA	high	31.0	32.9	32.2	8.4	28.7	low
	low	33.1	35.5	32.6	8.4	30.5	low
DELTA	high	16.5	14.5	29.3	8.2	16.8	moderate
	low	28.8	30.3	31.8	8.3	27.2	low-moderate
EPSILON	high	12.3	9.3	28.5	8.1	13.4	moderate
	low	20.6	19.7	30.1	8.2	20.2	moderate
ZETA	high	26.8	27.7	31.3	8.3	25.5	low-moderate
	low	31.0	32.9	32.2	8.4	28.7	low
OMEGA	high	16.4	14.5	29.3	8.2	16.8	moderate-high
	low	22.7	22.4	30.4	8.2	22.0	moderate

DESCRIPTOR: OLD-GROWTH

EFFECTS COMMON TO ALL ALTERNATIVES

While there will be considerable difference between alternatives in the extent of stocking reduction treatments in stands currently between 115 and 140 years old, it will take time for many of these stands to become old-growth. Consequently, the extent of such treatments will have only a limited effect on the amount of old-growth in 2020. However, the longer-term effects of stocking control in young to mature stands may be substantial.

In 2020, we predict that between 53 and 62 percent of the older forest will consist of stands currently between 115 and 140 years old. Of this amount (roughly the difference between the corresponding figures in Tables IV-V21 and IV-V22), it is probably safe to assume that less than half would actually be old-growth by 2020 under all alternatives.

Over the next 25 years, any substantial harvest of old-growth will probably result in declines in old-growth acreage. Over the longer term, any increases in the acreage of old-growth will depend on the amount of stocking reduction treatment done in younger sawtimber stands. This is especially true for EG A and B sites, which depend on periodic low-intensity disturbances to control stand density and develop ponderosa pine and western larch old-growth (Habeck 1990).

DESCRIPTOR: OLD-GROWTH	
EFFECTS OF ALPHA	EFFECTS OF BETA
Under the range of harvest level estimates for this alternative, between 20 percent and 45 percent of the existing old-growth would be harvested between now and 2020. We predict the acreage of older forest to increase substantially at all Land Offices, except for SWLO at the high harvest level. The net result would probably be a slight increase to a slight decline in the amount of old-growth over the next 25 years, depending on harvest level. The likelihood that current younger forest will eventually become old-growth is only low to moderate. An emphasis on maintaining big game cover in many areas would reduce the amount of stocking reduction that is done in mature stands. Old-growth in 2020 would probably be located primarily in areas where resource concerns discourage harvest of existing and potential old-growth. These areas would tend to be stringers along drainages, inaccessible or inoperable areas, and possibly a few critical winter range areas that still have old-growth. Douglas-fir and spruce/fir forest types would probably be disproportionately represented. The proportions of old-growth consisting of ponderosa pine, western larch and white pine forest types would probably decline further.	We estimate that 15 percent to 40 percent of the existing old-growth would be harvested by 2020. Because of specific provisions to maintain old-growth, actual old-growth harvest may be less. We predict the acreage of older forests to increase substantially at all Land Offices. This increase may be sufficient to provide a net increase in old-growth acreage by 2020, especially at the low harvest level. Overall old-growth amounts should not decline at the high harvest level, but net declines may occur locally in areas that currently have high percentages of old-growth. As densely-stocked sawtimber is currently over-represented, it is likely that there would be an emphasis on stocking reduction in such stands under this alternative. Consequently, there is a moderate to high potential for stands currently 60-140 years old to become old-growth eventually. With the emphasis on maintaining and restoring old-growth, future old-growth would tend to be distributed more evenly across topographic positions and forest types. While it would take many decades to restore old-growth in badly-depleted forest types such as ponderosa pine, a slight increase in the proportion of old-growth consisting of early-successional forest types may occur.

DESCRIPTOR: OLD-GROWTH	
EFFECTS OF GAMMA	EFFECTS OF DELTA
Less than 10 percent of the existing old-growth would be likely to be harvested between now and 2020. This alternative would result in the highest amounts of older forest, with these amounts more than doubling between now and 2020. This should result in net increases in the amount of old-growth over the next 25 years. The low levels of timber harvest would not allow for much stocking reduction to be done in younger stands. As a result, extensive long-term development of old-growth from existing mature forest would be unlikely. Very little old-growth would be harvested, especially in ponderosa pine forest types where it is currently rare. However, long-term increases in these amounts would be limited, as extensive silvicultural treatment would be necessary to accomplish this. A continued shift toward late-successional old-growth is likely.	Up to half of the existing old-growth could be harvested by 2020. Old-growth harvest would be substantially less than this at the low harvest level. There would be small to substantial increases in the amount of older forest, except at SWLO under the high harvest estimate. Overall amounts of old-growth may either increase or decrease over the next 25 years, depending on harvest level. There is a low to moderate potential for current younger stands to develop old-growth characteristics in the long term. While the alternative does not specifically feature stocking reductions in these stands, there is little to preclude it except in areas where resources other than timber provide the primary revenue source. Future old-growth would occur mostly along streams, in inoperable areas, and in areas where trust income is derived primarily from sources other than timber harvest. If remnant ponderosa pine or western larch old-growth helps provide high recreational values in some areas, the proportion of old-growth consisting of these types may increase; otherwise they may decline because of high values for timber.

DESCRIPTOR: OLD-GROWTH	
EFFECTS OF EPSILON	EFFECTS OF ZETA
At the high harvest level estimate, essentially all of the current old-growth on non-deferred lands would be harvested by 2020. At the low harvest level, we predict that about 40 percent of the current old-growth would be harvested. The percentage of older forest would remain steady or have a slight increase overall, but might decline at NWLO and SWLO. The net result would probably be a slight to substantial decline in the overall amount of old-growth between now and 2020. Estimated harvest levels would be high enough to allow stocking reduction on a substantial acreage of younger stands. However, the emphasis under this alternative is more likely to provide for harvest rather than thinning of stands when they become mature. There is a moderate potential for old-growth characteristics to develop eventually in stands that do not receive a final harvest. Remaining old-growth in 2020 would be heavily skewed toward streamside stringers, and sites with poor access or operability. The proportion of old-growth in ponderosa pine and western larch forest types would decline, with a corresponding shift toward late-successional old-growth types.	At the harvest level estimates for this alternative, between 10 and 20 percent of existing old-growth would be harvested between now and 2020. Actual harvest could be less because of provisions to maintain old-growth. The predicted acreage of older forest would approximately double by 2020. With a low harvest level and an emphasis on maintaining dense stands for big game habitats, there would be a low to moderate probability that current younger forest would become old-growth in the long term. There would be an emphasis on maintaining representation of old-growth in all forest types and environments, so the proportion of ponderosa pine old-growth and other early-successional forest types would be maintained. However, harvest levels would be insufficient to provide for large-scale restoration of ponderosa pine old-growth.

DESCRIPTOR: OLD-GROWTH
EFFECTS OF OMEGA We estimate that 30 to 50% of existing old-growth may be harvested under this alternative. Because of specific provisions to maintain old-growth, actual old-growth harvest may be less than indicated. Omega calls for maintaining old-growth in amounts equal to 50% of historical levels as well as providing for replacement old-growth stands. Future amounts of older forest are predicted to increase 30 to 60% over current levels, except at the SWLO. Given the emphasis on restoring historic conditions we expect old-growth representation to increase in the badly depleted early successional forest types over time. However, this is a long term proposition and will not occur substantially within the planning horizon. Partial harvest within stands that would probably not become old-growth due to species and stocking characteristics will facilitate this long term development of old-growth across the landscape. Net declines may occur locally in areas that currently have high percentages of old-growth. As densely-stocked sawtimber is currently over-represented, it is likely that there would be an emphasis on stocking reduction in such stands under this alternative. Consequently, there is a moderate to high potential for stands currently 60-140 years old to become old-growth eventually.

Other ownerships: An increased emphasis on managing for conditions within historic ranges should lead to restoration of old-growth in early-successional forest types on National Forest lands. These efforts will require many decades to accomplish. Old-growth amounts on non-Federal ownerships will probably continue to decline across all forest types.

Cumulative Effects on Old-Growth

While we project the amount of older forest to increase with all alternatives with the possible exception of Epsilon, the character of this forest may continue to deviate from historic conditions. Currently, the older age classes are primarily old-growth. In the future, without stocking control they may also contain a number of smaller-diameter, densely stocked stands that do not meet old-growth criteria. Omega specifically addresses this concern through thinning of encroaching tolerant tree species.

Under historic conditions, the highest proportions of old-growth tended to occur in relatively dry ponderosa pine larch forests, and in protected moist environments (Losensky 1993). These correspond mostly to Ecological Groups A and F. The least old-growth apparently occurred in lodgepole pine and Douglas-fir forest types (EGs D and E), while moderate to moist upland environments (EGs B and C) supported intermediate amounts. Because of relative accessibility and timber values, these distributions have almost reversed now.

Under the Alpha, Delta, and Epsilon alternatives, these deviations from historic old-growth distribution will probably continue. While management direction under the Beta, Gamma, and Zeta alternatives calls for some restoration of historic old-growth distribution, harvest levels will probably be too low to provide the required degree of stocking control on EG A sites. Only the high harvest level estimate under Beta appears adequate to provide for effective restoration of ponderosa pine old-growth. However, we expect that under Omega we would be restoring the representation of these early successional old-growth stands.

Maintaining or restoring old-growth in locations where it will provide effective habitat for associated species will require targeted efforts toward this goal. Because of ownership patterns, the state has limited control over this. Ensuring old-growth habitat effectiveness will depend on the success of cooperative ecosystem management efforts across ownerships. While we would actively promote such agreements under the Beta, Gamma and Omega alternatives, effective efforts cannot be guaranteed under any alternative.

Snag Abundance

The Descriptor Relationship

Snags are dead trees, although live trees with broken tops and heart rot are sometimes included also. Snag numbers per acre are often estimated according to species, diameter, and height class. Tree species and degree of decay determines whether a snag is "hard" or "soft." In the absence of data, relative amounts may be compared for different forest types, successional stages and timber harvest influences.

Snags are an important old-growth element but can be prevalent in other structural stages as well. They are important as nesting, denning, roosting, or feeding sites for a number of bird, mammal and insect species. Down logs and decayed wood provide habitat elements for additional species, and play important roles in plant nutrient availability and symbiotic relationships between soil fungi and higher plants (mycorrhizae). Down logs along streams are an important influence on stream channel stability.

Current Conditions

Data is not currently available for estimating the abundance of snags on state lands or across ownerships, or for evaluating trends. Some general trends, however, seem apparent:

- Under natural fire cycles and prior to extensive logging, snags would not have been common in forests with frequent fires, especially EG A forests. Trees killed by one fire would have been largely burned up by subsequent burns. In these environments, fire suppression has probably increased the number of snags, barring other activity.

- Environments with less frequent fires would have had larger numbers of snags. Snags would have been most abundant in old-growth forests and in early post-burn environments (Hansen et al. 1991).

- Timber harvests remove trees that would be killed and left on site as snags in a wildfire. Consequently, timber harvests have reduced the numbers of snags in forest areas, compared to what wildfires of comparable intensities would do (Hutto et al. 1993).

- The conversion of old-growth to younger forest through timber harvest has reduced the numbers of snags, especially large snags, in harvest areas.

- Fire suppression and partial cutting have increased the proportion of area in closed-canopy "stem exclusion" stands (Oliver and Larson 1990). A number of trees die due to suppression in these types of stands, creating snags. However, these are generally small-diameter.

- Elevated levels of insects and disease associated with densely-stocked young and mature forests are likewise increasing the rate of snag creation in many areas (Monnig and Byler 1992, Mutch et al. 1993). These too are generally small in diameter.

- Sanitation and salvage logging, along with firewood cutting, have reduced the numbers of large snags in otherwise unharvested areas with road access. In recent years, helicopter yarding has begun allowing the expansion of salvage logging into previously inaccessible areas.

- Efficient slash disposal has reduced the number of down logs in many harvest areas.

The overall effect of human activity on snags most likely has been to reduce the numbers of large snags in roaded areas, and possibly to increase these numbers in some unroaded areas. Numbers of smaller snags (less than 15 inches or so in diameter) have probably increased.

Most forested state lands, especially in Western Montana, are relatively accessible by road and have had some harvest activity. It is highly likely that numbers of large snags on state lands have been reduced substantially over the past several decades. Forests that had frequent natural fires, primarily EG A sites, may be an exception.

Implications: Trends in snag abundance have probably reduced overall habitat suitability for wildlife species dependent on large snags for nesting or other habitat. Efficient slash disposal that has occurred in some harvest areas may contribute to reductions in long-term site productivity (Graham et al. 1991).

Expected Future Conditions

We predicted relative trends in numbers and sizes of snags across alternatives. Factors that may influence snag abundance are: level of timber harvest; silvicultural treatment methods; other silvicultural practices targeted at providing snags; amount of open road (providing access to firewood); and fire suppression. Predicted effects of alternatives on numbers of small and large snags on state lands are summarized in Table IV-V23.

Table IV-V23
PREDICTED TRENDS IN SNAG ABUNDANCE
ON FORESTED STATE TRUST LANDS

```
                      Predicted trend   (<--> = predicted
                     from present levels       range)
Alternative and item  <-decrease | increase->
                                 |
ALPHA    small snags (<=15")     |<-->
         large snags (>15")  <-->|
                                 |
BETA     small snags           <-|->
         large snags             |<->
                                 |
GAMMA    small snags             | <-->
         large snags             |<-->
                                 |
DELTA    small snags             |<-->
         large snags        <--->|
                                 |
EPSILON  small snags         <-->|
         large snags        <--> |
                                 |
ZETA     small snags             | <-->
         large snags             |<->
                                 |
OMEGA    small snags          <->|
         large snags             |<->
```

DESCRIPTOR: SNAG ABUNDANCE

EFFECTS COMMON TO ALL ALTERNATIVES

Fire suppression will continue to promote dense "stem exclusion" stands (Oliver and Larson 1990), in which small snags are continually created as trees die from suppression. These snags will mostly be less than 10 inches in diameter, and almost all will be 15 inches diameter or smaller. These dense stands will not produce many large-diameter trees, and thus replacement snags larger than 15 inches in diameter will become increasingly scarce in areas that do not receive stocking reduction treatments.

Because of net declines in representation of early-successional tree species such as ponderosa pine and western larch, snags of these species will be more poorly-represented in the future. An increasing percentage of snags in all diameter classes will consist of late-successional species. Lodgepole pine snags will probably comprise a higher proportion of the small-diameter snags as well, as more lodgepole pine stands reach ages and sizes that render them susceptible to mountain pine beetle epidemics.

Densely-stocked stands will be subject to increasing levels of insects and disease, and eventually to more intense wildfires. This will lead to increased numbers of snags; these will generally be less than 15 inches diameter (Monnig and Byler 1992, Mutch et al. 1993).

Existing snags will generally be left during timber harvest under all alternatives, unless they are salvageable or safety hazards. However, harvests will remove trees that would be left on the site as snags or down logs under a natural disturbance of comparable intensity.

Firewood cutting will continue to reduce the number of snags, especially large snags, in areas with open road access.

<table>
<tr><th colspan="2">DESCRIPTOR: SNAG ABUNDANCE</th></tr>
<tr><td>EFFECTS OF ALPHA

In timber harvest areas, trees may be left as replacement snags where identified as an important wildlife issue. Some salvage logging would be done, which would reduce numbers of larger snags in accessible areas. Road closures implemented for wildlife habitat or other management concerns would continue to reduce access to firewood.

Overall, numbers of large snags would probably remain at current levels or decline over time, depending on harvest level, while smaller snags may increase somewhat.</td><td>EFFECTS OF BETA

An increased emphasis on stocking reduction in small sawtimber stands would improve the overall vigor of these stands at the high harvest level estimates. This may reduce the long-term rate at which small snags would be created. More retention and replacement of old-growth, along with reduced salvage logging, would provide more large snags in the long term. An increased emphasis on road closures would reduce access to firewood.

On the whole, numbers of large snags would probably remain similar to present levels or increase slightly over time. Numbers of smaller snags may either increase or decrease, depending on whether the harvest level is sufficient to control stocking over a substantial portion of the forested area.</td></tr>
<tr><td>EFFECTS OF GAMMA

Low harvest levels would result in an abundance of dense stands, and hence in increasing numbers of small snags over time. With little or no harvest of old-growth and more emphasis on road closures, numbers of large snags would probably increase as well.</td><td>EFFECTS OF DELTA

Overall snag trends would be similar to Alpha. A more aggressive approach to sanitation and salvage harvest to capture values at risk to mortality may result in a faster reduction in the number of large snags.</td></tr>
<tr><td>EFFECTS OF EPSILON

Practices to enhance timber production would emphasize both harvest of older stands and stocking control of younger stands. This would tend to result in declines over time both in small and large snags.</td><td>EFFECTS OF ZETA

Low harvest levels and an emphasis on promoting old-growth would probably result in increases over time in the numbers of large snags. However, road management to emphasize recreational opportunities may increase public access to large snags for firewood. Limited levels of timber harvest would tend to maintain dense stands and result in increasing numbers of smaller snags.</td></tr>
</table>

DESCRIPTOR: SNAG ABUNDANCE
EFFECTS OF OMEGA
An increased emphasis on stocking reduction in small sawtimber stands would improve the overall vigor of these stands at both harvest level estimates. This may reduce the long-term rate at which small snags would be created. More retention and replacement of old-growth, along with reduced salvage logging, would provide more large snags in the long term. An increased emphasis on road closures would reduce access to firewood thus promoting the maintenance of larger persistent snags. On the whole, numbers of large snags would probably increase slightly over time. Numbers of smaller snags would likely decrease, depending on whether the harvest level is sufficient to control stocking over a substantial portion of the forested area.

Other ownerships: Trends in snag abundance on other ownerships will depend on the harvest levels and types of management practiced there. The ecosystem management approach being adopted by the Forest Service, if implemented over large areas, would probably involve extensive restoration of old-growth qualities, with stocking control treatments in younger stands. This would tend to result in maintenance or increases over time in the numbers of larger snags, and decreases in the numbers of small snags, on National Forest lands. Short timber rotations on industrial lands would result in few large snags, and low to high numbers of small snags depending on the level of investment in reforestation to seral species and thinning.

Road access will continue to affect numbers of large snags across ownerships. If there is a stronger emphasis on road closures in grizzly bear recovery areas or for other reasons, access to snags for firewood will decline. Large snags near open roads, especially near populated areas, will be virtually absent.

Cumulative Effects on Snag Abundance

Trends toward fewer large snags will likely continue under the Alpha, Delta and Epsilon alternatives. Some recovery in numbers of large snags will probably occur under the Gamma, Zeta and Omega alternatives, and possibly under the Beta alternative, over the next 25 years.

Cumulative trends in snag availability, especially large snags, will affect habitat suitability for snag-associated wildlife. In areas where state forest lands are scattered among other ownerships, the state will have limited influence over snag habitats at landscape scales. However, snag trends on state parcels may have a substantial effect on these habitats locally.

Snag numbers will ultimately affect amounts of down woody material in the forest. Moderate levels of down woody material (10-15 tons per acre) may be important to maintaining site productivity in virtually all forest environments (Graham et al. 1991). If snags are not available to provide this material, otherwise-merchantable trees may need to be left on site to provide it.

On the other hand, excessively high fuel loadings, especially in drier environments such as EG A, B and E, will increase the likelihood of stand-replacing fires in environments that were naturally influenced by lower-intensity underburns (Mutch et al. 1993, Covington et al. 1994). Overall increases in down log numbers can be expected in areas that do not receive some type of harvest; these areas will be most abundant under alternative/harvest estimate combinations that provide for the lowest harvest levels.

Patch Sizes and Shapes

The Descriptor Relationship

Patch size means the size of contiguous acreage with similar forest characteristics. Stand development stage and stocking level are generally the most important conditions that differentiate one forest patch from another. Landscapes can be analyzed based on mean patch size and the distribution of acreage among patches of different sizes.

Patch shape means the degree to which a patch is square or round versus linear or narrow in shape. This can sometimes be expressed as the ratio of perimeter to area for a patch of given acreage, or as a length-to-width ratio. Patch size and shape are sometimes integrated by evaluating the percentage of area that is within a certain distance of an edge between two conditions.

Patch size and shape influence habitat suitability for many animal species. Small, closely-spaced patches of similar habitat favor dispersal for some species, while other species are associated with large contiguous patches. Some species benefit from a mosaic of different habitat conditions. Many species are associated either with edges or with interior conditions.

Patch characteristics of all stand structural stages, including recent harvests or other disturbances, also influence wildlife habitat suitability. Dispersed timber harvest units tend to fragment large blocks of later-successional forest. Consequently, large patches of old-growth and other closed-canopy forest are at particular risk of being lost in managed forests.

Current Conditions

Useful data is not currently available to quantify existing conditions, except for the Swan and Stillwater State Forests, for which GIS evaluations can be done for the state lands.

Data to evaluate trends in patch characteristics is likewise lacking, but some changes over the past century are apparent. Many of these changes are specific to particular ecological groups. These trends can be briefly summarized as follows:

- Fire suppression has reduced the amount of open-canopied and nonstocked forest in unharvested areas. This has produced larger patch sizes in these areas by obscuring natural mosaics.

- Partial cutting has often been done rather uniformly over large areas and has generally caused only temporary reductions in stocking. Consequently, it has tended to reinforce the results of fire suppression in creating larger patches.

- Even-age harvests (clearcut, seed tree and shelterwood) have generally been done in dispersed patches, commonly 10 to 80 acres in size, on both state and federal land. These are typically larger than patches in some environments (e.g., Ecological Groups A, B and E), but smaller than patches in moister forests (e.g., EGs C and D). This has resulted in the reduction in width of the intervening matrix of closed-canopy forest in these moister environments (Hansen et al. 1991).

- Cutting in dispersed patches has been practiced to minimize cover disruption for big game, and because of a general forest management philosophy that favors dispersing harvest impacts across a broader area.

- In some places on state land and other ownerships, even-age harvests have been done in much larger blocks of hundreds of acres. This has produced patch sizes more consistent with natural disturbances in some moist environments; however, cutting boundaries are generally set at artificial locations such as ownership boundaries, rather than following natural breaks in topography or stand history.

- Edges of even-age harvest units tend to be straighter and more abrupt than boundaries of natural disturbances. The degree of variation is also greater in a clearcut than in a recent wildfire, where standing snags provide more continuity with standing forest. These abrupt edges create more extreme boundaries between patches than would usually occur naturally.

The net effect, for the most part, has been to obscure natural variation between small patches (i.e., fractions of an acre to several acres) and large patches hundreds of acres in size. At the same time, variation between patches of intermediate acreage has been increased. As a consequence, the amount of edge between closed forest and distinct openings has been markedly increased in many areas.

Implications: The homogenizing of patch sizes and increases in the amount of abrupt edge may have major effects on wildlife habitat. In effect, natural mosaics both of large uniform areas of even-age forest and of naturally patchy and clumpy forest have been fragmented (Freedman and Habeck 1984; Hunter 1990, p. 80-100). More of the forest area is influenced by distinct edges than would be the case in a natural environment, which probably reduces habitat suitability for species associated with "forest interior" conditions.

These changes may also affect timber management opportunities in several ways. The dispersal of past timber harvest units and consequently of remaining mature forest increases the amount of road required to access a given volume of timber, and may increase harvest and prescribed burning costs. Abrupt edges may result in increased blowdown in some situations. The spread of wildfire, insects, and disease may either be increased or decreased, depending upon the situation.

People generally see dispersed harvest units as unnatural and ugly. Thus, recreational value and a public climate for further timber management may have been negatively affected.

Expected Future Conditions

DESCRIPTOR: PATCH SIZES AND SHAPES
EFFECTS COMMON TO ALL ALTERNATIVES Legally-required suppression of wildfires will continue to obscure variation between small patches by allowing increases in stand density. This effect will occur mainly on Ecological Group A, B, and E sites, where frequent natural fires tended to maintain a small patch structure. In spite of concerns about the fragmentation caused by dispersed-patch timber harvests (Hansen et al. 1991), the harvest of timber in dispersed 10 to 80 acre patches will probably continue to a large extent under all alternatives. Reasons will include minimizing distance to cover for wildlife and public objection to large even-age harvest units. On the other hand, it will probably become more common under all alternatives to locate new harvests next to older regenerated harvest units rather than among mature forest, to reduce the degree to which older forest is fragmented. As regenerated stands in current and past harvest units develop, the differences between these stands and the surrounding forest will decrease over time. As a result, the number of medium-sized patches will decline over time in areas with little or no additional harvest. In areas where periodic dispersed-patch harvests continue, the degree of medium-scale patchiness will also continue to increase up to a point. Timber management practices would continue to differ in some respects from natural disturbances. Trees that would remain on site as snags or down logs following a wildfire would be removed from the site in a timber harvest. This will lead to sharper short-term differences between disturbed and undisturbed areas than those typically resulting from natural processes.

DESCRIPTOR: PATCH SIZES AND SHAPES	
EFFECTS OF ALPHA	EFFECTS OF BETA
A continuing emphasis on maintaining big game habitat suitability might favor extensive use of 5- to 20-acre harvest units scattered among relatively mature timber, where even-age silviculture is practiced. This would continue the trend toward reducing the size and width of large patches. This effect would probably be largest on Ecological Group C and D sites, where natural processes tend to favor an abundance of large closed-canopy patches.	An emphasis on more diverse landscapes would lead to more use of uneven-age management in drier environments such as EG A and E, which would promote greater diversity among small patches within stands. In moister areas (EGs C and D), even-age harvest units would continue to be relatively small. However, techniques such as locating new cutting units next to old harvests may maintain mature and older forests in larger patches, and reduce at least somewhat the development of medium-scale patchiness. Other techniques to promote more "natural" patch and edge patterns would be used more often, reducing the degree of edge abruptness. All of these practices would probably lead to a net restoration of historic patterns.
EFFECTS OF GAMMA	EFFECTS OF DELTA
The emphasis on more diverse patterns described for Beta apply here as well. However, harvest levels under Gamma would be lower, resulting in a smaller direct effect on patch characteristics. Low harvest levels would also result in fewer medium-sized patches as stands in past harvest areas develop and become more like the surrounding forest. Continued effects of fire suppression would be the dominant effect.	Overall trends would be similar to Alpha. A stronger short-term financial emphasis would probably lead to use of larger harvest units to lower management costs. However, unit sizes that match those of large-scale disturbances would not be used often. Big game habitat considerations would have less influence on harvest pattern, probably resulting in less increase in medium-scale fragmentation than with Alpha. Sites managed for revenue sources other than timber would probably have little harvest activity. On these sites, fire suppression would have the strongest effect on patch characteristics.

DESCRIPTOR: PATCH SIZES AND SHAPES	
EFFECTS OF EPSILON Effects would be very similar to those described for Delta, except that income potential from resources other than timber would have little effect on management. Efficient timber management practices would lead to medium-size patches, with less variation at small and large scales.	EFFECTS OF ZETA With low levels of timber harvest, overall effects would be similar to Gamma. If timber management were used to enhance wildlife habitat, harvests would probably be mostly selection cutting in dry to moderately moist environments (EGs A, B, E). This would lead to more variation between patches at small scales on these sites. Development of the new stands in past harvest areas would tend to reduce the degree of medium-scale patchiness.
EFFECTS OF OMEGA An emphasis on more diverse landscapes would lead to more use of uneven-age management in drier environments such as EG A and E. This would promote greater diversity among small patches within stands. In moister areas (EGs C and D), even-age harvest units may continue to be relatively small, although some emphasis will be placed on increasing large patch size representation. Furthermore, techniques such as locating new cutting units next to old harvests may maintain mature and older forests in larger patches, and reduce the development of medium-scale patchiness. Other techniques to promote more "natural" patch and edge patterns would be used more often, reducing the degree of edge abruptness. All of these practices would probably lead to a net restoration of historic patch size and pattern characteristics.	

We predict relative trends in patch characteristics for each alternative. The major influences will be those that have affected the current environment: fire suppression; silvicultural treatment methods, including details of harvest layout intended to produce particular patch characteristics; and the timing and location of timber harvests. We summarize the predicted patch size trends in Table IV-V24.

Table IV-V24
PREDICTED TRENDS IN PATCH CHARACTERISTICS ON FORESTED STATE LANDS

```
                     Predicted trend    (<---> = predicted
Alternative and      from present levels      range)
patchiness scale*   <-decrease | increase-> (X = historic
                               |              status)
ALPHA:                         |
  small scale               <->|      X
  medium scale           X     |<--->
  large scale               <->|    X
                               |
BETA:                          |
  small scale                  |<->   X
  medium scale           X   <-|->
  large scale                 <|->  X
                               |
GAMMA:                         |
  small scale               <->|      X
  medium scale           X <-> |
  large scale                <-|>   X
                               |
DELTA:                         |
  small scale               <->|      X
  medium scale           X    <|-->
  large scale               <--|>   X
                               |
EPSILON:                       |
  small scale              <-> |      X
  medium scale           X     |<--->
  large scale               <->|    X
                               |
ZETA:                          |
  small scale                <-|->    X
  medium scale           X  <->|
  large scale                <-|>   X
                               |
OMEGA:                         |
  small scale                  | <-> X
  medium scale           X  <->|
  large scale                  |<-> X
```

* Scale: small scale - variation between patches less than 5 ac.
medium scale - variation between patches 5-100 ac.
large scale - variation between patches larger than 100 ac.

Other ownerships: Harvests on industrial lands will probably continue to be relatively large in acreage for economic reasons, but may deviate more from traditional even-age management. This may result in patch variation at both small and large scales. Large patches of closed-canopy and mature forest will be uncommon, though, because rotations would mostly be short.

Ecosystem management on National Forest lands is designed to mimic natural vegetation patterns more closely. If this involves the use of rather large harvest units with variation in treatments within units, it would also result in both small-scale and large-scale patchiness with eventual representation of all successional stages.

Cumulative Effects on Patch Size and Shape

The fragmentation associated with increases in medium-size patches will be largely proportional to harvest level, except with Omega. Continued increases in such fragmentation are likely under the Alpha, Delta, and Epsilon alternatives. Management objectives under the Beta and Omega alternatives call for greater attention to landscape patterns in harvest design, which should reduce fragmentation over time. The degree of fragmentation should also be reduced over time under the Gamma and Zeta alternatives, because of low harvest levels and attention to landscape patterns in management activities.

Recovery of small and large scale natural patchiness will depend largely on harvest patterns that simulate the results of wildfires. The nature and level of timber harvest would probably result in continued reduction in small and large patches under the Alpha, Delta, and Epsilon alternatives. The landscape emphases under the Beta and Zeta alternatives might allow some recovery of patchiness at these scales, if harvests were extensive enough to create patches. Given the philosophy and the harvest levels in Omega, it is expected this alternative would do the most to restore historic patch size and shape characteristics. Harvest levels would be too low under the Gamma and possibly Zeta alternatives to allow much development of patches of any size.

The predicted trends in patch characteristics only apply if extensive high-intensity wildfires do not occur. With the likelihood of such fires increasing over time, landscapes dominated by large openings may predominate in many places. Variation at small scales would be much less than would have occurred with the low- to moderate-intensity burns that prevailed in many environments.

Further fragmentation associated with medium-size patches will cause reductions in forest interior habitats and increases in edge habitats, with effects on a number of wildlife species. Forests dominated by medium-size patches will lack both the large areas of homogeneous conditions and the diversity of small patches within stands that are important habitats for many "specialist" wildlife species (Freedman and Habeck 1984; Hunter 1990, pp. 80-100; Hansen et al. 1991).

The visual impact of dispersed even-age harvest units can be reduced in several ways. These include placing harvests adjacent to young stands rather than in the midst of mature stands, feathering edges, locating edges along existing terrain or stand breaks, leaving some large reserve trees in harvest units, and leaving patches of vigorous young trees where they are present. These same practices, with the exception of leaving large reserve trees, will also tend to reduce the potential for blowdown after timber harvest. While these practices are most strongly favored under the Beta, Gamma, Zeta and Omega alternatives, they can and probably would be used to some extent under all alternatives.

SUMMARY

The level of timber harvest under each alternative will shape trends in vegetative communities to a large degree. However, the nature of the timber harvest--how harvest locations are selected and the silvicultural treatments used--will also have substantial influences on vegetation. Given the need to provide for public safety and protect homes and property, the legal requirement for continued suppression of wildfires is not expected to change, and fire suppression will remain a major influence on vegetative communities under all alternatives.

Cumulative trends in the condition of vegetative communities are frequently discussed in terms of "forest health." Forest health has been defined by O'Laughlin et al. (1993) as "a condition for forest ecosystems that sustains their complexity while providing for human needs."

Defined as such, forest health refers to the integrity of forest ecosystems as well as our ability to meet management objectives. In terms of ecological integrity, a healthy forest is one that maintains all of its natural functions. Historic or pre-settlement conditions are useful as a basis for evaluating ecological function, although the historic range of variability may not be sufficient as a management goal.

In relation to management objectives, forest health represents a condition which meets current and prospective future management objectives. A forest can be considered unhealthy if levels of stress, insects, pathogens, or wildfire threaten the values people place on the forest. These values include commodities such as timber, as well as concerns such as water quality, aesthetics, and wildlife habitat (Monnig and Byler 1992, O'Laughlin et al. 1993).

Both fire suppression and methods of timber harvest have greatly influenced forest health. These combined influences have resulted in forests more heavily stocked, with smaller trees and more shade-tolerant species, than in the past. The natural patterns of variation between patches of forest have also changed substantially. The results are elevated levels of stress, greater susceptibility to insects and diseases, and increased wildfire intensity when fires do occur. Grazing practices have also combined with fire suppression to change the composition of grasslands, shrublands, and riparian areas. To some experts, these trends represent poor forest health (Mutch et al. 1993, O'Laughlin et al. 1993).

Loss of old-growth forest in at least some forest environments may also have adverse implications for forest health. While losses of habitat for old-growth associated animal species are a major consideration, other less-understood aspects of ecosystem function may also be affected (Habeck 1988).

These changes have impacted or may impact the viability of wildlife populations, soil qualities, and watershed function. They will most likely reduce our ability to manage forests for desired levels of timber production, water quality, wildlife habitats, aesthetic and recreational values, and biological diversity. These factors have been described above in some detail, and are further evaluated in the analyses of wildlife, watersheds, and fisheries. For a longer discussion of the forest health issue, see Appendix VEG.

CUMULATIVE EFFECTS OF ALL DESCRIPTORS

In the following section we combine the effects of all descriptors to determine the overall effects on the ecological health of vegetation communities.

Effects Common to All Alternatives

Given society's interest in protecting communities, watersheds, wildlife habitats, and timber resources, we expect wildfire suppression policies to continue under all alternatives. Even in wilderness areas and National Parks, we expect fire suppression efforts to continue during years of high fire danger, when the most extensive natural wildfires would have occurred in the past. The net effect is that fires will continue to play a diminished role in shaping forest ecosystems. On the other hand, fires that do occur will generally be more intense, with effects on soils and vegetation that are more severe than those of pre-settlement fires (Mutch et al. 1993, Covington et al. 1994).

Conditions on adjoining ownerships will affect state lands in these ways:

- High susceptibility of adjoining lands to insects or intense wildfire increases the risks to intermingled state lands. Fires that begin on other ownerships and escape control can spread onto state lands. Similarly, insect outbreaks may achieve epidemic proportions based on overall susceptibility over a broad area, and may cause abnormal levels of damage even in relatively "healthy" stands.

- Viability of wildlife populations will depend on habitat suitability over a broad landscape in many cases. Poor habitat quality on state lands may have fewer adverse impacts if conditions are healthy at a broader scale, and maintaining good conditions on state lands may not maintain habitat suitability for some species if surrounding conditions are unsuitable.

This does not mean that vegetative conditions on the state lands themselves have little influence on their manageability or ecological function. However, the ecological health of state lands must be evaluated in the context of conditions at a landscape or even a regional level. The effects of conditions on other ownerships will be most pronounced where state lands are scattered parcels, but will have some influence even in areas of concentrated state land ownership.

Effects of ALPHA

The range of possible harvest levels would tend to maintain or increase current deviations from historic conditions. The emphasis on maintaining forest cover and late-successional tree species associated with ideal big game winter range conditions would reinforce these trends. As a result, forest health would probably decline further over time, at least in the drier ecological groups.

Effects of BETA

This alternative emphasizes restoring the historic distribution of vegetative conditions. This would entail substantial harvest in younger sawtimber stands, much of it intermediate cutting for stocking control or restoration of early-successional species.

Even with these objectives, only the upper end of the possible harvest range appears sufficient to provide a net recovery of historic characteristics. At lower harvest levels, rates of stand development would exceed harvest rates to a degree that continued declines in forest health would probably occur.

Effects of GAMMA

The objectives of this alternative call for reliance on natural processes to restore ecological health. However, further departures from natural conditions appear unavoidable, as stocking levels and dominance of late-successional species would continue to increase with low timber harvest levels. Natural processes of insect and pathogen activity and wildfire would operate at unnatural levels when they did occur, and reestablishment of natural patterns and stand structures after such disturbances would take a very long time. This alternative would preserve the greatest amount of existing old-growth, and would provide the greatest increase in the amount of older forest. The low harvest levels would restrict the amount of stocking control that could be done, and thus limit the long-term development of old-growth conditions from existing immature stands.

Effects of DELTA

Depending on harvest level and methods, this alternative could result either in improvements or declines in some aspects of forest health. Management under this alternative may place a greater emphasis on harvesting where the potential for short-term losses of timber appear greatest, rather than on improving the health of younger forests. Protection and restoration of old-growth would be unlikely except in areas where it would provide an apparent source of trust revenue.

Effects of EPSILON

Given the relatively high possible harvest levels and emphasis on maintaining vigorous stands for timber production, this alternative would provide for improvement in some aspects of forest health. In particular, the extent of early-successional species would probably increase and the acreage in densely-stocked stands might decrease substantially.

On the other hand, this alternative would also promote the most rapid loss of remaining old-growth. Short timber rotations would not provide for old-growth restoration, but would generally produce well-spaced stands that could develop into old-growth if future management direction changed. Continued deviations from natural patch characteristics would also be most pronounced under this alternative.

Effects of ZETA

Low harvest levels, combined with a likely emphasis on maintaining high stocking levels and late-successional tree species on big-game winter range, would probably result in continued forest health declines. A relatively high proportion of existing old-growth would be retained, but high stocking levels in younger stands would limit opportunities for old-growth restoration.

Effects of OMEGA

This alternative emphasizes restoring the historic distribution of vegetative conditions. This would entail substantial harvest in younger sawtimber stands, much of it intermediate cutting for stocking control or restoration of early-successional species.

With these objectives, the possible harvest range appears sufficient to provide a net recovery of historic characteristics. Recovery or maintenance of forest health is a primary consideration.

Old-growth representation is specifically described and harvest levels should be sufficient to provide for future development of old-growth where it is under represented. Areas with amounts of old-growth which exceed historic levels would experience a decrease towards the historic level.

VEGETATION

PLANT SPECIES OF SPECIAL CONCERN

INTRODUCTION

In this section we describe the likely level of impacts of each alternative on plant species of special concern and the methodology we used to estimate those impacts. In the Executive Summary, we presented a summary table of the environmental consequences of each alternative for plant species of special concern. When speaking of plant species of special concern, we sometimes refer to them for convenience as "sensitive" species. This usage of "sensitive" does not specifically refer to the U.S. Forest Service "sensitive" definition.

METHODOLOGY

Plant populations, unlike animal populations, are immobile and generally occupy a discrete, relatively stable area on the landscape. Each of the plant species of special concern has individual critical life history characteristics, habitat requirements, and ecological responses. Many factors may cause a positive or negative response in a sensitive plant population. These factors that determine "potential vulnerability " can be grouped into three main categories: a) the geographical distribution, b) plant species biology, and c) the autecological characteristics (ecological response) of the species (Shelly 1992). The extent of our knowledge of these characteristics varies greatly. For some plants we have exhaustive information on geographic distribution, biology and habitat requirements. For other plants we have very little or no information. In most cases we have little information about plant species biology and ecological response; consequently, it is extremely difficult, and potentially misleading, to generalize about the effects of management activities (especially concerning indirect effects on ecological response) on these diverse taxa, at least in the short term (Shelly 1992).

Plant populations are vulnerable to direct, physical impacts from management activities, and we can estimate the area at risk of direct impacts. We recognize that species of special concern are adapted to some broad habitat types and can estimate the potential risks to a plant type or community posed by management activities. As knowledge about the distribution, biology and ecological responses of many of these species is limited, we will not attempt to predict the response of any individual species to forest management under the various alternatives. Instead, we will predict trends in the factors to which plant species of special concern are likely to be vulnerable.

Several features tend to characterize "sensitive" species, in contrast with species that are relatively safe from extirpation (Keystone Center 1991, Shelly 1992, 1994):

- Their rates of changes in population size may fluctuate greatly depending on various factors, such as ecological relationship or biological characteristics, making them vulnerable to factors that adversely influence their population growth.

- They may be rare because of very specialized habitat requirements that limit their distribution. They may be susceptible to disturbances within their limited habitats, to losses of required habitat features, or to exotic species that are more competitive within their niches.

- They may have a limited geographic range or be represented by isolated populations on the fringe of a broader range. They may consequently become non-viable if populations are reduced, further fragmented or subjected to increased stress levels.

- They may be associated with another species, such as an insect or vertebrate pollinator, whose populations must be maintained in order for the plant species to remain viable.

In consideration of these features, we will concentrate this analysis on management practices that a) contribute to cumulative changes in natural habitat characteristics such as levels of shade or moisture stress; b) involve changes in natural disturbance regimes, especially fire; c) cause mechanical disturbances that may kill individual plants or small populations; d) increase or reduce competition from noxious weeds or other exotic species; and e) involve unnatural patterns or levels of grazing.

These five sets of practices will be treated as descriptors of risk to plant species of special concern, and will be evaluated separately by alternative. We will give primary attention to these practices as they affect forest lands, but will also consider effects on grasslands, riparian habitats, and other conditions that are represented on some lands covered by the Plan.

ENVIRONMENTAL CONSEQUENCES FOR PLANT SPECIES OF SPECIAL CONCERN

In the following section, we will outline the predicted effects for each individual descriptor. First we will describe effects common to all alternatives, if there are such effects, and then effects specific to individual alternatives.

DIRECT AND INDIRECT EFFECTS

Natural Habitat Characteristics

The Descriptor Relationship

Classifying plant species of special concern by habitat provides insight into the likelihood of management impacts associated with forest management, recreational uses, and special uses. For example, plants that live in grasslands would not be affected by forest management, except possibly by access roads; however, they may be affected by grazing management practices. Some species of special concern may be associated with particular successional stages, although little is known about these relationships for many species (Shelly 1992, 1994). Accordingly, changes in cover types and stocking levels may affect sensitive plants. Because different species will respond differently to changes, we will consider the likelihood of adverse impacts to be related to the degree of cumulative variation from historic baseline conditions.

We have predicted that alternatives with low harvest level estimates would tend to increase the representation of closed-canopy and late-successional forests. Higher harvest level estimates would tend to have the opposite effect, especially where management efforts were specifically directed at restoring early-successional and open-canopy forests. As described in the vegetation analysis, Montana's forests have shifted toward denser stocking and late-successional forest types due to fire suppression and partial cutting practices. Consequently, the alternatives that would continue these trends are most likely to have adverse cumulative effects on some natural plant communities. The alternative scenarios that result in a net recovery of early-successional species and open canopy conditions are more likely to be beneficial to some natural communities.

Current Conditions

As described in the vegetation analysis, Montana's forests have shifted toward denser stocking and late-successional forest types due to fire suppression and partial-cutting practices. Areas that have been harvested in the past may have increased or decreased plant populations. Those plants most sensitive to change may have declined throughout all or part of their geographic range in Montana.

Expected Future Conditions

<table>
<tr><th colspan="2">DESCRIPTOR: NATURAL HABITAT CHARACTERISTICS</th></tr>
<tr><td colspan="2">EFFECTS COMMON TO ALL ALTERNATIVES

Under all alternatives, fire suppression and grazing will tend to favor shrub and conifer encroachment on nonforested land. This may adversely affect sensitive plant species associated with grasslands.</td></tr>
<tr><td>EFFECTS OF ALPHA

Alpha would tend to favor species associated with shade conditions and late-successional forest types. Grazing effects on riparian communities would be most pronounced under this alternative because the stricter grazing standards of the other alternatives would not be used.</td><td>EFFECTS OF BETA AND OMEGA

The high harvest level estimates and emphasis on diversity of stand structure under Beta & Omega would tend to favor plant species adapted to early-successional and more open-canopied forests. Stricter riparian grazing standards would reduce grazing effects on riparian communities and should provide for some recovery of species associated with riparian and cottonwood habitats on classified Forest lands.</td></tr>
<tr><td>EFFECTS OF GAMMA AND ZETA

The low harvest level estimates of Gamma and Zeta would probably favor species associated with shade conditions and late-successional forest types. Stricter riparian grazing standards would reduce grazing effects on riparian communities and should provide for some recovery of species associated with riparian and cottonwood habitats on classified Forest lands.</td><td>EFFECTS OF DELTA AND EPSILON

The high harvest level estimates of Delta and Epsilon would tend to favor plant species adapted to early-successional and more open-canopied forests. Stricter riparian grazing standards would reduce grazing effects on riparian communities and should provide for some recovery of species associated with riparian and cottonwood habitats on classified Forest lands.</td></tr>
</table>

Natural Disturbances

The Descriptor Relationship

We consider here the more direct effects of natural disturbance regimes, primarily wildfire, on plant ecological responses. We have already discussed the effect of changes in fire regimes on overall vegetation structure. While we will address the direct responses of plants to disturbance, the sum

of these responses will have a cumulative effect on the viability of some species if disturbance regimes change over the long term.

Fire affects individual plant species in a number of ways, either positively or negatively. A number of species have specialized responses to fire; these include the ability to resprout readily, seeds that can remain dormant many years until the next fire, and abundant production of small, light seeds that can disperse into disturbed areas (Oliver and Larson 1990). Species that lack such mechanisms may be adversely affected by wildfire unless other disturbances can fulfill a similar role.

Current Conditions

Fire suppression over the past century has already caused a decline in some species with specialized adaptations to wildfire. The decline in tree species such as aspen is discussed in the vegetation section, but it may be true that wildfire suppression has caused the decline of sensitive plant species population or range as well.

Expected Future Conditions

DESCRIPTOR: NATURAL DISTURBANCES
EFFECTS COMMON TO ALL ALTERNATIVES
Wildfire suppression is expected to continue under all alternatives. Increased use of prescribed fire may be favored under some alternatives (Beta, Omega, Gamma and Zeta), but the overall extent of fire will probably be less than in presettlement forests that naturally had frequent fires (EGs A, B and E). This may have adverse impacts on sensitive species that are fire-dependent, especially those associated with drier, frequent-fire environments. For some of these species, mechanical disturbance may be able to fill a similar role, but this may not be the case for many other species. The predicted reduction in the natural extent of wildfire is a continuation of fire suppression effects over most of the past century. Cumulatively, a number of species with specialized adaptations to wildfire may decline. We have already discussed this for tree species such as aspen, but it may be true for a number of less prominent species as well. These effects are most likely to occur in habitats that had frequent natural wildfire. On the other hand, species that are sensitive to disturbance of any sort and prefer later-successional stages may be favored by fire suppression. For these species, the reduction in the extent of fire may help counteract the increased threats from mechanical site disturbances.

Mechanical Disturbances

The Descriptor Relationship

Mechanical disturbance may directly damage or kill individual plants or small populations, and probably affects species of special concern more than any other management activity. In contrast with moderate wildfire, below-ground portions of plants are more likely to be mechanically disturbed, which may reduce or prevent resprouting. The disturbance may also create conditions in which plants can reproduce, but this may also favor more aggressive competitors such as noxious weeds

(Shelly 1992). On the whole, plants that depend on longevity rather than aggressive reproduction for their persistence will be vulnerable (Keystone Center 1991).

The most extreme examples of mechanical disturbances are excavations for roads and structures. These areas will also be most likely subjected to repeat or continuous disturbances, that may prevent re-establishment of plant communities and provide habitat for exotic species that prefer areas of disturbance. Less intensive disturbances include those from the log skidding, slash disposal and site preparation associated with timber management, and use of off-road vehicles. Direct trampling by humans or livestock along trails or near developments may have similar effects.

We assume that effects will be proportional to the level of road construction, timber harvest and recreational uses (especially intensive Group I uses) under each alternative. However, we also expect impacts to be modified somewhat by the application of sensitive species resource management standards developed for each alternative.

Current Conditions

Timber harvest practices used today have been developed to minimize the ground they disturb. We identify areas where harvests have occurred in the past and use existing trails for new harvests to limit the area of disturbance. Designated trails and winter harvest areas also help to reduce the area and degree of disturbance. Mitigation measures such as winter logging causes negligible ground disturbance and has little direct impact on species of special concern. Prescribed fire of low to moderate burn intensity is occasionally used following harvest and is considered to be within the natural range of fire effects. For many plants, fires can stimulate reproductive output and establishment. Fires also encourage an increase in earlier successional stage forest types.

All forest roads are designed to minimize disturbance within riparian areas and therefore reduce the risk of disturbing wetland- or riparian-associated plants. Forest roads are also seeded to reduce erosion and weed spread. Revegetation of roads, trails and disturbed areas can reduce the spread of weeds, but this new vegetation may also compete with native plants. The trend toward more cable harvest requires additional roads on slopes, which disturb considerably more ground than roads on flatter terrain.

Existing Type I Special Recreational Uses such as cabins and developed sites have already disturbed plant communities and sensitive plants that occurred on site. Recreational use during the summer months may have reduced plant populations as a result of trampling or wildflower collection. Winter uses on snow, however, would have had negligible impacts. New trail construction is minimal and species of special concern have been considered during trail design on some sites.

Expected Future Conditions

DESCRIPTOR: MECHANICAL DISTURBANCES	
EFFECTS COMMON TO ALL ALTERNATIVES Mechanical site disturbances are somewhat different in their site effects from wildfire in that the plants can be physically injured and portions of the soil surface is generally disturbed. Therefore, the effects on shrubs and forbs do not emulate wildfire very closely (Antos and Shearer 1980). Under all alternatives the level of effects from mechanical disturbances may thus increase over time as more areas are disturbed or as disturbances are repeated on a given site. For example, each disturbance provides an additional chance for weeds or other more competitive species of an earlier successional stage to replace native plants.	
EFFECTS OF ALPHA We predict the extent of both total and open roads would increase slightly to moderately over the next 20 to 25 years, increasing the number of disturbed sites. Annual timber harvest is estimated at 20 to 40 MMBF. Each category of recreational uses would probably increase moderately from current levels. Under this alternative, we would attempt to identify and mitigate impacts to sensitive species, but only if this did not substantially reduce trust revenue. Consequently, a moderate level of predicted impact to plant species of special concern appears likely.	EFFECTS OF BETA We expect total road density to increase slightly, but open road mileage may decrease slightly. This would result in an increase in the number of disturbed sites, but the continuity of disturbance may be reduced. Possible annual timber harvests would range from 15 to 35 MMBF. All categories of recreational use would probably increase at rates greater than under Alpha, yet would occur on a minor area of total forest lands. This alternative includes stronger provisions for mitigating direct impacts to plant species of special concern. Consequently, the overall predicted impact to such plant species would probably be third lowest, after Gamma and Zeta.

DESCRIPTOR: MECHANICAL DISTURBANCES	
EFFECTS OF GAMMA The Gamma alternative would involve the lowest direct impacts of any alternative. Total road densities would probably remain near current levels, and the mileage of open roads would decline. Possible timber harvest levels are lower than any other alternative, at five to ten MMBF per year. Recreational uses would probably decline, with the exception of the least-impacting Group III uses. The Gamma alternative implements stronger provisions for mitigating impacts to plant species of special concern, similar to Beta. Overall, the predicted level of impacts to these species would be low.	EFFECTS OF DELTA We estimate that both total and open road densities would increase slightly to moderately. Timber harvest level estimates range from 15 to 45 MMBF per year. Developed recreational uses would increase substantially from current levels. Sensitive species resource management standards are identical to the Alpha alternative. The potential mechanical disturbance impact to plant species of special concern is likely to be moderately high.
EFFECTS OF EPSILON The Epsilon alternative has the highest estimated densities of total and open roads, and, at 35 to 55 MMBF per year, the highest range of timber harvest level estimates of any alternative. However, we predict recreational uses would increase less than they would with other alternatives. Standards for mitigating impacts to sensitive plants are the same as with the Alpha alternative. The overall potential for impacts is probably the highest of all alternatives.	EFFECTS OF ZETA Total road mileage would probably increase slightly, but the amount of open road is expected to decrease. Possible annual timber harvest levels are estimated at 10 to 20 MMBF. On the other hand, the amount of recreational use, especially developed uses, would be the highest of any alternative, but sill a relatively small percentage of total forest lands. Standards for sensitive species are identical to the Alpha alternative. The overall potential for mechanical disturbance impacts should be moderate to low except in areas with high recreational value.
EFFECTS OF OMEGA We expect total road density to increase over the next 20-25 years compared to Gamma, Delta and Zeta. We would control the number of open roads to slightly less than Alpha and Epsilon. This alternative includes stronger provisions for mitigating impacts to plant species of special concern than Alpha, Delta or Epsilon.	

Exotic Species Infringement

The Descriptor Relationship

Exotic species are those which are not native to an area, and may have been introduced either deliberately or accidentally. They include but are not limited to noxious weeds. While most exotic species of concern are vascular plants, exotic fungi and animals can be threats to native species in some circumstances.

Exotic species can be a threat to sensitive plants, primarily by competing aggressively for their habitats. Disturbances often favor such species, allowing them to gain a foothold and outcompete native species. Other exotics can harm native plants by causing diseases or feeding on them (Covington et al. 1994). It is also possible that human efforts to control weeds with herbicides or physical treatment methods could damage or destroy adjacent sensitive species, in the same locale.

We consider the effect of exotic species on sensitive plants, which is primarily a function of the amount of mechanical disturbance that provides avenues for them to colonize new areas and increase their abundance. We also address the aggressiveness of weed control practices that would be followed under each alternative. Herbicide treatments are primarily limited to weed control by site specific application on roads and adjacent disturbed areas such as landings and borrow sources.

Current Conditions

Exotic species have already replaced or reduced native species in some areas of state forested lands, especially where ground disturbance, livestock grazing, or other activities have changed historical habitat conditions. Areas of noxious weed infestation treated with herbicides have actually shown an increase in diversity of native plant species (Rice et al. 1992). However, forest ecotones and grasslands are regions of higher risk for sensitive plant species because they are often leased and licensed sites where the lease holder is responsible for implementing weed control. We are currently not apprised of the extent and type of herbicide use by lease holders, and it is conceivable that non-target plant species of special concern have been lost to their weed control efforts.

Expected Future Conditions

DESCRIPTOR: EXOTIC SPECIES INFRINGEMENT	
EFFECTS COMMON TO ALL ALTERNATIVES Noxious weeds and other exotic species have greatly expanded their ranges in recent years, with large potential effects on native plants that compete poorly on disturbed sites. Creating further opportunities for their spread would tend to increase the magnitude of these effects. The effectiveness of prevention and control of noxious weed spread on state lands will depend heavily on efforts made on surrounding ownerships. If adjacent lands have high populations of exotic weeds, the abundant seed source will make it much more difficult to control their spread onto state lands, and vice versa.	
EFFECTS OF ALPHA With the minimal control efforts called for in this alternative, weed infestations would continue to spread and increase. The moderately high possible harvest levels of Alpha would also create considerable ground disturbance, giving exotic species opportunities to establish themselves.	EFFECTS OF BETA AND ZETA The Beta and Zeta alternatives would reduce the spread of exotics in comparison with Alpha, Epsilon and Delta. We would take a more aggressive approach to weed control on proposed projects and existing infestations. Ground disturbance under Beta would be most often related to timber harvest levels, and under Zeta more frequently to development of access to recreational opportunities, but would continue at a moderate level under both alternatives.
EFFECTS OF GAMMA Gamma would have the lowest risk of exotic plant spread because of its lower level of ground disturbance and more intensive weed treatments to maintain diversity of forest plant communities. The Gamma alternative would have the smallest number of roads constructed and more road closures, which would reduce the spread of weeds by traffic. Control of noxious weeds in areas of sensitive plants may require more costly physical and cultural treatments. Effectiveness may be less if funding is limited.	EFFECTS OF DELTA The spread of noxious weeds would be reduced where economic benefits exceeded control costs. Delta would have an expanded weed control effort compared to Alpha and Epsilon, but it would not be a high priority. Mechanical ground disturbance would continue at moderately high levels, especially when market opportunity favored timber harvest to produce trust revenue.

DESCRIPTOR: EXOTIC SPECIES INFRINGEMENT	
EFFECTS OF EPSILON	EFFECTS OF OMEGA
The Epsilon alternative would disturb more ground with fewer control measures and have a higher risk of exotic plant spread than any other alternative. Without inventories of weed occurrences, new infestations may start and spread. As weeds spread, sensitive plant communities at risk of weed infestation would probably be damaged.	The Omega alternative would reduce the spread of exotics compared to Alpha, Delta and Epsilon alternatives. We would take a more aggressive approach to weed control on proposed projects and existing infestations. On a project specific basis, we would minimize disturbance to that needed for silvicultural objectives.

Livestock Grazing

The Descriptor Relationship

Livestock grazing can impact sensitive plants in a number of ways. Livestock may directly damage or kill plants by grazing or trampling. They may introduce noxious weeds by seeds they carry on their bodies, and create disturbed sites that weeds can invade more easily. Grazing may also affect plant community dynamics by favoring less palatable and disturbance-associated species (Shelly 1992).

In evaluating the potential for grazing impacts on sensitive plants, we consider both grazing level estimates and the ways in which grazing would be regulated under each alternative. The evaluation of cumulative effects must consider how the effects of livestock grazing compare with pre-settlement grazing of native herbivores.

Current Conditions

Livestock grazing has differed markedly from natural grazing by native herbivores, both in extent and type. While grazing by bison was natural in the Great Plains, this was apparently not the case in Western Montana and elsewhere in the Inland West. Furthermore, while native herbivores disperse seasonally into upland areas, livestock tend to concentrate in lowlands. As a consequence, both the quantity of forage and the species composition of plant communities have changed greatly (Oliver and Larson 1990, Covington et al. 1994).

Livestock grazing has affected sensitive plants in several ways. Trampling or consumption of individual plants or entire populations is one means of impact. Some species, however, may increase seed production if their root systems are left intact after grazing. Intense grazing has caused increased soil disturbance, compaction of roots, and erosion in riparian zones. Livestock have also been carriers of weed seed from one place to another.

Expected Future Conditions

DESCRIPTOR: LIVESTOCK GRAZING	
EFFECTS COMMON TO ALL ALTERNATIVES The alternatives will influence grazing practice only on classified Forest lands. On forested classified Grazing lands, current grazing practices would continue, and thus none of the alternatives would greatly change the current extent of grazing effects on these lands. There may be some reduction in grazing effects on forested classified Grazing lands under the Delta and Zeta alternatives, where other uses may supplant grazing in some areas. As grazing continues under all alternatives, it will have adverse consequences for species that are not resilient to disturbance, that have limited abundance, or are highly palatable to livestock (Oliver and Larson 1990, Keystone Center 1991).	
EFFECTS OF ALPHA The highest estimated level of grazing on classified Forest lands would occur under the Alpha alternative. Regulation of classified Forest land grazing practices would be less heavily regulated by the condition of riparian areas, meaning the level of impact on sensitive plants in riparian areas would be greater under this alternative as well. Under Alpha, grazing-associated impacts on sensitive plants would be greater than under any other alternative.	EFFECTS OF BETA AND OMEGA The grazing effects of Beta and Omega would be similar on classified Forest lands. Regulation of classified Forest land grazing practices would be based more heavily on the condition of riparian areas than under Alpha or Epsilon. Consequently, the level of impacts to sensitive plants associated with riparian areas and wetlands would be further reduced relative to the level of grazing.
EFFECTS OF GAMMA The estimated level of classified Forest land grazing under the Gamma alternative would be only half that under Alpha, and lower than any other alternative. Regulation of classified Forest land grazing practices would be based more heavily on the condition of riparian areas than under Alpha. Consequently, the level of impacts to sensitive plants associated with riparian areas and wetlands would be further reduced relative to the level of grazing.	EFFECTS OF DELTA The third lowest estimated level of grazing on classified Forest lands would occur under Delta. Regulation of classified Forest land grazing practices would be based more heavily on the condition of riparian areas than under Alpha. Consequently, the level of impacts to sensitive plants associated with riparian areas and wetlands would be further reduced relative to the level of grazing.

DESCRIPTOR: LIVESTOCK GRAZING	
EFFECTS OF EPSILON	EFFECTS OF ZETA
The second highest estimated grazing level on classified Forest lands would occur under Epsilon. Regulation of classified Forest land grazing practices would be based more heavily on the condition of riparian areas than under Alpha. Consequently, the level of impacts to sensitive plants associated with riparian areas and wetlands would be further reduced relative to the level of grazing.	Zeta would have the second lowest estimated grazing level on classified Forest lands. Regulation of classified Forest land grazing practices would be based more heavily on the condition of riparian areas than under Alpha. Consequently, the level of impacts to sensitive plants associated with riparian areas and wetlands would be further reduced relative to the level of grazing.

CUMULATIVE EFFECTS

Effects of ALPHA and EPSILON

We predict that Alpha and Epsilon would probably have the most negative impact on plant species of special concern. Alpha would tend to produce harvest levels and practices that would continue the trend toward late-successional, closed-canopy forests, high grazing levels, a moderate emphasis on weed control, and less stringent regulation of riparian grazing. These practices would result in conditions unfavorable for plant species of special concern associated with historical forest conditions.

Epsilon would have even higher harvest levels than Alpha, which would result in a greater percentage of early-successional/open canopy forest types and favor species adapted to those conditions. It would also have stricter riparian grazing standards and should protect riparian communities more than Alpha. These advantages would be offset by a higher level of mechanical disturbance and an even lesser emphasis on weed control. Overall, Alpha and Epsilon have the greatest potential to harm plant species of special concern.

Effects of BETA, DELTA, and ZETA

We expect alternatives Beta, Delta, and Zeta to be very similar in their impact on plant species of special concern. Timber harvest levels and methods under Delta and Beta would tend to develop more early successional/open canopy forest types and favor species adapted to those conditions, while Zeta would tend to develop late successional/shady forest conditions. Zeta would have a lower level of harvest than the other two, however, and thus there should be less mechanical ground disturbance related to timber cutting than under Beta and Delta. All three alternatives place a similar emphasis on noxious weed control. Beta would have the highest grazing levels of the three, with levels for Delta fluctuating more over time in response to market conditions. Of the three, we would expect Zeta to favor more plant species of special concern than Beta or Delta.

Effects of GAMMA

Gamma would provide the most protection to plant species of special concern. Although its low harvest level estimates, combined with continued wildfire suppression, would tend to favor the trend toward late successional/closed canopy forest types and plants adapted to those types. Gamma would also have the lowest level of ground disturbance and place the greatest emphasis on control of noxious weeds. Grazing levels would also be quite low, providing protection for riparian communities of plants.

Effects of OMEGA

We expect the impacts to plant species of special concern to be slightly greater compared to Beta, Delta and Zeta, yet less impact than with Epsilon or Alpha. Omega harvest levels would result in a trend towards more early successional/open canopy forest types on commercial timber lands and favor species adapted to those conditions. Management activities would disturb more area than with Alpha, but Resource Management Standards would provide a greater level of mitigation and protection than with Epsilon, Delta or Alpha. Prevention and control of noxious weed infringement would provide more protection than alternatives Alpha, Delta, Epsilon or Zeta. Grazing associated effects would be similar to those of Beta.

SUMMARY

Human-induced reductions in the natural occurrence of wildfire, and concurrent increases in grazing, mechanical site disturbances and competition from exotic species have a cumulative adverse effect on plant species that are not well-adapted to these changes. The alternatives that maintain the highest level of these disturbances and involve the fewest protective measures would tend to have the greatest adverse impacts on plant species of special concern. Overall, the Alpha and Epsilon alternatives would probably have the greatest impacts, and Gamma the least.

These effects may be countered to a degree by a net restoration of historic forest type and stocking level distributions under the alternatives with the highest disturbance levels. These benefits are likely to be limited at best, because the nature of the disturbances that produce this restoration will have different effects on many understory plants than wildfire would. At the same time, the cumulative effect of changes in the overall vegetation structure, which would be most pronounced under the alternatives with the lowest disturbance levels, should not be downplayed either (Covington et al. 1994).

VEGETATION

NOXIOUS WEEDS

INTRODUCTION

In this section we will consider the likelihood of noxious weed spread under each alternative. We will also explain the methodology we used to estimate those consequences. In the Executive Summary, we presented a summary table of the environmental consequences of each alternative management plan for noxious weed infestation.

METHODOLOGY

The spread of noxious weeds will be most affected by the area of disturbance associated with management activities such as timber harvest, road construction, grazing levels, and level of weed control effort. Weeds directly affect range productivity, plant community diversity, sensitive plants, and soil productivity by erosion. Indirectly they affect domestic and wildlife grazing. The nature and extent of these impacts vary for each alternative.

To determine the areas at risk of noxious weed infestation and the effectiveness of each alternative in controlling weeds, we use three descriptors:

Miles of Road Constructed and Open
Area of Disturbance Associated with Land Management Activities
Noxious Weed Treatment Methods

The relative amount of road building, use, and closure gave us a partial measure of area available for noxious weed colonization. Since timber harvest creates ground disturbance and provides opportunities for weeds to spread, we assumed that harvest levels and methods would play a role in determining the success of weeds. Development of recreation sites is another potential source of weed spread. Finally, we assumed the level of investment in weed control under each alternative would make a difference in the ability of weeds to maintain or expand their territory. The more roads, the higher the harvest levels or development of recreation sites, and the lower the investment in weed control, the greater the tendency of weeds to succeed and spread.

Table IV-N1 contributed to our analysis of the effectiveness of weed control efforts under each alternative. It describes weed control methods and priorities for each potential management plan.

Table IV-N1
NOXIOUS WEED CONTROL METHODS BY ALTERNATIVE

	BIOCONTROL	HERBICIDE	PHYSICAL	CULTURAL	PREVENTION
ALPHA	LOW - Expect some bioagents to spread onto DNRC from adjacent lands.	LOW - New weed outbreaks priority along roads, developed sites, only where ongoing mgmt projects in progress.	LOW - Some blading on roads.	MOD - Promote shade retention as feasible seed along roads, landings, borrow areas.	MOD - Clean equipment of weed seed. Consider winter harvest. Consider road closures.
BETA	MOD - Degree of implementation defined by budget. Release/redistribute bioagent. Cooperate w/others.	MOD - Prioritize site types and weed species for treatment and apply where most effective.	MOD - Use physical methods, blading, mowing where herbicides impractical; protect other species.	MOD-HIGH - Promote shade retention. Seed roads, landings. Minimize soil disturbance.	HIGH- Implement all prevention measures feasible.
GAMMA	HIGH - Aggressively procure bio-agents and release/ redistribute. Cooperate with others.	LOW-MOD - Only on high priority sites at risk of infestation. Eradicate new sites, contain on large areas.	MOD-HIGH - Apply maximum physical treatments to high priority sites (small and new infestations).	HIGH - Maximize shade retention. Minimize soil disturbance. Seed roads and disturbed areas.	MOD-HIGH - Implement all feasible prevention measures.
DELTA	LOW - No present benefit/ cost advantage for biocontrol.	HIGH - Based on site priority with best benefit/cost ratio. Sites that will have better forage/range return.	LOW - High implementation costs and marginally effective. Apply where effective with ongoing projects, blading.	MOD - Incorporate shade retention where it does not decrease mid-range return. Seed roads, landings and disturbed areas.	MOD- Implement prevention measures so it doesn't decrease returns alot.
EPSILON	LOW - Same as DELTA.	LOW-MOD - Applications only on roads and to meet laws. Would not control weeds to improve sites except for timber.	LOW - Same as DELTA.	LOW - Seed along roads, disturbed areas.	MOD- Same as DELTA.
ZETA	MOD - Emphasize improving range sites for wildlife and developed recreation sites.	MOD - Focus efforts on winter ranges to improve forage and developed recreation sites.	LOW-MOD - Focus on developed recreation sites. Not effective to physically treat winter ranges.	MOD.	MOD-HIGH - Implement all feasible prevention measures. Consider road closures.
OMEGA	MOD - Degree of implementation defined by budget level. Release/ redistribute bioagents. Cooperate with others.	MOD - Prioritize site types and weed species for treatment and apply where most effective.	LOW-MOD - Use physical methods, blading, mowing where not practical to use herbicide and protect other species.	MOD-HIGH - Promote shade retention. Seed roads, landings. Minimize soil disturbance.	HIGH - Implement all prevention measures feasible.

ENVIRONMENTAL CONSEQUENCES OF NOXIOUS WEED MANAGEMENT

In the following section, we will outline predicted effects of each descriptor. Effects common to all alternatives, if there are such effects, will be listed first, and then effects specific to individual alternatives.

DIRECT AND INDIRECT EFFECTS

This section describes the predicted direct and indirect effects of noxious weed management efforts under each alternative.

Miles of Road Constructed and Open

The Descriptor Relationship

New roads and the associated disturbed sites (borrow pits, etc.) are at high risk of weed infestation until revegetated. Roads expose subsoils and create droughty conditions that give weeds a competitive advantage. There is currently an average of about two miles of road per section, equivalent to eight acres of land.

Well-maintained open roads control erosion and sedimentation, but are avenues for the spread of noxious weeds. Traffic from logging equipment, recreational vehicles and maintenance equipment tends to pick up and transport weed seed along roads, increasing the rate of weed spread. Currently about 0.8 miles of road per section, or less than half of existing roads, are open. Adequately drained and revegetated closed roads control erosion and keep the spread of noxious weeds at lower levels than do open roads.

Expected Future Conditions

<table>
<tr><th colspan="2">DESCRIPTOR: MILES OF ROAD CONSTRUCTED AND OPEN</th></tr>
<tr><td colspan="2">EFFECTS COMMON TO ALL ALTERNATIVES

We expect to build some roads under all alternatives, which means that conditions favorable to the spread of weeds will be created. Prompt grass revegetation of disturbed areas would provide competition and reduce the area available for weeds to establish.</td></tr>
<tr><td>EFFECTS OF ALPHA

Alpha would continue the trend toward increasing road density and number of open roads. Under this alternative, we would expect to see a higher road density on state lands over time, which would favor the spread of noxious weeds and make their control more difficult.</td><td>EFFECTS OF BETA

Under Beta, road density would probably increase but not as much as under Alpha. Open road mileage would remain the same or decrease. With adequate drainage and prompt revegetation of closed roads, Beta would probably have a more favorable impact on weed spread than Alpha.</td></tr>
</table>

DESCRIPTOR: LIVESTOCK GRAZING	
EFFECTS OF GAMMA Although some road construction would probably still take place under Gamma, it would be very limited, and overall miles of open road would decrease. The emphasis on closure of open roads and restoration of natural conditions would probably have the most favorable impact of any alternative on the control of noxious weeds.	EFFECTS OF DELTA Under Delta, we would build at least as many new roads as under Alpha, and possibly more. Miles of open road would increase as well. These conditions would favor the spread of noxious weeds and make their control more difficult.
EFFECTS OF EPSILON Epsilon would result in more new roads and more open roads than any other plan, creating more opportunities for weeds to spread. Weed spread due to road construction and high road density would be most likely under Epsilon.	EFFECTS OF ZETA After Gamma, Zeta would result in the smallest number of new roads and the largest number of road closures. Road-related weed spread would probably be more limited under Zeta than under any alternative but Gamma.
EFFECTS OF OMEGA The effect of Omega on weed spread associated with roads would be greater than Gamma, Beta, Zeta and less than Epsilon. Omega would employ more road closures than Epsilon, Alpha or Delta, which would reduce the spread of noxious weeds by traffic.	

Area of Disturbance Associated With Land Management Activities

The Descriptor Relationship

Soil disturbance as a result of land management activities such as timber management or development of recreation sites creates growing areas suitable for noxious weeds to establish. The area of disturbance is proportional to the method and amount of timber harvest or size of the recreational development.

The potential to introduce weeds with cable harvest is low, since skidding corridors typically disturb only five to seven percent of a harvest area (Purser 1992), and the likelihood of bringing weed seeds onto the site is small. The area disturbed and the potential to introduce weed seeds increases with methods that use ground skidding methods. Ground-based log skidding and slash treatments have the greatest potential to cause soil displacement and thus increase the risk of noxious weed establishment, depending on the percentage of the area covered by skidding, scarification, and season of operation. Tractor skidding typically disturbs up to 20 percent of surface soils. Dozer piling and site preparation disturb another 20 to 25 percent, for a total average disturbed area of 40 percent on regeneration harvests and less on partial harvest areas. Areas of slight disturbance can be quickly revegetated by tree seedlings and native vegetation.

Recreation use and other special uses of state forest lands have been categorized into one of four general groups. Group I involves recreational use at developed or concentrated use sites, Groups II and III dispersed use scattered throughout the forest, and Group IV public and commercial uses that are confined within the perimeter of the actual lease site.

Recreational use has the greatest potential to disturb ground and encourage weeds where traffic levels are high. Off-road vehicles, llamas, and horses can trample native plants and leave soil exposed or open to increased erosion. Human beings, livestock, motorized traffic, or weedy hay can introduce seeds. Trail heads and newly constructed trails are higher impact areas, and thus at greatest risk for noxious weed infestation.

Expected Future Conditions

<table>
<tr><th colspan="2">DESCRIPTOR: AREA OF DISTURBANCE ASSOCIATED WITH LAND MANAGEMENT ACTIVITIES</th></tr>
<tr><td colspan="2">EFFECTS COMMON TO ALL ALTERNATIVES

Ground-disturbing uses of state forest lands will continue to occur under all alternatives, which means that weeds will find opportunities to establish themselves and spread. A portion of recreational access fees will be used to treat new outbreaks of weeds and possibly to contain existing infestations if funds are available.</td></tr>
<tr><td>EFFECTS OF ALPHA

The estimated levels of timber harvest and growth of recreational use under Alpha, combined with minimal weed control efforts, means weeds would continue to spread on already infested and new territory.</td><td>EFFECTS OF BETA

We estimate that timber harvest under Beta would be slightly lower on average than under Alpha. We expect recreational use to grow at least as quickly as it is currently, with an increase likely in all categories. Ground disturbance under Beta would probably be similar to Alpha levels, although a greater part of the disturbance would come from recreational use and a smaller part from timber harvest than at present.</td></tr>
</table>

<table>
<tr><th colspan="2">DESCRIPTOR: AREA OF DISTURBANCE ASSOCIATED WITH LAND MANAGEMENT ACTIVITIES</th></tr>
<tr><td>EFFECTS OF GAMMA

Gamma calls for a much smaller timber harvest and harvest methods that are in general less ground disturbing. Recreational uses in Categories I, II, and IV would drop, and only grow slightly in Category III and V. Gamma would provide fewer opportunities for weeds to spread because of less ground-disturbing activities than any other alternative.</td><td>EFFECTS OF DELTA

The market focus of Delta would probably mean a wide range of timber harvest levels, but at the high levels it would create more ground disturbance than Alpha. Potential high-income recreation uses would be actively promoted under Delta. Group I uses, in particular, would be an attractive opportunity for development. These factors mean that ground disturbance under Delta would likely be greater than under current practices, and that weeds would find more opportunities to establish themselves.</td></tr>
<tr><td>EFFECTS OF EPSILON

Selection of Epsilon would be a formal commitment to high levels of timber management, with correspondingly high levels of ground disturbance. Recreational activities in Categories II and III would probably increase at roughly the same rates as under Alpha, with Category I uses growing more slowly if at all. Factored together, these activities would result in the highest level of ground disturbance and weed spread opportunity of all the alternatives.</td><td>EFFECTS OF ZETA

Recreation and wildlife management would be the foremost revenue-generating activities under Zeta. High-impact Group I and II activities would grow at high rates, and all recreational uses would increase substantially. Low timber harvest levels would offset the increased disturbance from recreational uses. Zeta would probably produce the second lowest level of ground disturbance and opportunity for weeds to spread.</td></tr>
<tr><td colspan="2">EFFECTS OF OMEGA

The disturbance of Omega associated with timber harvest would be greater than Alpha, but less than Epsilon. We expect recreation and special uses to continue to increase more than Epsilon, similar to Beta. We would implement greater weed control efforts than Alpha, Delta or Epsilon to control weed spread.</td></tr>
</table>

Noxious Weed Treatment Methods

The Descriptor Relationship

Treatment methods for noxious weeds will involve the Integrated Weed Management approach to include prevention, biocontrols, herbicides, and physical treatments. Some areas of weed infestation may receive one or more integrated treatments, such as burning and herbicide application or grazing and use of bio-control insects, as part of integrated pest management. The type and degree of weed control affects the spread of weeds and can impact natural resources. Current treatment methods focus on prevention, grass seeding of roads, and controlling land disturbance from silvicultural treatment. DNRC has required timber purchasers, right-of-way users, and lessees to take limited responsibility for weed control, or has retained some of the timber purchaser's funds and contracted with the county weed board to perform weed control operations, such as site-specific herbicide applications.

Prevention is the most effective means of weed control. Prevention methods include cleaning off-road equipment, operating on snow, minimizing soil disturbance, and limiting access of people and vehicles to reduce weed spread.

Many biocontrol agents are being tested for release in Montana. Introduction of exotic biological control agents may have unforseen effects on native plants. The process of testing bio-agents prior to release on weed populations is slow, lasting up to ten years, to ensure the bio-agents feed on the target noxious weeds and are not a threat to agricultural crops or native vegetation.

Small populations of bio-agents have been released at a few sites on DNRC lands in Montana, but it is too early to assess the effect of these biological agents on noxious weed populations. In many cases, an individual biological agent does not provide adequate weed control, and a complex of several different bio-agents that attack different parts of the weed may be required to control the level of infestation. Currently, bio-agents can reduce the population densities or slow the spread of certain noxious weeds, but will not contain them.

Herbicide treatments can be highly effective to contain or stop the spread of noxious weeds when coupled with prompt revegetation. Herbicides are chemicals formulated to control broadleaf and grassy weeds. All herbicides have specific limitations on type of application and degree of control.

DNRC strictly complies with legal regulations on herbicide application including the Montana Pesticide Act, the Montana Water Quality Act, the Montana Agricultural Chemical Ground Water Protection Act, and BMPs. DNRC personnel always follow label recommendations and safety precautions to minimize risk of health or environmental effects.

Herbicide treatments have been very limited on forested lands and used only for specific weed outbreak areas or in silvicultural treatment of competing vegetation. Herbicide use may increase as one of the tools for Integrated Weed Management within budgetary constraints, but overall will still be very limited. Where herbicides are used, treatments would focus on new outbreaks and locations where weeds could be most effectively treated, such as roadsides. Herbicide treatment of large-scale noxious weeds is generally not practical, unless undertaken as a coordinated effort by all of the affected landowners.

Broadleaf herbicides such as 2-4-D and picloram are effective on noxious weeds. Herbicides can also kill non-target vegetation and sensitive plants, which may change plant diversity in the short term and promote grasses. Following herbicide treatment, plant diversity can increase as native plants fill niches between grasses and trees and reoccupy sites that where predominately noxious weeds (Rice 1992). Environmental effects include possible risks due to misapplication, varying persistence of chemical in the ecosystem, and potential contamination of water supplies. See Table IV-N2 for information on the five herbicides in prominent use in Montana (Montana Department of Agriculture 1992a). These are the herbicides most likely to be used on state trust lands. However, DNRC may consider the use of other herbicides. If other herbicides are used, DNRC will carefully follow label application and safety instructions.

Human health risks associated with herbicides used for noxious weed control have been documented in "Analysis of Human Health Risks of USDA Forest Service Use of Herbicides to Control Noxious Weeds in the Northern Region" (Monnig 1986). The report concluded that even when considering mixing errors and a variety of accident scenarios (e.g., spills, leaks, etc.) The "No Observable Effects Levels" for human health are not exceeded.

The toxicity of a herbicide in water is affected by several factors in addition to those which affect herbicide performance in soil. The acidity, hardness of the water, and the absorbent qualities of suspended clays and organic matter can affect the toxicity. Rate of water flow or movement, dilution and oxygen content can affect chemical concentration and possible toxic effects.

Studies of toxicity hazards to fish have shown that formulation variations result in greater differences in toxicity than differences in toxicity between basic compounds. For example, ester formulations of 2-4-D are more toxic than amine salt formulations (MSU 1990). In all cases, we would maintain buffer areas between surface water and herbicide sites to lessen the risks of herbicides entering groundwater on streams. All mixing/loading would be located well away from water.

Physical control methods include pulling, blading, grazing or tillage. These methods remove plants or seed heads and help slow the spread of weeds, but they are expensive, marginally effective, and require repeated treatments. Physical control methods are typically low intensity and have limited impact on plant diversity or other resources.

Table IV-N2
FIVE HERBICIDES IN PROMINENT USE IN MONTANA & PROPERTIES RELATING TO THEIR INTERACTION WITH SOILS, WATER & AIR*

CHEMICAL NAME	**2,4-D**	**Picloram**	**Glyphosate**	**Clopyralid**	**Hexazinone**
COMMERCIAL NAME	**(Various Names)**	**Tordon**	**Roundup, Rodeo**	**Stinger, Curtail**	**Pronone, Velpar**
Organic Compound Classification	Phenoxy (Phenosyalkanoic)	Picolinic Acid	Miscellaneous and Aliphatic	Picolinic Acid	Triazine
Molecular Weight	221.0	241.5	169.1	192	252
Persistence**	1-4 weeks	1 month→4 years	Short***	1-3 months	1-6 months
Mobility	Relatively High	High	Relatively Low	High	Relatively High
Adsorption Soil Colloids	Moderate	Low	High *Strong; low phytotoxicity produced by soil applications*	Low	Low *Mainly adsorbed by organic*
Leaching Potential	Low to Medium *Formulation dependent: salts more leachable than esters; runoff potential greater for esters*	High *Seldom leaches below 20-30 cm for most soil types except sandy soils; runoff likely with heavy rainfall with 1-2 mos after application*	Low *Minimal*	High	Medium to High *Seldom leaches below 15 centimeters*
Surface Runoff Loss Potential	Low to Medium	Low	High	Low	Medium
Microbial Degradation	Rapidly Degraded	Slowly Degraded	Slowly Degraded	Major Mechanism	Slowly Degraded
Volatile	Yes *(formulated products)*	No	Low	No	No

* Adapted from Montana Department of Agriculture 1992a.
** Factors affecting persistence are volatility, photodecomposition, adsorption, leaching, runoff, plant intake, microbial decomposition, chemical decomposition.
*** No herbicidal activity in soil, although residues can be detected.

Expected Future Conditions

DESCRIPTOR: NOXIOUS WEED TREATMENT METHODS	
EFFECTS COMMON TO ALL ALTERNATIVES All alternatives include at least a minimum weed control effort, in the form of compliance with the noxious weed management law, cooperation with weed districts, and employment of integrated weed management methods. Only herbicides approved by the Montana Department of Agriculture and local weed districts would be used and applied under the supervision of licensed applicators. We would promptly implement revegetation plans to provide competition for weeds and reduce the area available for their establishment.	
EFFECTS OF ALPHA Prevention of weed spread is a low to moderate priority under Alpha. We would rely on prevention and cultural methods such as promoting shade retention to minimize new outbreaks, and limited use of herbicides on new outbreaks along roads and on developed sites where projects were ongoing.	EFFECTS OF BETA Beta places a moderate to high degree of importance on weed control. Prevention and cultural methods would still be the primary methods of control, but we would also expand the use of integrated pest management and focus control on new weed outbreaks.
EFFECTS OF GAMMA Weed control would be a high priority under Gamma. We would use every method of weed control in our arsenal, but limit herbicides to high priority sites at risk of infestation. We would aggressively procure and use biocontrol agents. Protection of sensitive plants would be important.	EFFECTS OF DELTA Delta would place a low priority on treatment of noxious weeds, and would use herbicides more frequently than other alternatives. Weed control would focus on creating better forage and rangeland to maximize returns. Protection of sensitive plants would be minimal.
EFFECTS OF EPSILON Epsilon would place the lowest priority on treatment of noxious weeds, with efforts aimed at controlling weeds when it would improve timber sites and to comply with laws. Prevention measures would be similar to Delta and Zeta. Protection of sensitive plants would be minimal.	EFFECTS OF ZETA Weed control under Zeta would be a slightly lower priority than under Beta, but higher than Alpha, Delta, or Epsilon. We would focus our efforts on improving range sites to create forage for wildlife. Prevention measures would be the most important method of control.

DESCRIPTOR: NOXIOUS WEED TREATMENT METHODS
EFFECTS OF OMEGA
Omega places a moderate to high emphasis on weed control using integrated weed management methods. We would use a more aggressive weed control program than Alpha, Delta or Epsilon based on weed management standards.

CUMULATIVE EFFECTS

In the following discussion, we will combine the impacts of all descriptors to determine the overall effectiveness of weed control under each of the alternatives.

Under all alternatives, conditions favorable to the accelerated spread of noxious weeds would be created. Disturbances caused by road construction and reconstruction, landing construction, timber skidding, burning of logging debris, and developed recreation sites would create seedbeds conducive to noxious weed establishment if a seed source were present.

Effects of ALPHA

With the minimal control efforts called for in Alpha, weed infestations would continue to spread and increase. Focus would be on prevention, revegetation, and some control at ongoing land management projects. A portion of timber receipts would be used to control weeds on timber projects. A portion of recreation access fees would be used to treat new outbreaks of noxious weeds and possibly contain existing weeds if adequate funds were available. There would be some carryover of bio-control agents if adjacent landowners used them, but it would take considerable time before observable control occurred.

Effects of BETA and ZETA

The Beta and Zeta alternatives would reduce the spread of weeds in comparison with Alpha, Epsilon, and Delta. We would take a more aggressive approach to weed control on proposed projects and existing infestations. We would implement monitoring to identify the extent of weed infestations and prioritize control or containment treatments. We would likely use more herbicide control methods where appropriate, since herbicides are often the most cost-effective means of control, followed by revegetation with desirable vegetation.

Effects of GAMMA

The spread of weeds would be reduced because this alternative would cause less ground disturbance and use more intensive weed treatments to maintain diversity of forest plant communities. The Gamma alternative would have the least number of roads constructed and more road closures, which would reduce the spread of weeds by traffic. Control of noxious weeds in areas of sensitive plants might require more costly physical and cultural treatments. Herbicides would be used only where there were no other viable treatments.

Effects of DELTA

The spread of noxious weeds would be reduced where economic benefits exceeded control costs. Delta would have an expanded weed control effort compared to Alpha. We would likely use more herbicide control methods where appropriate, since herbicides are often the most cost effective means of control, followed by revegetation with desirable plants.

Effects of EPSILON

The Epsilon alternative would disturb more ground with fewer control measures than the other alternatives and have a higher risk of weed spread. Without inventories of weed occurrences, new infestations might start and spread. As weeds spread, plant communities at risk of weed infestation would be altered and range conditions and values could decline.

Effects of OMEGA

We expect the Omega alternative would reduce the spread of noxious weeds in comparison to Alpha, Delta and Epsilon through implementation of more aggressive weed control actions, based on integrated weed management methods. We would prioritize weed control efforts on proposed projects and existing infestations. On selected projects, such as weed free sites, we would monitor our preparation and control measures for weed occurrences and follow-up actions. A portion of timber sale receipts would be used to control weeds on timber projects. We would likely use more herbicide control methods on a site specific basis, where most cost effective means of control, followed by revegetation with desirable vegetation.

SUMMARY

The effect of land management activities on the ability of noxious weeds to spread on state lands depends to some extent on the alternative selected, and on management activities on adjoining lands. Our management activities can limit and control weeds only on state parcels. Adjoining landowners' practices can affect our weed control program in both positive and negative ways. All alternatives will create conditions favorable for the spread of weeds, but some place a greater emphasis on mitigating these conditions and aggressively eradicating existing weed infestations.

Noxious weed spread is directly related to areas of disturbance created by activities such as timber harvest, road construction, and development of recreation sites. Weed control measures such as prevention, herbicides, and integrated pest management will limit weed spread if applied thoroughly and consistently. Weed control is important because infestations can harm native plant communities, increase soil erosion, and reduce trust revenue by impairing range productivity. The priority placed on controlling weeds under each alternative can have a positive or negative impact on the health and productivity of state forested lands.

WILDLIFE

INTRODUCTION

In this section we model and discuss the effects of each alternative on terrestrial vertebrates. In the Executive Summary we presented a summary table of the environmental consequences of each alternative management plan.

Wildlife biologists have used a variety of approaches to assess the environmental consequences of broad-scale land management on terrestrial wildlife species. The use of management indicator species, keystone species, ecological indicator species, or indicator guilds are all intuitively appealing. These approaches simplify the task of dealing with hundreds of unique species by clustering them into similar groups, or by identifying a few species as surrogates for others. However, each approach assumes that a few species can accurately represent the habitat needs of the entire wildlife community. This assumption has been criticized on fundamental ecological grounds: each species has its own unique set of requirements and responses to environmental conditions (Landres et. al 1988, Ruggiero et al. 1988, Mills et al. 1993, Marcot et al. 1994).

The approach we chose instead is a variant of what is often termed the "species/habitat matrix approach", in which the value of various vegetative communities is related to the entire assemblage of wildlife species that occur over a large area (Thomas et al. 1979, Marcot et al. 1994). To vegetative characteristics, we added other elements of habitats likely to affect their usefulness (e.g., human impacts), and that would vary depending on our management philosophy. An advantage of the species/habitat matrix approach is that it allows consideration of the particularities of each species. A weakness is that it requires ecosystem-appropriate data on habitat affinities for each species. If available at all, such data are likely to be based on few studies and small sample sizes, and be categorical or qualitative in nature. Therefore, in addition to presentations of species richness generated by the species/habitat matrix approach, we also stepped back from our model to make general observations about the expected consequences that changes to the landscape from each alternative will likely produce on wildlife communities.

Regardless of the approach used, any attempt to project effects on wildlife of a chosen programmatic plan on state trust lands is fraught with difficulty. Although each alternative represents a distinct philosophy and is accompanied by unique Resource Management Standards, modifications to specific wildlife habitats are not, and cannot, be detailed. All alternatives allow considerable scope for responding to specific situations. Further, most State Lands tracts are small and insular. Wild animals, by their very nature, move about the landscape, undeterred by patterns of legal ownership and management. Therefore, one cannot project with any certainty the effects on a given species of changes on a relatively small parcel of land, without also knowing the condition of the surrounding landscape.

This does not imply that such tracts are necessarily unimportant for wildlife, or that no reasonable assessment of programmatic alternatives is possible. Lands managed by DNRC are an important contributor to habitats for species spread widely over the forested landscape. It merely implies that our assessment must be viewed cautiously. Wildlife populations may respond in ways other than projected here if adjacent land is managed quite differently from that envisioned under an alternative, particularly where DNRC tracts are small and/or isolated. To make this problem manageable, our models represent a caricature of the effects we would expect from each alternative were similar policies to be applied on all lands, not just those managed by the Department. Project-specific analysis for wildlife is in no way precluded by this assessment.

METHODOLOGY

For data on habitat affinities of Montana terrestrial vertebrates we relied on two sources: (1) for habitat affinity information, U.S. Forest Service wildlife-habitat matrices developed by Prather and Burbridge (1979), and (2) for additional range and distribution data, the Montana Natural Heritage Program's (MNHP 1994) databases maintained in Helena, Montana. The USFS data set contains current (to 1979) information associating wildlife species with specific vegetative communities and their structural attributes, on seasonal residency, migratory status, special or legal designations, use of specialized habitat features and requirements for seclusion from human activity, and their geographic distribution within the state. We considered a total of 420 terrestrial wildlife species.

We used descriptors to characterize specific habitat components that influence the condition of our wildlife communities. We made no attempt to project trends of wildlife populations. Rather, we limited our assessment to the appropriateness of habitat conditions for each species, as described by the nine descriptors.

Because all raw data we used were qualitative or categorical in nature, we were unable to quantify species' responses to projected changes in habitat conditions, even where those conditions could be projected quantitatively. At best, we were able to categorize projected habitat changes as beneficial or detrimental (i.e., because that species was associated with a habitat component projected to increase or decrease). In some cases, even the direction of change for a component of habitat could not be projected with certainty. In these cases, we were similarly uncertain about the consequences for wildlife. Uncertainty about the qualitative change in habitat effectiveness associated with a given descriptor for a given alternative should not be equated with lack of change, however. That is, it would be wrong to infer from a categorization of a descriptor's effect on a given species as "uncertain" that complacency is in order. The correct interpretation of our "uncertain" category is that there may well be adverse or beneficial effects, locally or even statewide, but that we cannot confidently project which might apply given the necessarily crude sieve through which we must view species and their habitats in this programmatic-level analysis.

We used the data manipulation functions of SAS (SAS Institute, Inc., 1988) to organize matrices into useable forms. Species only occasionally reported from Montana, or considered as accidentals, were removed from all data bases. For each descriptor, we then developed matrices consisting of species (rows) and habitat attributes (columns), with cells containing a '1' if the species was primarily associated with that habitat attribute, or a '0' if not.

We present results in two forms: (1) a summary form, in which we list the number of species for which effects would be beneficial or detrimental, or whose effects could not be confidently projected, for each alternative and for each descriptor separately, and (2) lists of individual species by descriptor, each with an accompanying symbol to represent the projected effect of each alternative. Because of their length, these lists are printed in Appendix WLD.

For those not wishing to consult the entire list printed in the Appendix, we have also included under each descriptor a list of 20 "illustrative species" to provide a quick overview of effects on all species (Table IV-W1). These 20 were subjectively selected from the entire 420 using the following criteria:

1) They were present on either (a) the list of Montana Natural Heritage Program species of special concern (a list that includes listed and candidate[1] federally threatened and endangered Species, as well as U.S. Forest Service listed sensitive species (Montana Natural Heritage Program, 1994)), or (b) the list of game or furbearing species recognized by the state of Montana.

2) Selection would help in representing a broad taxonomic array, in approximate proportion to frequency in Montana (one amphibian, one reptile, eleven birds, seven mammals).

3) Selection would help to represent a broad array of required habitats, including such special conditions as old-growth, burns, and riparian habitats.

4) Selection would help to represent a broad array of geographic regions treated in this plan.

We emphasize that we are not proposing to manage habitat solely, or even specifically, for these 20 species, or that we view these as substituting for, or indicating the requirements of, others not listed for illustrative purposes. At the same time, we point out that, given the current structure of the Department and our limited resources to consider wildlife, particular focus on the 66 Species of Special Concern and on the 67 game/furbearing species is both inevitable and appropriate. Thus, these 20 provide a snap-shot of the concerns likely to arise about wildlife. We consider the same 20 for each descriptor, allowing the reader to track them.

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[1] Please note that since the printing of the DEIS, the USFWS has eliminated C2 species from their listing. C2 species were candidate species being considered for protection by the USFWS. Despite the elimination of this category, we have retained the information on C2 species in this EIS because we feel it provides useful information in assessing the impacts of management activities on sensitive and threatened species.

Table IV-W1
LIST OF SPECIES USED FOR ILLUSTRATIVE PURPOSES IN TABLES

Common Name	Latin Name	US FWS	FS	MNHP	Global	State	Sport
Tailed Frog	Ascaphus truei			SC	3	3	
Harlequin Duck	Histrionicus histrionicus	C2	S	SC	5	2	MB
Bald Eagle	Haliaeetus leucopcephalus	E	E	SC	3	3	
Ferruginous Hawk	Buteo regalis	C2	S	SC	4	3	
Peregrine Falcon	Falco peregrinus	E	E	SC	3	1	
Ruffed Grouse	Bonasa umbellus				5	5	UG
Spruce Grouse	Dendragapus canadensis				5	4	UG
Black Tern	Childonias niger	C2		SC	4	3	
Flammulated Owl	Otus flammeolus		S	SC	4	1	
Boreal Owl	Aegolius funereus		S	SC	5	3	
Black-backed Woodpecker	Picoides arcticus		S	SC	5	3	
Le Conte's Sparrow	Ammadramus leconteii			SC	4	1	
Townsend's Big Eared Bat	Pletoctus townsendi		S	SC	4	2	
Beaver	Castor canadensis				5	5	FU
Northern Bog Lemming	Synaptomys borealis		S	SC	5	2	
Gray Wolf	Canis lupus	E	E	SC	4	1	
Grizzly Bear	Ursus arctos	T	T	SC	4	1	
Fisher	Martes pennanti		S	SC	5	2	FU
Elk	Cervus elaphus				5	5	GA
Spiny Softshell Turtle	Apalone spinifera			SC	5	3	

Key:

USFWS: (U.S. Fish and Wildlife Service) E: Listed as endangered, T: Listed as threatened, C2: candidate species, considered by USFWS for protection (see Footnote 1 on previous page for status of C2).

FS: (U.S. Forest Service) E: endangered, T: threatened, S: sensitive

MNHP: (Montana Natural Heritage Program) SC: species of special concern

Global: Montana Natural Heritage Program abundance index to worldwide abundance (1 = most rare, 5 = most abundant)

State: Montana Natural Heritage Program abundance index to statewide abundance (1 = most rare, 5 = most abundant)

Sport: Montana Department of Fish, Wildlife and Parks designation: MB: migratory bird, UB: upland game bird, FUR: furbearing species, GAME: game species.

Descriptors

The nine descriptors used in the effects assessment were:

General Wildlife Habitats
Forest Successional Stages
Forest Types
Forest Stocking Level
Snag Abundance
Large Woody Debris on the Forest Floor
Riparian Area and Wetlands Condition
Recreation Use Levels
Road Densities

Descriptors two through five are features of forest environments described earlier in the Vegetation section of this chapter, and follow those analyses closely. These features respond to similar ecological conditions and management practices, and thus are not wholly independent of one another. The last three descriptors represent potential adverse effects of human use, either through precluding wildlife use of habitats or through increased mortality due to contact with humans.

These nine descriptors characterize important elements of wildlife habitat for the 420 terrestrial wildlife species that can be expected to occupy habitats on state lands. Each descriptor represents only one of many elements that comprise suitable and useable wildlife habitat. However, looking at each of these nine elements separately allows us to identify interactions between competing needs of different wildlife species, and to identify trade-offs between beneficial and adverse impacts on individual species.

We provide additional details on specific methods used for each descriptor in the appropriate section. Readers are also referred to Appendix WLD, in which assumptions and methods are explained further.

Wild animals respond to the entirety of habitat elements presented to them ("*niche gestalt* ", sensu James 1971), not to each element separately. We treat descriptors separately as a convenience. Because of the categorical nature of this analysis, we have no way to systematically combine effects of different descriptors, but we do attempt to summarize the effects of each alternative in narrative form, following discussion of the descriptors.

DIRECT AND INDIRECT EFFECTS

Availability of General Wildlife Habitats

The Descriptor Relationship

Wildlife habitats can be categorized based on dominant characteristics of the site as follows: those associated with water or moist environments such as rivers, lakes, wetlands, or riparian areas; high elevations (alpine); plant communities dominated by tree species traditionally used for wood products (forests); by other non-commercial tree species (woodland); by shrubs (shrublands); by grasses (grasslands); and by widely scattered trees with an understory of grasses or shrubs (savannah). Many wildlife species are closely associated with, or even dependent on, unique resources and conditions found in these general habitat categories.

Current Conditions

Forests comprise approximately 93 percent of the lands affected by this management plan, with an undetermined amount of land in each of the remaining nine general habitats described above. Over 40 percent of the 420 wildlife species in Montana are associated with forested habitats to some extent (Table IV-W2). Forests rank third in number of species of special concern using each general habitat category (Table IV-W3). The remaining seven percent of land affected by this plan is "non-forest," roughly 44,700 acres. However, many small patches of other types of habitats are included within areas that are mapped as forest, and these are also important wildlife habitats.

Although affected acreage of all habitats other than forest may be small, these other habitats are critical for many wildlife species. For example, although western songbirds as a group seem to be doing well, species associated with grasslands, riparian areas, and shrublands have suffered steep declines (Dobkin 1992). Timber harvest, agricultural conversion, livestock grazing, flood control and various other human developments have had impacts on these habitats. (Finch and Ruggiero 1993).

Land management activities can directly alter the structure or plant composition of these habitats. Simple human presence in these areas can also influence wildlife's ability to effectively use a given habitat, even if the site is not directly altered. Either of these actions can directly affect the value of an area as wildlife habitat.

Table IV-W2

Number of Montana wildlife species using each of nine general habitats for at least a portion of their seasonal habitat needs in each DNRC land office area. Habitats missing from this table are not represented on DNRC lands in that land office area. Note that because many species use more than one habitat, regional totals are less than simple sums.

General Habitat[4]	NWLO	SWLO	CLO	NELO	SLO	ELO	Statewide
Rivers	82	80	80	80	77	70	88
Lakes	91	89	93	94	91	85	103
Wetlands or Riparian	272	271	282	274	272	249	308
Alpine	65	63	67	--	--	--	67
Forest	151	149	156	137	143	120	173
Savannah	67	67	69	73	69	71	80
Woodland	190	188	204	196	195	177	226
Shrubland	139	140	155	151	157	142	179
Grassland	197	196	218	216	216	205	246
Regional Totals	358	355	382	362	363	332	419

[4] See Appendix WLD, Table 13, to determine which species are associated with the numbers in Table IV-W1. For example, looking at Table 13 in Appendix WLD, we observe that the Long-Toed Salamander is associated with River habitats (first column of Table 13), and is found in DNRC's Northwest Area (NWLO column of Table 13); therefore, it is one of the 82 species represented by the first number in the above Table IV-W2.

Table IV-W3

Number of Montana wildlife species of special concern using each of nine general habitats for at least a portion of their seasonal habitat needs in each DNRC land office area. Habitats missing from this table are not represented on DNRC lands in that land office area.

General Habitat[5]	NWLO	SWLO	CLO	NELO	SLO	ELO	Statewide
Rivers	17	16	16	17	15	15	21
Lakes	14	13	15	17	15	16	19
Wetlands or Riparian	26	26	29	28	28	26	38
Alpine	5	5	6	--	--	--	6
Forest	17	18	18	11	15	9	25
Savannah	5	6	5	8	6	8	11
Woodland	8	9	14	13	13	10	21
Shrubland	7	8	13	13	15	13	22
Grassland	16	19	22	23	23	21	35
Regional Totals	40	42	46	41	42	39	66

5 See Appendix WLD, Table 11 to determine which species in each Land Office area are designated species of special concern.

Expected Future Conditions

DESCRIPTOR: AVAILABILITY OF GENERAL WILDLIFE HABITATS

EFFECTS COMMON TO ALL ALTERNATIVES

Of all the general wildlife habitats available on state lands, we project that only savannahs, woodlands, shrublands, and grasslands would experience measurable change in acreage. Livestock grazing (if excessive) and fire suppression are projected to decrease grassland acreage and may increase amounts of woodland, shrubland, and savannah. We evaluate riparian and wetland habitats later in this analysis.

Despite the projected increase in acreage of woodlands, shrublands, and savannahs, we project adverse effects on species associated with these general habitats. This is because the current condition of these habitats is often sub-optimal, lacking specific required elements. In woodlands and savannahs, livestock grazing and fire suppression have reduced regeneration and structural diversity, resulted in soil loss and compaction, and reduced habitat value (Finch and Ruggiero 1993). These habitats are considered some of the most threatened habitats in North America (Terborgh 1989). Grasslands and shrublands have also been affected, as evidenced by widespread declines in songbird populations associated with these habitats (Paige 1990).

The 60 species associated with these habitats include 14 species of special concern, five that are rare across their entire range, 14 rare in Montana, seven that are listed or candidates for listing under the Endangered Species Act, two U.S. Forest Service sensitive species and seven game and furbearer species.

All alternatives would continue treating shrublands, woodlands, savannahs, and grasslands as they are currently treated; fires would be suppressed and grazing levels set using standard USDA Soil Conservation Service methods. We project decreased grazing levels under all alternatives except Alpha, but only in order to improve riparian condition; this will not necessarily reduce grazing pressure on upland range. Continuation of existing management practices in shrublands, woodlands, savannahs, and grasslands is projected to maintain trends that have caused declining wildlife habitat conditions, and subsequent population declines in many species associated with these plant communities.

Other wildlife habitat changes resulting from each alternative are changes in habitat quality rather than the acreage of general habitat categories. We discuss these changes in the sections below. For example, livestock grazing will also affect the quality of riparian and wetland wildlife habitats as described in under the descriptor Riparian Areas and Wetlands Conditions. Recreation use and other developments may adversely affect the ability of wildlife to use any general habitat category for the 33 species sensitive to human disturbance as described in Recreation Use Levels on State Forest lands. Detailed effects of forest changes are described in the following sections.

Availability of Forest Successional Stages

The Descriptor Relationship

Forest successional stage reflects the relative age and structural complexity of forest stands; both generally increase as forests mature. Successional stages recognized here are grass and forb communities (nonstocked); seedling/sapling stands; poletimber stands; and sawtimber stands. Sawtimber stands in turn consist of young forests, mature forests, and old-growth stands.

Current Conditions

The vegetation analysis concludes that past forestry practices and fire suppression have produced declines in early and late successional stages and increases in medium-aged stands, relative to historical conditions. According to Prather and Burbridge (1979), two hundred and six wildlife species in Montana are associated with a particular forest successional stage for at least a portion of their life-cycle requirements (Table IV-W4). A large number of these species are associated with young and old stands, suggesting that past practices have had considerable adverse impact. In particular, old-growth forests support unique wildlife communities in each forest type (Arno et al. 1995, Finch and Ruggiero 1993, Habeck 1990, Hejl 1992) that have been adversely affected by these management practices.

Further, data in Table IV-W4 may underestimate the importance of later successional stages. Most use of early successional stages by wildlife is for feeding; use for reproduction accounts for only approximately 25-33 percent. In contrast, reproduction accounts for about 53 percent of the use of later successional stages.

Table IV-W4

Number of Montana wildlife species using each of six forest successional stages for at least a portion of their seasonal habitat needs in each DNRC land office area.

Successional Stage[6]	NWLO	SWLO	CLO	NELO	SLO	ELO	Statewide
Grass/Forb	118	118	121	115	115	103	134
Shrub/Seedling/Sapling	146	147	152	144	143	126	167
Pole	129	128	132	125	124	106	145
Young	146	144	148	140	141	121	161
Mature	158	157	165	151	154	133	179
Old-Growth	156	155	163	149	152	131	177
Total Species	182	182	189	175	176	155	206

[6] See Appendix WLD, Table 15, to determine which species are likely to be associated with each successional stage.

The amount and quality of older forests in Montana have declined and their distribution has changed. These declines have occurred especially at lower elevations where some of DNRC's larger blocks of ownership occur. Reduced acreage and increasing fragmentation of larger patches due to timber harvest patterns may have further reduced the usefulness of the older forests that remain as habitat for many associated species (Harris 1984, Hejl and Paige 1992, Keller and Anderson 1992, Rosenberg and Raphael 1986, Spies et al 1994, Woodbridge and Detrich 1994).

The relative importance of older forest habitat on state lands depends largely on the condition of the intermingled lands of other ownerships. Remaining older forests on state lands may be especially important as wildlife habitat in areas where surrounding lands have been heavily harvested, if patches are large enough or are adequately interconnected (Habeck 1988). On the other hand, some remaining old-growth patches may be too small to provide the full range of habitat values, particularly if policies of adjoining land-owners do not allow for the development of connection mature forests. Large areas of older forest with relatively little human disturbance may be particularly critical for maintaining overall biological diversity and ecosystem integrity (Noss 1993).

Analysis Methods

Projected successional stages for each alternative were based on the simple models summarized by Tables IV-V6, IV-V9, IV-V21, and IV-V22 from the Vegetation section. These tables include both high and low timber harvest scenarios. For simplicity, we collapsed the two scenarios into one, categorizing the trend of any successional stage as "uncertain" when high and low timber harvests projected trends in opposing directions. We also categorized changes in successional stages as "uncertain" when changes were less than 10 percent, expressed proportionally to existing percentages, even when both high and low timber harvest scenarios implied that these small changes would be in the same direction. (For example, a given successional stage constituting 10 percent of all stages would be categorized as "uncertain" if it were projected to increase proportionally by 0.1 of 10 percent, i.e., to 11 percent.)

The resulting matrix of projected changes in successional stage is shown in Table IV-W5.

Table IV-W5

Matrix of categories of projected change (+ = increase, - = decrease, ? = direction of change uncertain) in the six forest successional stages for which data on wildlife habitat affinities were available. See Appendix WLD for methods.

Successional Stage	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
Grass/Forb (unstocked)	?	?	-	?	?	-	?
Seedling/Sapling	?	?	-	?	+	?	+
Poletimber	-	-	-	-	-	-	-
Sawtimber: Young	-	-	-	-	-	-	-
Sawtimber: Mature	+	+	+	+	+	+	+
Sawtimber: Old-Growth	?	?	+	?	-	+	-

Species were categorized as beneficially affected if both their primary feeding and breeding affinities were associated with successional stages projected to increase. Species were categorized as adversely affected if both their primary feeding and breeding affinities were associated with successional stages projected to decrease. We categorized effects as "uncertain" if breeding or feeding habitat affinities were associated with successional stages that we could not project confidently, or if primary affinities were associated with multiple successional stages which were projected to change in opposing directions.

Expected Future Conditions

Species effects under the descriptor Forest Successional Stage are summarized in Table IV-W6.

Table IV-W6

Wildlife species likely to be beneficially (+) or adversely (-) affected by projected changes in forest successional stages. A total of 206 species were considered as potentially affected by successional stage; effects on those not listed here are unknown.

A. Number of species.

Wildlife Category	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
All Species							
+	30	30	35	30	24	36	24
-	5	5	37	5	5	21	5
...of which Game/Furbearer							
+	3	3	3	3	0	3	0
-	0	0	1	0	0	1	0
Special Concern (MNHP)							
+	5	5	5	5	2	5	2
-	1	1	4	1	0	3	0
...of which T&E (Listed or Candidate)	4	4	4	4	0	4	0
+	0	0	0	0	0	0	0
-							

B. Illustrative Species. Symbols: beneficially affected (+), adversely affected (-), and effect unknown (?). Species not listed here are either not considered by the descriptor, or the descriptor's effects are unknown for all alternatives.

	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
Black-backed Woodpecker	+	+	+	+	?	+	?
Fisher	+	+	+	+	?	+	?
Bog Lemming	?	?	-	?	?	-	?

DESCRIPTOR: AVAILABILITY OF FOREST SUCCESSIONAL STAGES	
EFFECTS COMMON TO ALL ALTERNATIVES We project decreases in poletimber and young forest acreage and increases in mature forest under all alternatives (see Table IV-V6 in the Vegetation section). Thus, species with primary habitat affinities in either of these classes, but in no others, are projected to be affected identically, regardless of alternative. A total of 35 species fall into this category, of which six are species of special concern, and three are game or furbearer species. Only five species are associated solely with poletimber and young forests for all life history requirements. Twenty-four species, including such "typical forest" birds as nuthatches, chickadees, and woodpeckers, as well as such forest-associated mammals as red and flying squirrels, are associated with mature forests for both feeding and breeding, and are projected to be beneficially affected by all alternatives for this descriptor. The similarity of projected stand class distributions among alternatives, as described in the Vegetation section, enforces similarity in this component of wildlife habitat, as well.	
EFFECTS OF ALPHA, BETA, AND DELTA The direction of change for grass/forb, seedling/sapling, and old-growth stages cannot be projected with confidence for Alpha, Beta, and Delta. Only the projected changes common to all alternatives can be projected with confidence. However, the provision in Beta (in the Biodiversity RMS) that at least one-half of historical amounts of old-growth be retained suggests that old-growth species will fair better than suggested by the simple projection of successional stages based on harvest rate alone (and thus better than under Alpha or Delta).	EFFECTS OF GAMMA We expect Gamma to reduce the acreage in the four earliest successional stages, and increase the acreage of both mature and old-growth forest. Thus, we project beneficial effects for such old-growth associated species as northern pygmy owl and pileated woodpecker, in addition to those benefitted by all alternatives. However, because all younger stages are projected to decrease, Gamma is also projected to produce the largest number of adverse affects. Many species expected to be adversely affected are common, opportunistic, or are generalists (e.g., robin, skunks, meadow vole), but some locally rare species are included, as is an important big game species, mule deer. Both adverse and beneficial effects of this alternative are large relative to the other alternatives because Gamma results in a clear shift from early successional stages to older forests.

<table>
<tr><th colspan="2">DESCRIPTOR: AVAILABILITY OF FOREST SUCCESSIONAL STAGES</th></tr>
<tr><td>EFFECTS OF EPSILON

We expect Epsilon would increase seedling/sapling stages but reduce old-growth. Seedling/sapling acreage could potentially double. Existing old-growth forest would experience corresponding decreases. Thus, such old-growth obligates as the three-toed woodpecker would be adversely affected, while species associated with younger stands, such as juncos and white-footed mice, would benefit.</td><td>EFFECTS OF ZETA

The effects of this alternative are similar to Gamma, except that the timber harvest levels of Zeta relative to Gamma make projections of the seedling/sapling acreage uncertain. This reduces the number of species that would be affected under Zeta compared to Gamma.</td></tr>
<tr><td colspan="2">EFFECTS OF OMEGA

Based on our harvest volume-based model, expected forest successional stages under Omega closely resemble those under Epsilon. Seedling/sapling stages would likely increase, but the younger stages within the Sawtimber class, as well as old-growth, would decline. However, unlike Epsilon, Omega contains standards that call for retaining no less than one-half the estimated amount of old-growth that would occur historically, given natural disturbance patterns. Thus, although not modeled explicitly, we would expect cutting patterns to allow for retention and replacement of more old-growth in Omega than suggested by the model (and more than under Epsilon). Because Omega emphasizes basing desired forest conditions on likely historical patterns, certain types of old-growth that are currently abundant would be expected to decrease in abundance, but other types, presently under-represented (notably low-elevation, shade-intolerant dominated old-growth types) would gradually increase in abundance.</td></tr>
</table>

Discussion--Availability of Forest Successional Stages

We categorized the effects of changes in successional stages on a majority of species as uncertain. Even for alternative Gamma, we remain uncertain as to the effect on 134 of the 206 species for which we had information on successional stage affinities. In part, this reflects uncertainties in our projection of individual successional stages (11 of the 36 possible combinations of stage and alternative). However, our uncertainty also reflects the frequency with which species have affinities for one set of habitat conditions for breeding and a separate set for foraging. (Often, later successional stages are associated with breeding or cover requirements, while earlier stages are associated with foraging). Categorization as "uncertain" often resulted because we structured our model to produce beneficial or adverse affects only when both breeding and foraging affinities were associated with stages projected to change in the same direction.

In fact, many effects may be real, but we cannot generalize about them statewide. In order to predict specific effects, we need to know what, if any, habitat elements are limiting. If, for example, a species requires elements provided by early successional stages for foraging and elements provided by old-growth for nesting, but old-growth is limiting whereas poletimber is not, then alternatives Gamma and Zeta would likely benefit that species, despite their projected reductions in poletimber acreage. Similarly, a species that is currently limited by insufficient supply of seedling/sapling forests would benefit from Epsilon or Omega, despite the same reduction in poletimber acreage. Neither of these hypothetical species would be listed in Table IV-W6, because we cannot generalize about limiting factors for specific species.

However, it does seem reasonable to conclude that species with specific requirements for early and/or late successional stages (particularly old-growth) are currently at a disadvantage, given the recent trend toward middle age classes (Table IV-V7 and IV-V8 in the Forest Vegetation section). Thus, movement toward greater representation of both younger and older age-classes is likely to favor species needing help, at the expense of those that currently enjoy an abundance of favored successional stages.

Availability of Forest Types

The Descriptor Relationship

Forest types describe plant communities based on the most prevalent tree species, or in some cases the most prevalent combination of species, in a stand. Wildlife communities are often associated with the overall plant community structure rather than particular plant species at a site. In some instances, relatively few plant species may provide the structure that wildlife species need. For example, pileated woodpeckers need snags that meet certain criteria for size and how they decay; ponderosa pine and western larch best meet these criteria. White-tailed deer need forest cover that intercepts snowfall; Douglas-fir, spruce, and grand fir intercept snow better than other conifers.

Current Conditions

There are 209 wildlife species associated with forests or woodlands in Montana (Table IV-W7). Each forest type supports some wildlife species that are rare or absent in other types. Ponderosa pine and western larch forests support the largest number of species, but have experienced the greatest decline due to past management activities, as described in the Vegetation section of this analysis. Conversely, spruce and subalpine fir forests, the second most species-rich forest type, have increased substantially. Grand fir forests, which support the smallest number of species, have also increased in abundance. Western Montana generally supports more forest-associated wildlife species than eastern portions of the state; however, the Central Land Office, because of its location, supports increased numbers of species from both regions.

Table IV-W7

Number of Montana wildlife species using each of seven forest types for at least a portion of their seasonal habitat needs in each DNRC land office area. Habitats missing from this table are not represented on DNRC lands in that land office area.

Forest type[7]	NWLO	SWLO	CLO	NELO	SLO	ELO	Statewide
Hardwood	147	147	151	142	140	129	162
Douglas-fir	139	139	142	131	131	--	150
P. Pine/Larch	158	158	167	151	154	134	180
Grand Fir	115	113	--	--	--	--	121
Lodgepole Pine	126	125	128	113	115	--	134
Spruce/Subalpine Fir	141	142	151	134	--	--	163
Cedar/Hemlock	135	136	--	--	--	--	156
Total Species	182	182	191	176	178	157	209

The statewide trend has been an increase in late-successional forest types (Douglas-fir, grand fir, spruce, and subalpine fir) and a decrease in early-successional types (ponderosa pine, lodgepole pine, and western larch). This has probably tended to favor relatively common wildlife species and reduce numbers of rarer species, potentially reducing overall wildlife diversity. Trends in the Central Land Office differ because Douglas-fir is the primary seral as well as climax species in the habitat types that dominate this region. Acreage of Douglas-fir forest here is less likely to have experienced measurable change; most changes in wildlife habitat value have probably been in terms of tree density and stand age.

Analysis Methods

As in the previous descriptor, we categorized species as beneficially affected if both their primary feeding and breeding affinities were associated with forest types projected to increase, but neither were associated with types projected to decrease. Species were categorized as adversely affected if both their primary feeding and breeding affinities were associated with forest types projected to decrease, but were not also associated with types projected to increase. We categorized effects as "uncertain" if either breeding or feeding habitat affinities were associated with forest types that we could not project confidently, or if primary affinities were associated with multiple forest types which were projected to change in opposing directions.

Projected changes in forest types are based on Table IV-V14 in the Vegetation section. Using this table as a basis for our analysis, we categorized forest types as increasing and decreasing only if the entire range of projections from Table IV-V14 suggested increases or decreases (i.e., did not overlap both zones). When projections for changes in acreage of forest type were symmetrical

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[7] See Appendix WLD, Table 14, to determine which species are likely to be found in each forest cover type.

about the center line, we categorized that type as either unchanging (if the range was narrow, e.g., lodgepole pine under alternative Alpha) or uncertain (if the range was wide, e.g., ponderosa pine under alternative Alpha). We included two additional categories to most nearly reflect our projections of forest type: "uncertain as to direction, but somewhat more likely to increase than decrease" (which we denote with the symbol "?+"), and "uncertain, but somewhat more likely to decrease than increase" ("?-").

Expected Future Conditions

Effects on species under the descriptor Forest Types are summarized in Table IV-W8.

Table IV-W8

Wildlife species likely to be beneficially (+), adversely (-) affected by projected changes in forest types, or upon which effects are uncertain but considered somewhat more likely to be beneficial (?+) or detrimental (?-). A total of 209 species were considered as potentially affected by forest type; effects on those not listed here are unknown.

A. Number of Species.

Wildlife Category	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
All Species							
+	18	18	11	0	3	11	4
?+	0	3	3	18	0	3	27
?-	0	2	0	2	9	0	0
-	28	28	37	27	29	37	10
...of which Game/Furbearer							
+	5	5	4	0	1	4	1
?+	0	1	1	6	0	1	2
?-	0	1	1	1	3	0	0
-	2	2	3	2	3	3	4
Special Concern (MNHP)							
+	2	2	1	0	1	1	1
?+	0	1	1	3	0	1	2
?-	0	0	0	0	1	0	0
-	2	2	5	2	2	5	1
...of which T&E (Listed or Candidate)	2	2	1	0	0	1	0
+	0	0	0	2	0	0	0
?+	0	0	0	0	1	0	0
?-	0	0	1	0	0	1	1
-							

B. Illustrative Species. Symbols: beneficially affected (+), adversely affected (-), and effect unknown (?). Species not listed here are either not considered by the descriptor, or the descriptor's effects are unknown for all alternatives.

	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
Ruffed Grouse	-	-	-	-	-	-	?+
Spruce Grouse	+	+	?	?+	?	?	?
Black-backed Woodpecker	?	?	-	?	?	?	?

DESCRIPTOR: AVAILABILITY OF FOREST TYPES

EFFECTS COMMON TO ALL ALTERNATIVES

Under all alternatives (with the possible exception of Omega) the acreage of hardwoods (principally *Populus* spp.) was projected to decrease. Although hardwoods constitute only about two percent of state-owned forest lands and are negligible for timber production, they are disproportionately important for wildlife. Twenty-seven species have both feeding and cover affinities associated only with hardwoods, including such wide-ranging species as ruffed grouse, long-eared owl, raccoon, and white-tailed deer. Under all but Epsilon, cedar/hemlock types were projected to be somewhat more likely to increase than to decrease, but no species were identified as having primary habitat affinities solely for cedar/hemlock types.

EFFECTS OF ALPHA

Late successional types were projected to continue their upward trend under Alpha. Trends among the seral types ponderosa pine, western larch, and lodgepole pine forest acreage are uncertain, and will probably depend on timber harvest level.

EFFECTS OF BETA

Effects of Beta on wildlife were projected to be similar to those of Alpha, with the exception being the possible increase in the acreage of ponderosa pine and larch, favoring wild turkey, great gray owl, and violet-green swallow, at the expense of Douglas fir types, adversely affecting blue grouse and ruby-crowned kinglet.

DESCRIPTOR: AVAILABILITY OF FOREST TYPES	
EFFECTS OF GAMMA AND ZETA	EFFECTS OF DELTA
We projected Ponderosa pine and western larch acreage to decrease, and grand fir and spruce/fir types to increase. In general, the effect of these changes would be to "feed the rich and starve the poor", as these are types that have already seen a trend in these directions. However, among species projected to benefit from Gamma and Zeta are interior forest dwellers such as chestnut-backed chickadee, pine grosbeak, and wolverine.	We have the greatest uncertainty in our projections of future forest types under alternative Delta. No types were projected unambiguously to increase, thus no wildlife species were projected to be benefitted. Depending on type and intensity of timber harvest (vs. competing sources of revenue), the effect on wildlife in Delta for this descriptor could resemble almost any of the other alternatives.
EFFECTS OF EPSILON	EFFECTS OF OMEGA
Effects of Epsilon on species associated with specific forest types would largely be the reverse of alternatives Gamma and Zeta. Because we projected a decrease in the acreage of Douglas-fir types, we projected adverse effects on blue grouse and ruby-crowned kinglets, in addition to those affected by loss of hardwoods. Conversely, we projected an increase in ponderosa pine and larch types, favoring wild turkey, great gray owl, and violet-green swallow.	Because the intention of Omega is to gradually emulate the relative abundance of forest types existing prior to substantial human disturbance, we project that forest types will all proceed toward their historical abundances. Thus, we project decreases in the abundance of the (largely) shade-tolerant Douglas-fir, grand fir, and Englemann spruce/subalpine fir cover types, and increases in the (largely) shade-intolerant ponderosa and lodgepole pine covertypes. Additionally, we would prioritize management strategies that would retain hardwood and Cedar/Hemlock types. Thus, species such as wild turkey, great gray owl, and flammulated owl would (eventually) be provided additional habitat, but species such as blue grouse and ruby-crowned kinglets would face reductions in preferred forest cover type.

Discussion--Availability of Forest Types

Our analysis here largely parallels that for successional stage: uncertainties abound, both because we cannot confidently project the direction of change for some forest types under some alternatives, and because most terrestrial wildlife species use more than one forest type for at least part of their life history requirements, and many thus would find themselves with increasing cover and decreasing forage, or vice versa. As well, trends in forest types tend to track trends in successional stages. Again, without detailed knowledge of project-specific proposals, and of limiting factors for each species, confident projections of beneficial or adverse effects are necessarily limited.

Forest Stocking Level

The Descriptor Relationship

Forest stocking level is determined by the extent to which the growing space in a stand or patch is occupied by trees. Stocking level can be viewed as roughly equivalent to canopy density.

Forest stocking level influences habitat availability for animal species associated with open, closed, or medium canopy forests. Individual species may utilize forests with different canopy densities to meet different habitat needs; for example, a number of bird species feed in open forests, but seek shelter or reproductive habitat in more dense stands. There are also some terrestrial vertebrate species associated with specific canopy densities, which are thus susceptible to changes in canopy structure.

Current Conditions

There are 133 wildlife species in Montana for which some association with forest canopy structure has been identified (Table IV-W9). There are more species associated with open canopied forests; the number of species drops progressively as canopies close. However, data presented in Table IV-W9 underestimates the importance of closed-canopy forests. Approximately 60 percent of species use open-canopied forest for feeding. In contrast, closed-canopy forests are used disproportionately for reproductive needs. Only 44 percent of species use closed-canopy forests for feeding; the majority of species depend on it to provide suitable areas for reproduction. The difference is even more striking for those species that find optimum habitat conditions in closed-canopy forests. Of 49 species whose optimum habitat conditions are provided by closed-canopy forests, 29 percent find optimum feeding conditions there, and 71 percent find optimum breeding conditions there. Open-canopy forests provide only 38 species with optimum breeding conditions, while 68 species find optimum feeding conditions there. In general, reproductive habitat requirements are more limiting than feeding habitat requirements.

The vegetation analysis indicates that more forests have become heavily stocked over time with smaller trees. This should tend to favor wildlife species associated with closed-canopy forests. Species such as white-tailed deer, which associate with closed-canopy forests for their thermal cover value, have probably benefitted from these trends. However, many of the species associated with closed-canopy forests also depend on large trees to provide nest cavities, roost sites, feeding areas or support for large nests. Species closely associated with open-canopied forests for both feeding and reproductive habitat would also have been adversely affected by this trend in forest canopy structure.

Table IV-W9

Number of Montana wildlife species using each of three levels of forest canopy closure for at least a portion of their seasonal habitat needs in each DNRC land office area.

Canopy Closure[8]	NWLO	SWLO	CLO	NELO	SLO	ELO	Statewide
Closed Canopy (> 70%)	46	46	48	40	42	31	48
Medium Canopy (30-70%)	74	74	77	69	72	60	83
Open Canoy (< 30%)	90	90	96	89	90	80	103
Total Species	119	119	126	114	116	101	133

Analysis Methods

As in the previous descriptor, we categorized species as beneficially affected if both their primary feeding and breeding affinities were associated with stocking densities projected to increase. Species were categorized as adversely affected if both their primary feeding and breeding affinities were associated with stocking densities projected to decrease. We categorized effects as "uncertain" if either breeding or feeding habitat affinities were associated with stocking densities that we could not project confidently, or if primary affinities were associated with multiple densities which were projected to change in opposing directions.

Projected changes in stocking level were based on Table IV-V18 in the Vegetation section. Using this table as a basis for our analysis, we projected stocking levels as increasing or decreasing only if the entire range of projections from Table IV-V18 suggested increases or decreases (i.e., did not overlap both zones). When projections for changes in acreage of stocking level were symmetrical about the center line, we categorized that type as unchanging (e.g., "Medium stocked" under alternative Epsilon, Table IV-V18). As in the Forest Types descriptor, we included two categories to most nearly reflect our projections of stocking rate: "uncertain as to direction, but somewhat more likely to increase than decrease" (which we denote with the symbol "?+"), and "uncertain, but somewhat more likely to decrease than increase" ("?-").

We used a slightly different categorization of stocking level than indicated in Table IV-V18 to be consistent with our data sources on wildlife habitat affinities (Prather and Burbridge 1979). We recognized three categories: nonstocked (currently not supporting forest) or poorly-stocked (< 30 percent tree canopy - open canopy); medium-stocked (30-70 percent - medium canopy); and fully-stocked (> 70 percent - closed canopy).

8 See Appendix WLD, Table 16, to determine which species are associated with each level of canopy cover.

Expected Future Conditions

Effects on species under the descriptor Stocking Level are summarized in Table IV-W10.

Table IV-W10

Wildlife species likely to be beneficially (+) or adversely (-) affected by projected changes in stocking level, or upon which effects are uncertain but considered somewhat more likely to be beneficial (?+) or detrimental (?-). A total of 134 species were considered as potentially affected by stocking level; effects on those not listed here are unknown because stocking levels cannot be accurately projected.

A. Number of Species.

Wildlife Category	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
All Species							
+	12	0	12	0	0	12	0
?+	0	12	0	12	28	0	12
?-	0	2	0	2	14	0	20
-	33	28	33	0	0	33	0
...of which Game/Furbearer							
+	2	0	2	0	0	2	0
?+	0	2	0	2	2	0	2
?-	0	0	0	0	3	0	2
-	2	2	2	0	0	2	0
Special Concern (MNHP)							
+	3	0	3	0	0	3	0
?+	0	3	0	3	4	0	3
?-	0	0	0	0	3	0	1
-	4	4	4	0	0	4	0
...of which T&E (Listed or Candidate)							
+	2	0	2	0	0	2	0
?+	0	2	0	2	0	0	2
?-	0	0	0	0	2	0	0
-	0	0	0	0	0	0	0

B. Illustrative Species. Symbols: beneficially (+), adversely affected (-), effect unknown (?), effect uncertain but more likely positive than negative (?+), and effect uncertain but more likely negative than positive (?-). Species not listed here are either not considered by this descriptor, or the descriptor's effects are unknown for all alternatives.

	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
Flammulated Owl	-	-	-	?	?+	-	?
Black Backed Woodpecker	-	-	-	?	?+	-	?
Fisher	+	?+	?+	?+	?-	?+	?+

DESCRIPTOR: FOREST STOCKING LEVEL	
EFFECTS OF ALPHA, GAMMA, AND ZETA Harvest level estimates under these alternatives are not sufficient to reduce the amount of closed-canopy forest (>70 percent canopy) or to increase the amount of medium- (30-70 percent canopy) or open- (< 30 percent) canopy forest. The trend toward more acreage with dense canopies is projected to benefit species such as veery, Swainson's thrush, and fisher, with strong affinities for dense canopies. Conversely, species such as kestrel and meadow vole, with both foraging and breeding habitat preference for open habitats, are projected to be adversely affected.	EFFECTS OF BETA, DELTA AND OMEGA Projected changes in canopy density under these three alternatives are generally similar to those of Alpha, Gamma, and Zeta: acreages of open canopy forest are likely to decline, while acreages of closed canopy forests are likely to increase. However, there is greater uncertainty associated with these three alternatives than with Alpha, Gamma, or Zeta. Particularly for alternatives Beta and Omega, however, these trends are only averages that might be deceiving locally: canopy density under these alternatives is likely to become more open on low-elevation, xeric sites.
EFFECTS OF EPSILON Although timber harvest levels under Epsilon would increase, the effects on stocking level category could not be projected with much certainty (Table IV-V18). Thus, there is corresponding uncertainty about the effects on forest wildlife. To the degree that projection is possible, largely the same list of species is affected as under Alpha, Gamma, and Zeta, but in the opposite direction. Only two species, golden-crowned kinglet and western tanager, are associated solely with medium canopy conditions, and thus are projected to be unaffected by alternative Epsilon for this descriptor.	

Discussion--Forest Stocking Level

As with the previous two analyses, considerable uncertainty remains regarding the future stocking level under each alternative. This reflects, in part, the differences in our high and low timber harvest scenarios. Some areas will remain unaffected under any alternative because they are considered deferred lands. Fire remains a wild card, as well. Although all alternatives include continued fire suppression, we cannot expect 100 percent efficiency. Except under Epsilon, well-stocked stands are projected to increase, but fires could change that, potentially benefitting fire-dependent species, or those associated with open stand conditions, even under alternatives in which they are projected here to be adversely affected.

Snag Abundance

The Descriptor Relationship

Snags are standing dead trees (although live trees with broken tops and heart rot are sometimes considered snags as well). The diameter and height of snags influence their relative value for various wildlife species. Snags are important as nesting, denning, roosting, or feeding sites for a number of bird, mammal, and insect species (Thomas et al. 1977, Marzluff and Lyon 1983, Scott et al. 1977). Snags are also an important element characterizing the old-growth forest successional stage. They eventually fall to the forest floor, providing coarse woody debris, an important element for additional species, as described in the next descriptor.

Current Conditions

There are 79 wildlife species in Montana dependent on snags as an essential component of their overall habitat (Table IV-W11). All types of snags are used by wildlife, but many snag-dependent species rely on the largest trees to meet their habitat needs. By far the most common use for snags is nest sites. Some species excavate nest holes in snags directly; others lack this capability but depend on previously excavated cavities.

Forest management practices, reviewed in the Vegetation section, suggest that small diameter snags have increased but larger diameter snags have decreased relative to historical conditions. These trends in snag numbers have probably reduced overall habitat suitability for species dependent on large snags (> 15") to meet their habitat needs. Species that utilize snags 10"-15" in diameter may have been favored by increased snag abundance in this category.

Table IV-W11

Number of Montana wildlife species dependent on dead trees, fallen logs, or seclusion from human disturbance for at least a portion of their seasonal habitat needs in each DNRC land office area.

Special Habitat[9]	NWLO	SWLO	CLO	NELO	SLO	ELO	Statewide
Standing Dead Trees	69	70	76	64	65	57	79
< 10" dbh	12	12	12	8	9	6	12
10-15" dbh	37	37	40	32	33	30	41
16-20" dbh	41	42	45	35	36	32	46
> 20" dbh	48	49	53	42	43	39	54
Logs on Forest Floor	70	67	70	62	66	48	85
Seclusion from Humans	31	31	33	31	30	26	33
Total Number Species	138	135	145	127	129	107	162

9 See Appendix WLD, Tables 17, 18, and 19, to determine species dependent on snags, down logs, and seclusion.

Analysis Methods

Projected changes in abundance of small and large snags were based on Table IV-V23. In only one case (alternative Beta, small snags) were we unable to project a direction of change for snag abundance.

Unlike previous descriptors, our data simply categorized species as associated with snags or not. The only distinction was whether the affinity was for large (>15" diameter) or small snags. Thus, this analysis was more straight-forward than the previous three, not necessitating consideration of foraging vs. breeding requirements.

Expected Future Conditions

Effects on species under the descriptor Snag Abundance are summarized in Table IV-W12.

Table IV-W12

Wildlife species likely to be beneficially (+) or adversely (-) affected by projected changes in snag abundance. A total of 79 species were considered as potentially affected by snag abundance; effects on those not listed here are unknown because snag abundance cannot be accurately projected.

A. Number of species.

Wildlife Category	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
All Species							
+	52	27	79	52	0	79	27
-	27	0	0	27	79	0	52
...of which Game/Furbearer							
+	3	8	11	3	0	11	8
-	8	0	0	8	11	0	3
Special Concern (MNHP)							
+	5	4	9	5	0	9	4
-	4	0	0	4	9	0	5
...of which T&E (Listed or Candidate)	1	2	3	1	0	3	2
+	2	0	0	2	3	0	1
-							

B. Illustrative Species. Symbols: beneficially (+), adversely affected (-), or effect unknown (?). Species not listed here are either not considered by this descriptor, or the descriptor's effects are unknown for all alternatives.

	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
Bald Eagle	-	+	+	-	-	+	+
Flammulated Owl	-	+	+	-	-	+	+
Boreal Owl	+	?	+	+	-	+	-
Black-backed Woodpecker	+	?	+	+	-	+	-
Fisher	-	+	+	-	-	+	+

DESCRIPTOR: SNAG ABUNDANCE

EFFECTS OF ALPHA AND DELTA	EFFECTS OF BETA
We project an increase in small snags (15 inches in diameter or smaller) and a decrease in larger snags (> 15 inches). This would benefit the 52 species of wildlife that utilize smaller snags, including most woodpeckers, smaller owls, and bats. However, large snags, already likely reduced due to past forest practices, are projected to be further reduced, adversely affecting large snag-dependent species such as flammulated owl, three-toed woodpecker, and wood duck.	We are uncertain as to the likely trend in the abundance of small snags, but numbers of larger snags would probably increase. This would result in improved habitat conditions for the 27 species that depend on larger snags, including species such as bufflehead, osprey, barred owl, and raccoon.
EFFECTS OF GAMMA AND ZETA	**EFFECTS OF EPSILON**
We project an increase in numbers of both small and large snags. This would improve habitat conditions for all 79 species of wildlife that depend on snags for part of their overall habitat needs.	We project a decrease in abundance of both small and large snags. This would adversely affect all 79 species of wildlife that depend on snags for part of their habitat needs. Because snags are an essential habitat element for these species, a decrease in snags to less than their habitat requirements would render meaningless any beneficial effects resulting from other changes in forest structure. Because large snags have been reduced relative to historical levels whereas small snags have increased, habitat requirements are more likely to be limiting for users of large snags.

EFFECTS OF OMEGA

Our projections regarding snags under Omega are exactly the reverse of those under Alpha and Delta. Under Omega, we would manage so as to provide for an increase in the abundance of large (> 15 inches diameter) snags; however, the number of small snags would probably decline. Although the total number of species negatively affected by fewer small snags (52) is larger than those benefited (27) from retaining more large snags, the latter list tends to include species that have historically been hard hit by forest practices within managed forests.

Discussion--Snag Abundance

Large snags are probably the greatest concern, both because they have decreased historically, and because they are often associated with tree species that are valued both live and dead for timber and firewood (e.g., western larch, ponderosa pine). Retention and recruitment of large snags is specifically called for by inter-agency bald eagle management guidelines (Chew et al 1991). Maintaining these snags requires both adherence to silvicultural prescriptions and road management (because "leave trees" are often taken later by firewood gatherers). Maintaining the largest and oldest types, often those most valuable for large owls and woodpeckers, may become more difficult in the future under any alternative. This is because new safety regulations may be promulgated by the federal Occupational Safety and Health Agency (OSHA) that would regulate forestry activities near snags determined to be safety hazards.

Large Woody Debris on the Forest Floor

The Descriptor Relationship

Logs and other woody debris such as stumps, root wads, bark, and piles of limbs provide important habitat elements for many terrestrial vertebrate species (Swanson and Franklin 1992, Thomas et al. 1977). Adequate woody debris is often considered 10-15 tons per acre of material larger than six inches in diameter (Graham et al. 1994). Woody debris on the forest floor provides structural diversity for hiding cover and critical reproductive sites for a variety of small- and medium-sized wildlife species. This material is essential for numerous invertebrate species which, in turn, are critical food sources for the vertebrate species. As logs decay, the interior becomes soft enough for small mammals to burrow inside, supplementing the tunnels they created around and under the log in its earlier stages of decay. These burrow systems are also important to reptiles and amphibians. Large logs can provide access to the subnivean environment for such species as martens, which forage under the snow during winter.

Current Conditions

There are 64 wildlife species in Montana that depend on woody debris on the forest floor as an essential component of their overall habitat needs (Table IV-W13). All of the forest reptile and amphibian species depend on woody debris.

Trends in large woody debris have most likely paralleled trends in snag abundance and size, although to a lesser extent they probably reflect longer-term stand dynamics. Areas that remain unharvested or only lightly harvested probably have increased abundance of woody debris. Conversely, roughly 101,000 acres (16 percent) of state forest lands with stands less than 60 years old, primarily as a result of timber harvest (Table IV-V6 in the Vegetation section), likely have less woody debris. Overall, woody debris has probably increased on state forests, benefitting the wildlife species associated with this habitat component.

The one exception is for wildlife species that need large logs. The number of large logs on state lands has probably decreased. Larger logs persist longer in the environment and provide more burrowing area for insects, mammals, reptiles and amphibians. Large wildlife species that use hollow logs as den sites have probably experienced reduced habitat potential.

Analysis Methods

Projected changes in abundance of large woody debris parallel those for snags (see previous descriptor and Table IV-V23 in the Vegetation section) because we assume most large woody debris originates with snags. For alternatives Alpha and Delta, however, because we project abundance of small snags to increase but of large snags to decrease, we are unsure about the resultant trend in large woody debris. Similarly, for alternative Omega, the opposite trends argue against meaningful projection of woody debris abundance. Thus, we categorize as "uncertain" the effects on species associated with large woody debris under these three alternatives.

Expected Future Conditions

Effects on species under the descriptor Large Woody Debris are summarized in Table IV-W13.

Table IV-W13

Wildlife species likely to be beneficially (+) or adversely (-) affected by projected changes in abundance of down woody debris. A total of 64 species were considered as potentially affected by woody debris. For Alpha and Delta, amount of woody debris cannot be accurately projected because small snag abundance is projected to increase but large snag abundance is projected to decrease. For Omega, woody debris cannot be accurately projected because large snag abundance is projected to increase, but small snag abundance is projected to decrease.

A. Number of species.

Wildlife Category	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
All Species							
+	0	64	64	0	0	64	0
-	0	0	0	0	64	0	0
...of which Game/Furbearer							
+	0	9	9	0	0	9	0
-	0	0	0	0	9	0	0
Special Concern (MNHP)							
+	0	15	15	0	0	15	0
-	0	0	0	0	15	0	0
...of which T&E (Listed or Candidate)	0	4	4	0	0	4	0
+	0	0	0	0	4	0	0
-							

B. Illustrative Species. Symbols: beneficially (+), adversely affected (-), or effect unknown (?). Species not listed here are either not considered by this descriptor, or the descriptor's effects are unknown for all alternatives.

	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
Ruffed Grouse	?	+	+	?	-	+	?
Spruce Grouse	?	+	+	?	-	+	?
Harlequin Duck	?	+	+	?	-	+	?
Grizzly Bear	?	+	+	?	-	+	?
Bog Lemming	?	+	+	?	-	+	?
Tailed Frog	?	+	+	?	-	+	?

DESCRIPTOR: LARGE WOODY DEBRIS ON THE FOREST FLOOR	
EFFECTS OF ALPHA AND DELTA	EFFECTS OF BETA, GAMMA AND ZETA
Because our data on habitat affinities do not distinguish the size of woody debris, we remain uncertain about the effects of Alpha and Delta on debris-dependent species. Presumably, species that are associated with smaller diameter, finer material would benefit, but species that require large, coarse material would be adversely affected. However, any negative effects could be limited by provisions in the Silvicultural Resource Management Standards requiring replacement of down woody material in timber harvest areas. Thus, some recruitment of woody debris could be obtained from sources other than snags.	We project an increase in the abundance of large woody debris under these three alternatives, with the amount of smaller material either increasing (Gamma and Zeta), or uncertain (Beta). Reptiles and amphibians would benefit from such increases, as would most forest insectivores, many small rodents, and many of their predators (e.g., mink, otter, coyote).
EFFECTS OF EPSILON	EFFECTS OF OMEGA
We expect the amount of woody debris, both large and small, to decrease under Epsilon, because snag abundance is projected to decrease. All species that depend on logs to meet their habitat needs could thus be adversely affected by these changes. However, these effects could be limited by provisions in the Silvicultural Resource Management Standards requiring replacement of down woody material in timber harvest areas. Thus, some recruitment of woody debris could be obtained from sources other than snags.	Because our data on habitat affinities do not distinguish the size of woody debris, we remain uncertain about the effects of Omega on debris-dependent species. Presumably, species that are associated with larger diameter, coarser material would benefit, but the total amount of woody debris may not necessarily increase. However, any negative effects could be limited by provisions in the Silvicultural Resource Management Standards requiring replacement of down woody material in timber harvest areas. Thus, some recruitment of woody debris could be obtained from sources other than snags.

Discussion--Large Woody Debris on the Forest Floor

For some species, the presence of coarse, woody debris is a life-history requirement. Thus, for these species, a reduction in abundance of woody debris below required levels would render meaningless any beneficial effects suggested by other descriptors of habitat. However, for other species, woody debris merely provides a more favorable foraging environment; reduction of this component would adversely affect habitat quality, although not necessarily exclude occupance.

Silvicultural Resource Management Standards for all alternatives require consideration of the "long-term productivity of the soil and site," thus some retention of woody debris may be favored in any case, regardless of snag abundance.

Riparian Area and Wetlands Condition

The Descriptor Relationship

Riparian areas and wetlands are identified by the presence of vegetation that requires more moisture to grow than is normally found in adjacent lands. The presence of water or moist conditions is a characteristic of all such wildlife habitats. Riparian wildlife habitat, however, is more inclusive than the definition of riparian vegetation used for hydrologic and watershed analyses. It includes any vegetation different from that on adjacent uplands which requires more moisture.

Riparian zones and wetlands are critical features of the landscape and provide important aquatic and terrestrial wildlife habitats for a variety of reasons, such as:

- Their vegetation structure is often unique, very diverse, and multi-layered, with plant growth generally greater than adjacent uplands.
- They make up a minor portion of the overall area and often contain plant species not found in drier uplands, increasing diversity and complexity both locally and across the forest generally.
- They provide water, food, and cover, critical habitat components for wildlife in close proximity, resulting in increased abundance and diversity in the wildlife community.
- They tend to be linear, creating a series of travel corridors both between and along waterways.

Current Conditions

The acreage of wetlands and riparian areas affected by this forest plan is relatively small. However, these two habitats support 308 wildlife species, far more than any other habitat category. These habitats also support 38 species of special concern. Many wetland and riparian wildlife habitats fall outside the Streamside Management Zone defined by law to limit impacts to water quality and fish habitat. Nevertheless, watershed analysis should adequately represent trends in wildlife habitat condition. It indicates that most wetland and riparian habitats have been adversely impacted by past management activities, and that while there has been a recent slowing of degradation, conditions in many areas are probably still declining.

Steep population declines have been documented in songbird populations associated with wetland and riparian habitats (see Dobkin 1992 for a review). Other wildlife groups dependent on these habitats are likely to experience similar population declines. Riparian areas and wetlands have been impacted by timber harvest, agricultural conversion, livestock grazing, flood control, and various other human developments (Finch and Ruggiero 1993).

Analysis Methods

No numerical projections were made of riparian or wetland conditions expected under the various alternatives. Nor did we determine the actual condition of riparian and wetland habitats on state lands. Rather, we assumed that trends in riparian condition described in the Watershed section of this chapter would apply equally to wildlife habitat value. Species associated with riparian and/or wetland areas are projected to benefit from improved management of riparian areas; they are projected to be adversely affected by continuation of the status quo.

Expected Future Conditions

We present the environmental consequences separately for the land offices in eastern and Western Montana because effects differ in the two regions. Effects on species are summarized in Table IV-W14.

Table IV-W14

Wildlife species likely to be beneficially (+) or adversely (-) affected by projected changes in condition of riparian and wetland areas. A total of 275 species in western, and 296 species in eastern land office areas were considered as potentially affected.

A. Number of species.

	Western Land Offices		Eastern Land Offices
Wildlife Category	ALPHA	ALL OTHERS	ALL ALTERNATIVES
All Species			
+	0	275	0
-	275	0	296
...of which Game/Furbearer			
+	0	50	0
-	50	0	51
Special Concern (MNHP)			
+	0	28	0
-	28	0	38
...of which T&E (Listed or Candidate)			
+	0	10	0
-	10	0	14

B. Illustrative Species. Symbols: beneficially affected (+), or adversely affected (-). Species not listed here are not considered by this descriptor.

	Western Land Offices		Eastern Land Offices
	ALPHA	ALL OTHERS	ALL ALTERNATIVES
Harlequin Duck	-	+	-
Bald Eagle	-	+	-
Ferruginous Hawk	-	+	-
Black Tern	-	+	-
Boreal Owl	-	+	-
Black-backed Woodpecker	-	+	-
Le Conte's Sparrow	-	+	-
Grizzly Bear	-	+	-
Fisher	-	+	-
Beaver	-	+	-
Bog Lemming	-	+	-
Tailed Frog	-	+	-
Spiny Softshell	-	+	-

DESCRIPTOR: RIPARIAN AREA AND WETLANDS CONDITION

EFFECTS COMMON TO ALL ALTERNATIVES IN EASTERN MONTANA (CENTRAL, NORTHEASTERN, SOUTHERN, AND EASTERN LAND OFFICES)

In Eastern Montana, livestock grazing is the primary factor influencing riparian and wetland habitat quality. Grazing Resource Management Standards under this plan apply only to classified forest lands. Only relatively small amounts of land in the Central, Northeastern, Southern, and Eastern land offices are so classified. Even a majority of acreage supporting forest in these land office areas is not classified as such.

Our watershed analysis for Eastern Montana indicates that riparian and wetland habitats have been severely impacted, and that the trend is a continuing. None of the alternatives would change that condition. Consequently, continuing adverse impacts to riparian and wetland wildlife habitats are expected. These two habitats support 296 wildlife species, including 39 species of special concern and 51 game and furbearer species (Table IV-W14). No species are known to benefit from degraded habitat conditions in wetland and riparian areas.

EFFECTS OF ALPHA IN WESTERN MONTANA

Both grazing and timber harvest impact riparian and wetland habitats in Western Montana. The Alpha alternative would continue to implement BMP and SMZ guidelines to reduce impacts associated with timber harvest. However, grazing management practices would not change under this alternative; consequently, grazing-related impacts would continue. Riparian condition in Western Montana, while better than in the east, has suffered adverse impacts due to past management activities. Wildlife habitat conditions would continue to suffer adverse impacts in areas currently being impacted. Consequently, adverse impacts associated with Alpha would be similar to those projected in Eastern Montana. The 275 species associated with riparian and wetland habitats in Western Montana, including 28 species of special concern and 50 game and furbearer species, would continue to suffer adverse impacts.

EFFECTS OF ALL OTHER ALTERNATIVES IN WESTERN MONTANA

We project that all other alternatives would improve riparian and wetland habitat conditions west of the setting livestock grazing at levels based on plant utilization rates in riparian areas. Such changes would benefit the same 275 riparian wildlife species that would be adversely affected under Alpha.

Discussion--Riparian Area and Wetlands Condition

The analysis under this descriptor is rather simple, but the stark nature of the results underlines an important point: riparian areas are disproportionately important for many species of wildlife. Resource Management Standards that "...improve or restore both herbaceous and woody species to a healthy and vigorous condition," implemented under all alternatives except Alpha in western land offices, but not in eastern land offices, would have substantial beneficial effects on many wildlife species. However, the categorical nature of the analysis may also produce illusory effects: some wildlife species are associated with riparian habitats that nevertheless do not use attributes negatively affected by excessive livestock use, and thus a single categorization as "adverse" (i.e., under Alpha) may be overly simplistic.

Recreation Use Levels

The Descriptor Relationship

Recreation use and other special uses of state forest lands have been categorized into one of five general groups. Group I involves recreational use at developed or concentrated use sites; Groups II and III different types of dispersed use scattered throughout the forest; Group IV public and commercial uses that are confined within the perimeter of the actual lease site; and Group V exclusive dispersed land leases.

Human presence in occupied wildlife habitats can impact wildlife populations in a number of ways. Some species are hunted or trapped, and people interested in viewing wildlife actively search for and interact with wildlife, which can disturb normal behavior patterns. People at campsites or other concentrated use sites often feed wildlife, altering behavior and diet. Even recreationists not directly interested in wildlife increase the number of encounters between wildlife and humans.

Current Conditions

There are 33 species of wildlife identified by Prather and Burbridge (1979) as needing seclusion from humans as a critical part of their seasonal habitat needs (Table IV-W15). Effects of humans on wildlife can include direct mortality; avoidance of humans, and therefore loss of access to important habitats; attraction to humans in response to food rewards; and, in limited cases, injury to humans ranging from minor bites to predatory attacks. However, contact between people and wildlife, if done properly, can also result in benefits to wildlife through increased human concern and awareness regarding wildlife needs.

Analysis Methods

We based our analysis in part on estimates of recreational use (see Table IV-E5 in the Economics section of this chapter) for each alternative, and in part on Resource Management Standards for sensitive and big game species that call for special consideration of these species. In projecting effects on individual species, we assumed that recreational use could be effectively zoned to reduce impacts on certain species, if so stated in Resource Management Standards.

Many species tolerate disturbance by people. However, Prather and Burbridge (1979) listed 33 as particularly sensitive to human disturbance, and these are taken as species for consideration under this descriptor. Although it is possible to postulate ways in which recreational activity has indirect, positive effects on wildlife (e.g., raising awareness and thus support for habitat protection), we assumed that interaction between people and these sensitive wildlife species would always produce adverse effects. Positive effects from an alternative could only come about by a reduction in human interaction (e.g., from special consideration being given to these species to reduce human impacts).

Expected Future Conditions

Effects on species under the descriptor Recreation Use Levels are summarized in Table IV-W15.

Table IV-W15

Wildlife species likely to be beneficially (+), or adversely (-) affected by projected changes in levels of recreational use. A total of 33 species were considered as requiring seclusion from people, and thus potentially affected. All alternatives estimated levels of recreational use would increase, but Beta, Gamma, Zeta and Omega included provisions in Resource Management Standards that would likely produce positive effects for certain species by zoning use away from critical areas.

A. Number of species.

Wildlife Category	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
All Species							
+	0	12	12	0	0	8	12
-	33	21	21	33	33	25	21
...of which Game/Furbearer							
+	0	0	0	0	0	8	0
-	8	8	8	8	8	0	8
Special Concern (MNHP)							
+	0	12	12	0	0	0	12
-	12	0	0	12	12	12	0
...of which T&E (Listed or							
Candidate)	0	7	7	0	0	0	7
+	7	0	0	7	7	7	0
-							

B. Illustrative Species. Symbols: adversely affected (-), or beneficially affected (+). Species not listed here are not considered by this descriptor.

	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
Ferruginous Hawk	-	+	+	-	-	-	+
Bald Eagle	-	+	+	-	-	-	+
Peregrine Falcon	-	+	+	-	-	-	+
Townsend's Big-Eared Bat	-	+	+	-	-	-	+
Grizzly Bear	-	+	+	-	-	-	+
Gray Wolf	-	+	+	-	-	-	+
Elk	-	-	-	-	-	+	-

DESCRIPTOR: RECREATION USE LEVELS	
EFFECTS COMMON TO ALL ALTERNATIVES Under all alternatives except Gamma, we estimate that all categories of recreational use would increase (Table IV-E5 in the Economics section). Even under alternative Gamma, recreational use category III (which includes backpacking, hiking, and cross-country skiing) is projected to increase substantially. Differences among alternatives thus derive solely from different treatments afforded particular categories of wildlife through Resource Management Standards.	
EFFECTS OF ALPHA, DELTA, AND EPSILON Under each of these alternatives, the Resource Management Standards specify that we will attempt to avoid or mitigate for adverse environmental impacts, when consistent with producing trust revenue. Thus impacts may be reduced or minimized under these alternatives, but developments that generate sufficient revenue would cause wildlife impacts when we determined that resource protection was incompatible with development. Consequently, all species sensitive to human disturbance are projected to be adversely affected.	EFFECTS OF BETA AND OMEGA Beta and Omega include Resource Management Standards that focus management attention on species of special concern and place an emphasis on balancing trust revenue and maintenance of biological diversity. Twelve of the 33 species identified as sensitive to human disturbance are also identified as species of special concern. Thus, adverse impacts to these species from increased recreation use are expected to be offset by the increased emphasis on protecting sensitive species in the Resource Management Standards. We project that the remaining 21 species sensitive to human disturbance would be adversely affected by increased recreational uses.

DESCRIPTOR: RECREATION USE LEVELS	
EFFECTS OF GAMMA	EFFECTS OF ZETA
Resource Management Standards for this alternative give a high priority to maintaining site characteristics that support or enhance biodiversity, species of special concern, and threatened or endangered species. Consequently, any developments that conflicted with supporting or enhancing wildlife species of special concern would be required to mitigate any adverse impacts before development could proceed. If effective, this would provide habitat protection for the 12 species of special concern that are also sensitive to human disturbance. We project that the remaining 21 species sensitive to human disturbance would be adversely affected by increased recreational uses.	Resource Management Standards for Zeta give a high priority to management of wildlife populations and their habitat for the revenue they could provide, with special emphasis on game species. Consequently, we project that the eight game and furbearer species sensitive to human disturbance would enjoy increased seclusion from human disturbance, despite the much higher projected recreational use levels. We project that the remaining disturbance-sensitive species would be adversely affected.

Discussion--Recreation Use Levels

The interplay of the estimated increases in most types of recreational use with the effectiveness of Resource Management Standards is obviously critical for these projections. If it proves impossible to effectively protect sensitive species from increasing numbers of recreationists, the beneficial effects attributed to alternatives Beta, Gamma, Zeta and Omega would fail to be realized. Conversely, some or all adverse effects projected under Alpha, Delta, and Epsilon might not occur if mitigation is possible without compromising trust revenue.

Road Density

The Descriptor Relationship

Road density is defined as linear miles of road divided by area, and is usually expressed as mi/mi^2. Two types of road density are often recognized: "total road density" and "open road density". Estimates of total road density are based on all roads in the area analyzed. By contrast, estimates of open road density are based on only those roads that are open for legal public access under the State Land Access Rules.

Roads provide human access, which directly increases mortality rates of species that are hunted, trapped, or perceived as vermin or a threat to humans. Roads, with their associated human use, result in the displacement of wildlife attempting to avoid human contact, thereby reducing the habitat base effectively available to those animals. Roads increase sediment delivery to streams, affecting the food supply and reproductive success of many aquatic species. Roads also provide humans access to firewood, resulting in loss of snags and large woody debris on the forest floor, two critical habitat elements for a variety of wildlife species. In contrast, unroaded areas provide species sensitive to human disturbance with a place of security. Thus, the management of roads is one of the most critical elements affecting the effectiveness of wildlife habitat.

Current Conditions

State forest lands currently average 2.0 miles of road per square mile, with highest road densities in the Northwest area and lowest road densities in the Northeast. Open road densities average 0.8 miles per square mile and follow the same regional trend as total roads. However, a substantial number of closed roads are only closed by administrative rules and include no physical barriers or signs to discourage public travel. Wildlife effects have been documented even from low road use levels. Consequently, the density of roads actually used by the public and potentially impacting wildlife is higher than 0.8 miles per square mile. We have no way of knowing actual use levels on these administratively closed roads; use is influenced by the degree of public access and the extent to which adjacent private landowners use, or allow use of, state land. The actual density of roads receiving sufficient use to impact wildlife is probably closer to the estimate of total road density than that of open road density.

Several models have been developed to assess the effects of roads on wildlife. Mace and Manley (1993) estimated that total road densities in excess of two miles per square mile preclude grizzly bears from making full, effective use of available habitat. Most of the grizzly bear habitat managed by DNRC is in the Northwestern Land Office, where total road densities exceed this level. Other researchers have noted the generally negative effects of roads on grizzly bear habitat use and survival (Kasworm and Manley 1990; Mace and Aune 1988; Mattson et al. 1987; Mattson and Knight 1991; McLellan 1988,1989; McLellan and Shackleton 1988, 1989; Zager et al. 1980). Wolves, although they do not necessarily avoid roads, are more likely to encounter excessive mortality in highly-roaded areas. Wolf populations in the mid-western portions of North American have been correlated with areas of lower road-density than areas lacking wolves (Jensen et al. 1986, Mech 1989, Thiel 1985), although Fritts and Carbyn (1995) and Mech (1995) have recently pointed out that wolves' dispersal capability and the degree of human tolerance are ultimately more important factors than road density per se.

Hillis et al. (1991) estimated that 30 percent of the landscape must be at least ½ mile from a road driven by hunters to provide bull elk with secure habitat where they have a reasonable chance to survive the hunting season. In the Northwestern, Southwestern and Central Land Offices, which manage state lands that support the most elk, between 77 percent and 87 percent of the state parcels are roaded. We assume that these parcels are largely accessible by hunter vehicles, and thus provide less than adequate security for bull elk during hunting season.

Lyon (1982) tested a model to evaluate effectiveness of elk summer range. It requires estimates of road densities receiving relatively high levels of public use; such estimates are not available for state forest lands. Using only roads designated as open, the model shows elk summer habitat effectiveness in the Northwestern Land Office has been reduced by 45 percent, in the Southwestern Land Office by 25 percent, and in the Central Land Office by 15 percent. Using total roads, NWLO has lost 58 percent, SWLO 55 percent, and CLO 40 percent of their potential elk habitat. The actual loss is probably somewhere between these estimates.

It is also difficult to maintain snag densities along roads that receive public use. Inventories in the Lolo National Forest indicated that essentially all larger snags within 300 feet of a road are cut for firewood. Estimating an average of 2.0 miles of road per section with snags lost within 300 feet of the road suggests that roads may have resulted in a 23 percent loss of snags. At least some of these losses are in addition to snags lost from the 16 percent of state forests that are less than 60 years old, primarily as a result of past timber harvest.

Analysis Methods

We based our analysis primarily on estimated road densities for each alternative. To estimate open road density, "roading philosophy" coefficients (Table IV-W16) were applied to estimated total road densities. We clarify estimated statewide total and open road densities, under high and low harvest scenarios, by presenting them as percentage changes from current conditions (Table IV-W17).

Table IV-W16

Coefficients used for adjusting ratios currently used for estimating open roads from total roads to reflect each alternative's Resource Management Standards.

	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
Coefficient	1.0	0.75	0.6	1.0	1.0	0.75	0.75

Table IV-W17
Percent Change in Estimated Total and Open Road Densities

	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
TOTAL ROADS							
High Harvest	+50	+40	+5	+60	+65	+25	+45
Low Harvest	+25	+15	0	+20	+45	+10	+30
OPEN ROADS							
High Harvest	+50	0	-37	+62	+62	-12	+12
Low Harvest	+25	-12	-35	+25	+37	-12	0

We condensed the results of Table IV-W17 into the following matrix of effects for species considered sensitive to roads.

ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
-	?-	+	-	-	?	-

We further modified this matrix by considering the effects of Resource Management Standards that call for special consideration of sensitive and big game species. For alternatives Beta and Omega, we assumed that Resource Management Standards for sensitive species would counteract the possible adverse effects of increased roads for species of special concern. For alternatives Delta and Zeta, we assumed that Resource Management Standards for big game would counteract the possible adverse effects of increased roads for game and furbearer species. In projecting effects on individual species, we assumed that human use could be effectively zoned to reduce impacts on certain species regardless of road density. Our final matrix of effects for species considered sensitive to roads is shown here.

	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
All Species	-	?-	+	-	-	?	?-
Game/furbearer	-	?-	+	+	-	+	-
Special Concern	-	+	+	-	-	?	+

We considered a total of 200 species either to require seclusion from people, to require snags or woody debris, or to be subject to harvest, and thus potentially affected by roads. We assumed that species not meeting these criteria are unaffected by roads.

Expected Future Conditions

Effects on species under the descriptor Road Density are summarized in Table IV-W18.

Table IV-W18

Wildlife species likely to be beneficially (+), or adversely (-) affected by estimated changes in road density, or upon which effects are uncertain but considered likely to be detrimental (?-). A total of 200 species were considered as either requiring seclusion from people, requiring snags or woody debris, or being subject to harvest, and thus potentially affected. Effects on those not listed here are unknown because road density or effects of RMS cannot be accurately projected.

A. Number of species.

Wildlife Category	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
All Species							
+	0	33	200	62	0	62	33
?-	0	167	0	0	0	0	111
-	200	0	0	138	200	0	56
...of which Game/Furbearer							
+	0	0	62	62	0	62	0
?-	0	62	0	0	0	0	0
-	62	0	0	0	62	0	62
Special Concern (MNHP)							
+	0	33	33	0	0	0	33
-	33	0	0	33	33	0	0
...of which T&E (Listed/Cand.)							
+	0	11	11	0	0	0	11
-	11	0	0	11	11	0	0

B. Illustrative Species. Symbols: beneficially (+) or adversely affected (-), or effect uncertain but more likely adverse than beneficial (?-). Species not listed here were not considered by this descriptor, or road densities could not be accurately projected.

	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
Harlequin Duck	-	+	+	+	-	+	-
Ferruginous Hawk	-	+	+	-	-	?	+
Bald Eagle	-	+	+	-	-	?	+
Peregrine Falcon	-	+	+	-	-	?	+
Ruffed Grouse	-	?-	+	+	-	+	-
Spruce Grouse	-	?-	+	+	-	+	-
Flammulated Owl	-	+	+	-	-	?	+
Boreal Owl	-	+	+	-	-	?	+
Black-backed Woodpecker	-	+	+	-	-	?	+
Townsend's Big Eared Bat	-	+	+	-	-	?	+
Grizzly Bear	-	+	+	-	-	?	+
Fisher	-	+	+	-	-	?	+
Gray Wolf	-	+	+	-	-	?	+
Bog Lemming	-	+	+	-	-	?	+
Beaver	-	?-	+	+	-	+	-
Elk	-	?-	+	+	-	+	-
Tailed Frog	-	+	+	-	-	?	+

DESCRIPTOR: ROAD DENSITY	
EFFECTS OF ALPHA AND EPSILON	EFFECTS OF BETA
We estimate road densities would increase under Alpha by 25-50 percent and under Epsilon by 40-65 percent. Because Resource Management Standards do not require special consideration for wildlife, habitat effectiveness would likely decrease for the 200 species of wildlife considered under this descriptor. They include 33 species of special concern and the 62 game and furbearer species (Table IV-W18).	We cannot confidently project trends in road density under alternative Beta. Total roads may increase by 15 percent to 40 percent, but open road density may decrease slightly. We expect Resource Management Standards would be successful in shielding species of special concern from effects of roads. We are unsure about the effects on other species, but believe that adverse effects are more likely than beneficial effects because total road density would probably increase.
EFFECTS OF GAMMA	EFFECTS OF DELTA
Gamma is the only alternative that is likely to reduce open road density. Gamma would also implement more active road management. This would benefit all species for whom habitat conditions are influenced by road density and the human access which it provides.	We project possible increases in total and open road density under Delta approximating those under Epsilon. However, as with Zeta, we assume that increased concern with security for big game would manifest itself in zoning of road use such that these species would be benefitted. However, increased access would likely adversely affect the remaining species sensitive to human disturbance.

DESCRIPTOR: ROAD DENSITY	
EFFECTS OF ZETA	EFFECTS OF OMEGA
We cannot confidently project trends in road density under alternative Zeta. Total roads may increase by about 10 percent to 25 percent, but open road density may decrease slightly. As with Beta, there is potential for increased impact due to use of roads that are only closed administratively and not physically. However, Zeta would actively manage wildlife and wildlife habitat as a primary income-producing resource, with a special emphasis on game species. Consequently, increases in road densities would be coupled with more active road management to provide wildlife-related income while minimizing unnecessary road use. Thus we project that game species would be effectively shielded from projected possible increases in road density, but other species sensitive to humans would be adversely affected.	Because of a higher timber harvest level than has been the case in recent years, the total mileage of roads built under Omega is projected to increase above current levels. Total road density may increase by 30 to 45 percent, but open road density may increase only slightly. We expect Resource Management Standards would be successful in shielding species of special concern from effects of roads. We are unsure about the effects on other species, but believe that adverse effects are more likely than beneficial effects because of the increase in total road density.

Discussion--Road Density

Open road density estimates are based only on those roads that are open for legal public access under the State Land Access Rules. Many closed roads are closed only by administrative rules and include no physical barriers or signs to discourage use. Even if roads are not accessible to the general public, they may be accessed by surrounding landowners and anyone they allow through their property. Levels of road use that cause wildlife impacts can be quite low in some cases. For example, Hillis (1993) concluded that intensive and consistent effort was needed to prevent snags from being cut for firewood, and that casual efforts would invariably fail. Also, the U.S. Fish and Wildlife Service (1993) concluded that road use during one or two periods exceeding 14 days could adversely affect grizzly bears.

SUMMARY OF EFFECTS

Previous sections detailed changes resulting from each alternative for each of the nine wildlife habitat descriptors. In this final section we assess the overall impacts of each alternative on wildlife communities.

Although often relatively small in size and scattered in distribution, most land managed by the Department is important wildlife habitat. For example, grizzly bear recovery in the Northern Continental Divide ecosystem depends on maintenance of suitable habitat on the Stillwater State Forest in Northwestern Montana. The white-tailed deer herd in the Salish Mountains of

Northwestern Montana depends on maintenance of adequate winter range on state forest land west of Kalispell. The future of bighorn sheep populations in the Sula State Forest south of Hamilton may depend on state forest management practices. Public elk hunting opportunity could be heavily influenced by state forest management and access policy on blocks of land near Dillon. These are just a few examples of larger state forest acreage that are important for wildlife species. Thus, although forested state trust lands represent less than three percent of all forested land in the state, state forest management will directly influence population viability of most terrestrial vertebrate species in Montana.

Effects of each descriptor have been presented primarily in terms of species richness. Such an approach recognizes that all species have value and function within the forest ecosystem, and is in accord with the current emphasis on biodiversity. Appropriate as such a focus on biodiversity may be, it can easily be misinterpreted: even under the most "natural" of conditions, we would not expect all species to be present on any given site. Rather, a mosaic of forest conditions over the landscape is necessary, as is enough connectivity among patches of various conditions that none become ecological isolates. Further, sole reliance on species richness can obscure dynamics of real interest; there may be a greater number of species associated with disturbed habitats or small habitat patch sizes than with old-growth or large, uninterrupted patches, but these former will often be species well adapted to our changing landscape, and thus faring well. Concern over the effects of forest management is appropriately channeled toward those species that have evolved to exploit forest conditions increasing in rarity as human influence expands.

As well, the notion of a "balance of nature" is generally no longer understood as a static condition in which all habitats and species are constantly corrected from perturbations toward a single "correct" equilibrium. Rather, contemporary ecologists tend to view "balance" as a shifting of types through time, with any given piece of land capable of supporting a number of different vegetative communities, depending on the length of time since the previous disturbance. That is, ecologists recognize forests as dynamic systems that include some areas with little disturbance where the most shade-tolerant and fire-sensitive species dominate, and other areas where shade-intolerant, fire-dependent species dominate. Wildlife species that suffer from insufficient habitat elements generally do so not as a result of disturbance per se, but because the proportion and/or spatial configuration of the various elements of the forest have become skewed toward one extreme or another.

Wildlife using managed forests face a different set of perturbations than do those living entirely within completely natural environments. The challenge for forest managers wishing to conserve wildlife is to maintain a sufficient quantity and juxtaposition of habitat elements to allow the needed demographic and genetic connectivity for populations, not just individuals, to remain viable.

Thus, a comprehensive evaluation of effects on wildlife must also consider projections for state lands in the context of other ownerships, and in the context of historic changes that have already occurred. Historic changes include development of the existing road access, development of recreational uses, and alterations in forest vegetation due to fire suppression and timber harvest. For example, projected characteristics from DNRC activities might hypothetically favor species requiring characteristics of the forest interior, far from edges, but such benefits would likely not be realized if the tract in question was small and surrounded by other ownerships undergoing recent regeneration. In a contrasting hypothetical example, DNRC stand treatments that would have generally minor or temporary impacts on wildlife could nevertheless have far-reaching detrimental effects on some species if the particular DNRC tract physically linked parcels of important but rare types managed by other owners. Such analysis will be conducted on a more site-specific level under individual project assessments.

CUMULATIVE EFFECTS

Effects Common to All Alternatives

The predicted increases in road density and recreational uses under most alternatives will be added to existing roads and human pressures that have developed over the past century. This suggests that long-term increases in disturbances from contact with humans are likely to continue for species sensitive to these pressures. Thus, regardless of alternative chosen, road management will be crucial for ensuring the security of many species (and thus of ecosystem integrity). Specific road closures and enforcement will be addressed at the project level.

Cumulative effects related to vegetation changes are not as straightforward. Habitat elements of overriding importance to some species, such as large snags, have probably declined over time, while numbers of smaller snags have probably increased. These impacts are not uniform across State lands. Major historic shifts in forest types, stocking levels and successional stages have also caused corresponding shifts in habitat suitability for many wildlife species.

Under the current legal situation, fire suppression will continue as Department policy under all alternatives. In general, this will diminish habitat effectiveness for those species for which human-caused disturbances cannot adequately replace the effects of fire (e.g., many standing snags with charred bark, often harboring temporary flushes of unique insect assemblages). However, a precise projection of forest fires on State forested lands would be difficult, as we do not project 100 percent efficiency in fire suppression.

Effects of ALPHA

Alpha differs from the other five alternatives in its treatment of grazing practices in riparian habitats, often favored by wildlife. This difference affects primarily western Montana; east of the divide less than 20 percent of the forested grazing land would be affected by the plan, and no alternative provides for improvements in riparian condition. West of the divide, however, the maintenance of current grazing management practices in Alpha would allow continued degradation of riparian wildlife habitat.

Vegetation structure under Alpha would likely continue to favor species associated with closed canopies, mature forests, and small snags. Species associated with large snags, large patch size, old-growth, or corridors connecting large roadless areas outside of state lands, would not be favored.

Alpha also places a relatively low priority on land trades for the purpose of consolidating management. The scattered nature of many DNRC parcels makes it difficult to manage large landscapes, thus limiting the Department's discretion to create large patches and corridors.

Species that have received particular attention in recent years (notably elk, white-tailed deer, and threatened/endangered species) would likely continue to be considered thoroughly. However, the broad spectrum of wildlife is not afforded a high priority under Alpha. Most activities directed toward most species would be subsidiary in nature, mitigating or minimizing negative effects, rather than forming an integral part of the forest planning process.

Effects of BETA

Alternative Beta takes a pro-active approach toward wildlife habitats in attempting to restore a resemblance to naturally occurring proportions in forest types, successional stages, and stocking levels over time. Such a task is not easy, and is made more difficult by high levels of roading in many areas, and limitations in the use of fire to adjust forest composition and structure. Beta implicitly embraces a longer time horizon than the other alternatives (excepting Gamma and Omega), by emphasizing, for example, recruiting future old-growth rather than merely retaining current old-growth, and a return to naturally occurring variation in patch size (a process that will take many years). However, given time--and effective road management--Beta is likely to have beneficial effects for a wide array of species, because it may produce forests most nearly resembling pre-European settlement patterns of composition and structure.

Unlike Alpha, Beta would not prioritize needs of big game species, but would treat them as it would other species. Although promoting a variety of stand structures and patterns is seen primarily as a means to enhance "biodiversity", such diversity by no means excludes big game. However, because in some cases forest management has specifically improved forage/cover ratios for species of high interest, Beta may produce some reductions in habitat effectiveness for these species. By the same token, policies that have led to high ungulate numbers in many areas have failed to similarly succeed in providing security. The more active road management contemplated under Beta could thus favor big game species despite reduced attention paid to their preferred forest characteristics.

Beta, along with Gamma and Omega, calls for attempts to develop cooperative ecosystem management plans with other landowners, suggesting that the needs of highly mobile, far-ranging species could more easily be addressed than under other alternatives. Consolidation of lands could become a higher priority under Beta than is currently the case. Beta also sets standards for maintaining and restoring old-growth, and these, together with emphasis on considering patch size, are likely to favor many of the species whose needs are the most difficult to accommodate in managed forests.

Beta includes Resource Management Standards that provide for recovery of Threatened and Endangered species and measures to support species of special concern. In many cases, a simple way to benefit such species is to limit human access to them. However the active management contemplated under Beta would likely increase road density. Thus, protection of threatened and endangered species and species of special concern to meet resource management standards would primarily depend upon local efforts of more aggressive road management.

Effects of GAMMA

Gamma would have clear benefits for many species, largely because road density would be by far the lowest. Species sensitive to human disturbance would be likely to respond positively. Gamma also calls for retention of old-growth, and more acceptance of naturally occurring perturbations such as insect and disease outbreaks, thus benefitting species with particular associations with these elements. Gamma would likely result in increasing structure and complexity in most forests, at least in the short term, benefitting species associated with snags and down woody debris. In the very long term, adoption of Gamma would be expected to contribute to a semblance of naturally occurring distribution of forest types and patch sizes. Because Gamma is explicit in its directive to avoid clearcutting, species that do not tolerate such abrupt breaks in forest cover would fare better under Gamma than any other alternative.

However, given the likely limitations on fire and pest management in the relatively small, often insular tracts of land managed by the Department, some of objectives of Gamma might be difficult to accomplish. For example, projections of changes in forest type, stocking level, successional stages, and distribution of patch sizes all suggest that Gamma will produce forests less, rather than more similar to historic conditions over the medium-term future. Even old-growth, given high priority and protection from timber harvest under Gamma, might decline in the long-term future unless fire acts fortuitously to reduce stocking levels without replacing stands entirely.

Gamma, like Beta, includes Resource Management Standards that provide for the recovery of Threatened and Endangered species and measures to support species of special concern. Also like Beta, Gamma de-emphasizes producing habitat conditions of particular benefit to big game species. In general, we would expect this to lead to increasing cover, with the abundance and juxtaposition of openings largely dictated by unpredictable events. Also like Beta and Omega, Gamma calls for attempts to develop cooperative ecosystem management plans with other landowners, again likely assisting the maintenance of highly mobile, far-ranging species

Effects of DELTA

The overall effect of alternative Delta on wildlife habitats is the most difficult to assess because it includes the most uncertainty as to precisely what would occur on the ground. In general, Delta would not place a high priority on the needs of wildlife. However, the option is left open for the needs of wildlife to take a high priority, should they be more marketable than competing land uses. Thus, for example, old-growth might be retained in a given area if valued highly enough by a potential lessee, or optimum conditions for big game could be prioritized if a system of exclusive hunting leases produced enough revenue to become a dominant land use.

However, failing these types of scenarios, Delta is likely to cause difficulties for many species of wildlife that are either sensitive to humans or not a source of immediate financial return. It places relatively low priority on specific standards to promote biodiversity or to protect sensitive or endangered species. In conjunction with the higher road density estimates, Delta would likely make it difficult to address security concerns of species needing seclusion.

On a more positive note, Delta might enhance some forest conditions currently in short supply (e.g., more open stocking levels, patch size), and thus have indirect position effects on some species.

Effects of EPSILON

Alternative Epsilon prioritizes timber harvest and deals with wildlife in a largely subsidiary fashion. In general, species that respond favorably to greater amounts of open habitats, early successional stages, and forest types dominated by shade-intolerant species would benefit from practices under Epsilon. From the perspective of some habitat elements, forest structure changes would benefit a large number of species because current conditions have become skewed toward shade-tolerant species and high stocking levels.

However, because the needs of wildlife are afforded a low priority in virtually all relevant Resource Management Standards, even species associated with such conditions might not realize benefits. In particular, because road densities would be highest (and closures are contemplated only when required for Threatened and Endangered species), we would expect decreasing habitat effectiveness for species sensitive to human disturbance.

Species with special habitat requirements, often requirements difficult to reconcile with heavy timber harvest, are likely to be particularly hard hit by alternative Epsilon. We project decreases in the abundance of snags, down woody debris, and old-growth under Epsilon, negatively affecting many species. In general, then, management under Epsilon would tend to make state forest lands less hospitable places for many of the species that make Montana's wildlife resource unique.

Effects of ZETA

Zeta is unique among the alternatives in its emphasis on active management of wildlife and their habitat as the primary income-producing resource, with a special emphasis on game species. Contemplated road management practices under Zeta, if effective, would benefit game and furbearer species, along with some other wildlife species. However, the degree to which species that do not have income producing potential would be benefitted under Zeta is unclear. For example, despite it's association with wildlife, Zeta shares with Alpha, Delta, and Epsilon a low priority afforded to sensitive species.

Species requiring special habitat elements, such as snags, down woody debris, or old-growth, would probably be favored under Zeta, as its Resource Management Standards are similar to those of Beta, Gamma and Omega.

Effects of OMEGA

Alternative Omega shares many of the characteristics of Beta with respect to effects on wildlife habitat. It also takes a pro-active approach in attempting to restore a resemblance to naturally occurring proportions in forest types, successional stages, and stocking levels over time. Omega asserts that the long-term interests of the Trusts are served by maintaining species richness on State land parcels: thus, threatened, endangered, and sensitive species are given sufficient consideration to ensure that short-term revenue generation does not compromise their persistence on State tracts (although it also recognizes that the principal responsibility for such species continues to rest with Federal agencies). Focus on managing for forest characteristics that arise from natural disturbance regimes will generally benefit many species. For example, Omega emphasizes retaining and recruiting old-growth where it is presently under-represented, as well as managing for a return to naturally occurring variation in patch size (in both cases, processes that will take many years). Conversely, some species that have enjoyed increases in response to the past few decades of forest practices will be adversely affected under Omega.

As with Beta, the two principal difficulties to effectively enhancing wildlife habitat in Omega are the high levels of roading in many areas (based on our estimates of annual timber harvest activity), and limitations in the use of fire to adjust forest composition and structure. Innovative harvest methods may be considered, but often, road-based timber operations are the only ones resulting in net revenue generation. Thus, our duty to current Trust beneficiaries presents a great challenge us: how to manage forests intensively now, while preventing the presence of roads (and potentially-increasing human access) from reversing the very gains in biodiversity such intensive management can produce. Similarly, we are limited in our ability to reintroduce fire to ecosystems that have been shaped by it. However, in addition to our ability to emulate many structural characteristics of fire-adapted forests through silvicultural treatment, post-harvest fires to treat logging slash may provide an added opportunity to benefit fire-adapted species in some circumstances.

Omega would not prioritize needs of big game species, but would instead treat them as it would other species. Because forest management has, in some cases, specifically improved forage/cover ratios for game species of high interest, Omega may produce some reductions in habitat value for these species. As well, Omega would not give high priority to managing for (hunting season) security cover for big game, particularly where natural processes would favor a more open-canopied forest. Active road management could go a long way toward ameliorating such adverse effects, however, at a probable cost of convenient access for hunters.

Under Omega, the ability to manage for patch size, habitat connectivity, and spatial juxtaposition will largely be limited to large, blocked ownerships. These are located mostly in the Northwestern Land office. In smaller, scattered parcels, we may sometimes have opportunity to provide for these spatial elements, but our ability will largely be constrained by the management philosophies of adjoining land owners. In some cases, Omega therefore suggests it is better Trust policy to not attempt to provide for the needs of wide-ranging species (i.e., if habitat on neighboring lands is unlikely to be suitable), but rather to focus on ecological processes at the local level only. Thus, DNRC's ability to contribute to integrated efforts to conserve wide-ranging, forest-dwelling carnivores, for example, will be high in blocked ownerships, but low in scattered sections.

FISHERIES

INTRODUCTION

In this section we predict the environmental impacts on fisheries of implementing each alternative and explain the methodology we used to estimate those impacts. In the Executive Summary we presented a summary table of the environmental consequences on fisheries of each alternative management plan.

It is important to note that this analysis is, by necessity, general in nature. It is beyond our capabilities to precisely quantify the effects of different management scenarios. For this reason, the following analysis is based on plausible management scenarios which are used to approximate the range of impacts (see Appendix SCN). Certain aspects of each alternative are not explicitly reflected in the effects assessment. For example, the width of Streamside Management Zones (SMZs) prescribed in the Watershed Resource Management Standards varies between alternatives. All alternatives meet legal requirements, but SMZs of greater width provide a lower degree of risk to watershed values. This relationship is not directly incorporated into the analysis, however, it is indirectly reflected through the volume of timber harvested. Another example of an implicit relationship in this analysis is that of riparian standards. Varying levels of riparian standards are proposed in the Grazing Resource Management Standards. These will affect the magnitude of impacts to water quality. These impacts, however, are quantified in this effects analysis only to the extent that implementation of the Standards will alter the total number of animal unit months (AUMs) on State land. Similarly, timber harvest near streams may encourage higher levels of grazing which would reduce streamside vegetation, potentially affecting water temperature and sediment delivery. These factors are not directly reflected in the results of this effects analysis.

There are limitations to this type of analysis. The results presented in this section should act as a guide to the general ranking of alternatives but there are other factors which can only be considered by understanding the general philosophy and specific Resource Management Standards for each alternative. Care should be taken in applying the following results in isolation of the entire text of this document.

METHODOLOGY

The working assumption for this assessment is that the requirements of a select few fish are representative and can be used to characterize the habitat needs of species with similar life form, habitat preference, distribution, and/or survival strategy. We chose bull trout and westslope cutthroat trout to represent the habitat needs of coldwater species because these fish are very susceptible to human-induced environmental changes such as decreases in streamflow; increases in temperature, pollution, or siltation; and competition with introduced exotic species. We chose the goldeye and largemouth bass as representative of warmwater species because their habitat requirements reflect the needs of many other warmwater fish.

For the assessment of impacts to fisheries resources the primary focus will be on fish habitat. Effects from each alternative will be analyzed for three descriptors: sediment and nutrient input to streams and lakes, changes to large organic debris recruitment, and changes to water temperature. The effects were compared by alternative for the species chosen to represent warmwater and coldwater habitats.

The fisheries effects assessment was accomplished using a nonparametric ranking system which compared relative resource effects resulting from the primary variables impacting the fishery resource. Using the Resource Management Standards and the management scenarios developed for each alternative, the acting agents were ranked from 1-7 for each of the alternatives. In the event of a tied ranking, the next two rankings (in some cases there was a three-way tie) were averaged and assigned to each of the alternatives. For example, if alternatives Alpha and Beta were found to be tied for the second ranking behind Gamma, Gamma would receive a rank of '1' while Alpha and Beta would each receive a composite rank of '2.5' which reflects the second and third rank averaged (i.e. (2+3)/2 = 2.5). This procedure was used until all seven alternatives were assigned a rank. This ranking procedure was used to assess relative effects under each alternative.

The fisheries effects assessment was split into three impact components: sediment and nutrient loading, availability of large organic debris, and water temperature. Each of the impact components was analyzed based on variables expected to be affected under the plan. The sediment and nutrient impacts were evaluated based on four sub-components: volume of timber harvested, percentage of area clearcut or seed tree cut, road density, and numbers of AUMs. The large organic debris (LOD) section was evaluated based on three sub-components: number of retention trees, amount of open roads, and SMZ width. Finally, the third segment, water temperature, was evaluated based on three sub-components: number of retention trees, SMZ width, and numbers of AUMs.

We determined the effect on large organic debris (LOD) recruitment in each alternative by considering the number of trees retained in the SMZ, the density of open roads projected under the management scheme, and the width of SMZs provided in the RMS.

The rationale for using these parameters as indicators of changes to LOD is as follows: the quantity of trees retained in the SMZ is an index to the amount of future recruitable LOD, the density of open roads gives an indication of the potential risk of removal of recruitable streamside trees by firewood cutters, and the width of the SMZ is an indicator of the relative differences in stability of the SMZ and availability of recruitable trees not necessarily immediately adjacent to streams.

In all cases, timber harvesting in SMZs along streams which contain bull trout will be prohibited. Along other streams, timber harvesting is expected to continue under all alternatives. The differences between alternatives lie in the amount of activity, the handling of retention trees, and the combined influence of the RMS.

The width of SMZ and retention trees figures from the LOD analysis were used to determine impacts to water temperature. The impact of livestock on water temperature was estimated by comparing the differing riparian grazing RMS of each alternative.

Because direct solar radiation is the primary cause of increased water temperature in streams (Beschta et al 1987), we assumed that changes in water temperature are directly related to the amount of streamside vegetation removed. All alternatives require shrubs and submerchantable trees to be left in streamside zones when conducting forest practices. Timber harvest is not likely to have much of an impact on stream temperature; the small amount of variation among the alternatives is correlated to the relative differences in LOD, and both are based on the role of retention trees in providing LOD as well as acting as a temperature buffer.

Following the ranking of sub-components by alternative, the sub-components were summed to give an overall score for the three main components (Sediment and Nutrients, LOD, and Water Temperature) for each alternative. These components were given a weighting factor to indicate their relative influence on fisheries. The weighting factors assigned were 0.4 for sediment and nutrients, 0.4 for LOD, and 0.2 for water temperature. Water temperature, though important, was determined to have a smaller potential to be affected by activities under the alternatives.

The ranking by alternative is shown in Table IV-F1. The effects matrices involved in this analysis are shown in Appendix FSH.

Table IV-F1
FISHERIES EFFECTS RANK SCORING BY ALTERNATIVE FOR 3 PRIMARY EFFECTS AGENTS

Descriptor	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
Sediment & Nutrients	9	5.8	1.6	7	10.6	3.4	7.4
Large Organic Debris	5.4	3.8	1.2	7.8	7.8	3.4	4.2
Water Temperature	3.1	2.2	0.6	3.1	3.8	1.6	2.4
Total	17.5	11.8	3.4	17.9	22.2	8.4	14
Relative Ranking (1=lowest potential)	5	3	1	6	7	2	4

Each alternative promotes recreation to varying degrees and may produce some relative difference in the impact of angler demand on fish populations. It is not clear, however, what effect promotion of fishing on state land will have. There may be some cases of increased demand due to promotion, but in other cases license or other fee assessments may reduce demand. "Put and take" fishing in ponds or small lakes where access is controlled is another possibility. We assumed for the purposes of this analysis that angler demand, as affected by the plan, will not have a measurable effect on fisheries. Roads which may result from increased recreational development are considered in the sediment and nutrients ranking.

ENVIRONMENTAL CONSEQUENCES FOR FISHERIES

In the following section we will outline predicted effects for each individual descriptor. First we will describe effects common to all alternatives, if there are such effects, and then effects specific to individual alternatives.

DIRECT AND INDIRECT EFFECTS

Sediment and Nutrients

The Descriptor Relationship

Streams are dynamic systems, they rarely exist in a steady state for any appreciable length of time. Their behavior, however, is not purely chaotic. Streams are constantly going through adjustments which carry them towards a state of dynamic equilibrium.

Dynamic equilibrium is a condition in which the energy of the stream (the product of discharge and velocity) allows the amount of sediment entering the stream reach to equal the amount leaving it. When there is excess energy, for example during increased peak flows, the stream channel is eroded. When the sediment load is more than the stream can carry (as a result of mass failure, bank trampling by livestock, sediment delivery from roads, channel erosion, etc.) deposition occurs.

These interwoven processes will continue to adjust the channel morphology until a new equilibrium is reached.

Drastic changes to either sediment load or stream discharge may prolong the time until a new equilibrium is reached. These changes in channel morphology have a direct effect on channel structures (i.e. riffles, pools, undercut banks) essential to salmonid reproduction, survival, and growth. The past focus on suspended and deposited fine sediment on the health of fish populations has detracted attention from the indirect effect that increased sediment loads have on fish through the alteration of their habitat.

Bull trout appear to be more sensitive to substrate modifications than other species (Nakano et al. 1992). Generally no more than 25 percent of stream substrate volume should be made up of particles smaller than 6.4 millimeters in coldwater fish habitats.[10]

Bull trout incubate through the winter in the channel substrate and, in the spring, young bull trout are found in close association with the bottom of the channel (Fraley and Shephard 1989, Shephard et al. 1984b). Highly variable flows and increased channel erosion will influence the survival of young bull trout (Fraley et al. 1989, see Rieman and McIntyre 1993).

Harrison (1923) was the first to observe the inverse relationship between fine sediment and successful reproduction in salmonids. Many studies have concluded that activities associated with forest operations (road construction and maintenance, harvesting, slash disposal, and site preparation) (Rice et al. 1972, Ice 1979, 1985, Sidle et al. 1985) and grazing activities (Branson and Owen 1970, Branson et al. 1972, Council for Agricultural Science and Technology 1974, Gifford 1975, Grant 1975) can significantly influence the availability of sediment to streams. One must be careful in the interpretation of these results, however.

Everest et al. (1987) state the problem succinctly:

> The relatively few studies dealing with the effects of sediment from forest management in natural environments have been less conclusive [than laboratory studies]. Some negative effects observed in the laboratory also occur from acute or chronic sedimentation in the field. The problem with interpreting the results of field studies is that increased fine sediment from forest management is almost always accompanied by other environmental effects. Also, field studies have shown both increases and decreases in salmonid populations associated with forest management. The studies have generally failed to isolate the effects of fine sediment from other habitat changes.

Similar problems arise with the application of results from studies on grazing impacts. The literature is filled with instances of adverse hydrologic impacts when grazing is heavy. Many of

[10] Redd monitoring by Reiser and Bjornn (1979) showed the preferred range of stream bed material for westslope cutthroat trout and bull trout to be between 0.6 and 10.2 centimeters.

these studies "tend to indicate that livestock grazing is the same as heavy grazing; however, no such oversimplification is justified." (Blackburn 1983). Little information is available on the impacts of light or moderate grazing pressure on watershed parameters.

Some fine sediments appear to play an integral role in the reproductive success of salmonid fish although most studies to date have pointed out that large quantities of fine sediment change the structure and diminish the productivity of aquatic communities used by fish for spawning (Cordone and Kelley 1961, Saunders and Smith 1962, McNeil and Ahnell 1964, Cooper 1965).

All of the above mentioned factors as well as the sequence of flow events, basin lithology, stream gradient, species mix of salmonids and their various life histories interact in such a way that making simple generalizations about the effect of fine sediment on salmonid populations is precluded (Everest et al. 1987).

Elevated nutrient levels are a concern which is closely linked to sediment load in the stream (Chang et al. 1983, Whittier et al 1988). Increases in phosphorus and nitrogen levels have been reported in response to a wide range of conditions and factors resulting from forest management (grazing, sediment production, fire retardants, herbicides, organic debris, fertilization, altered stand structures). However, most studies indicate that the response to these activities is short-lived and small in magnitude (Salminen and Beschta 1991).

Expected Future Conditions

DESCRIPTOR: SEDIMENT AND NUTRIENT LEVELS	
EFFECTS COMMON TO ALL ALTERNATIVES None of the alternatives is expected to lower sediment and nutrient levels east of the Continental Divide where grazing and agriculture are the primary source of these substances. We do not expect any alternative to have an impact on warmwater fish or their habitats, as they are generally more tolerant of finer bed particles and higher levels of turbidity.	
EFFECTS OF ALPHA	EFFECTS OF BETA
Alpha would result in an increase in sediment and nutrients both east and west of the Continental Divide because it calls for no change in current riparian management standards. This alternative would not benefit any of the four representative species, and could harm coldwater species habitat.	West of the Continental Divide, Beta would result in a slight increase in sediment and nutrients, but a smaller increase than Alpha. This alternative would have lower impact than Alpha, Delta, Epsilon or Omega.

DESCRIPTOR: SEDIMENT AND NUTRIENT LEVELS	
EFFECTS OF GAMMA AND ZETA West of the Continental Divide, Gamma and Zeta would result in a decrease in sediment and nutrients. These alternatives would benefit coldwater species in habitats west of the Divide.	EFFECTS OF DELTA West of the Divide, Delta would result in an increase of sediment and nutrients. This alternative would have slightly less impact on fish habitats than Alpha, Epsilon or Omega.
EFFECTS OF EPSILON West of the Divide, Epsilon would result in the second highest increase in sediment and nutrients, with only Alpha being higher.	EFFECTS OF OMEGA From a Statewide perspective and west of the Continental Divide Omega is anticipated to have the third largest impact (after Alpha and Epsilon) on sediment and nutrient levels at high management levels. The relatively high harvest and roading levels in Omega will be offset somewhat by the Resource Management Standards regarding roads and riparian management.

Large Organic Debris (LOD)

The Descriptor Relationship

Large organic debris is an important functional components of many stream ecosystems (Swanson et al. 1976, Sedell and Luchessa 1982, Harmon et al. 1986, Bisson et al. 1987, Naiman and Sedell 1992). Large downed trees protruding into the stream channel create structural habitat features, store sediment, and alter water chemistry. Each of these functions will be discussed in turn below.

Past and present timber harvest activities have reduced the capability of riparian areas to contribute large wood to streams (Bryant 1980, Bisson et al. 1987). Laws such as the Montana Streamside Management Zone Law have helped to alleviate this problem.

Habitat Features

As an adaptation to life in flowing water salmonid species such as salmon and trout will favor locations which provide plentiful food and allow a minimum of energy expenditure (Dill et al. 1981, Fausch 1984). Features which meet these requirements are pools which often form behind woody debris (Swanson et al. 1976, Keller and Swanson 1979). The greater relative depth of pools provides protection from terrestrial predators and provides a location of cooler water (Bilby 1984) during low flows. In general, woody debris, by physically obstructing flow creates greater habitat complexity (Bisson et al. 1987) which provides a diversity of environmental conditions required by the many different life stages of diverse species.

Sediment Storage

As mentioned in the discussion of Sediment and Nutrients, sediment has been shown by many studies to have a negative effect on fish reproduction and survival. Large woody debris plays and important role in storage of this inorganic sediment (Bilby 1981, Nanson 1981, Marston 1982, Megahan 1982) as well as organic material (Naiman and Sedell 1979, Bilby and Likens 1980). This storage function acts to moderate sediment transport rates, allowing for natural adjustment processes to work.

Water Chemistry

Large organic debris in a stream alters water chemistry. The decomposition of organic matter can lead to dissolved oxygen levels low enough to stress fish physiologically. Generally, the turbulent flow of mountain streams provides sufficient aeration to avoid this problem. In areas of low or stagnant flow, such as beaver dams, anoxia may occur. In the spaces between the gravels of a stream bed the slower water and accumulated organic matter may lead to low dissolved oxygen levels (Ponce 1974, Ringler and Hall 1975).

Research has shown that leachates from decomposing woody debris may become toxic to fishes. This most likely will only occur where there is a large accumulation of fresh wood in the stream.

Expected Future Conditions

DESCRIPTOR: LARGE ORGANIC DEBRIS	
EFFECTS OF ALPHA The amount of large organic debris reaching aquatic systems is expected to decrease slightly under Alpha. This could be harmful to fish that need LOD in their habitat.	EFFECTS OF BETA, ZETA & OMEGA The amount of large organic debris is expected to remain the same or increase slightly under Beta, Zeta or Omega. This would have little or no impact on current fish habitat conditions.
EFFECTS OF GAMMA The amount of large organic debris would increase under Gamma. This could benefit fish that need LOD in their habitat.	EFFECTS OF DELTA AND EPSILON The amount of large organic debris would decrease slightly under Delta and Epsilon. This could be harmful to fish that need LOD in their habitat.

Stream Temperature

The Descriptor Relationship

Fish and other cold-blooded aquatic organisms, assume the temperature of the water in which they live. Their metabolism (i.e. growth rate) is therefore controlled by water temperature. Outside of certain temperature limits fish are stressed physiologically and may die, although logging-related temperature increases have generally not resulted in significant mortality of resident salmonids (Beschta et al. 1987). The maximum temperature for most salmonid species is approximately 12-14°C. For bull trout the limit is thought to be about 15°C (Fraley and Shephard 1989, Shephard et al. 1984).

Direct solar radiation is the principal source of heat delivered to streams (Brown 1983). Removal of streamside vegetation by harvest (see Wooldridge and Stern 1979, Brown 1983) and grazing exposes the water to direct sunlight and increases summer maximum temperatures. The lack of cover also allows for lower winter minimum water temperatures.

The amount of heat lost from streamwater due to conduction, convection, or evaporation is relatively small. For this reason temperature increases have an additive effect downstream and alternating short shaded and unshaded reaches will likely be an ineffective mitigation measure (Beschta et al. 1987).

Buffer strips, however, would be effective in keeping streams cool in proportion to the canopy shading efficiency and the length of the shaded reach. As more canopy is removed the stream becomes more susceptible to temperature increases. Brown and Krygier (1970) found no detectable increase in stream temperature where buffer strips shaded the stream in a patch clearcut watershed but they did not characterize the remaining canopy in any detail.

Expected Future Conditions

DESCRIPTOR: STREAM TEMPERATURE	
EFFECTS OF ALPHA	EFFECTS OF BETA, GAMMA, DELTA, EPSILON, ZETA AND OMEGA
The less stringent riparian management standards of Alpha are expected to result in a continued trend toward a slight increase in stream temperature on state lands.	All other alternatives, which would implement the stricter riparian management standards, are expected to result in no change in stream temperatures.

CUMULATIVE EFFECTS

In the following section we will combine the impacts of all three descriptors to determine the overall impact of each alternative on the fishery resource.

Effects of herbicide use: The effect of herbicide use on fisheries and water quality is a function of distance of application from water; type of chemical used; application method; amount and type of vegetative buffer; and soil moisture content, among other things. Herbicides used according to the manufacturer's recommendations, applied by a licensed operator, and applied in an area with adequate buffer strip retention should not adversely impact the fisheries resource. Brown (1983) gives a detailed description of the fate of chemicals in the forest ecosystem. Also see Chapter IV - Noxious Weeds.

Effects of ALPHA

In areas of contiguous state ownership with little or no grazing, such as the Stillwater and Swan State Forests, current trends would continue. This includes improvements in fish habitats due to application of the Bull Trout Immediate Actions and the Flathead Basin recommendations (see Appendix RMS: Fisheries). In areas of scattered ownership with little or no grazing, we anticipate no substantial change in level of impact due to the numerous perturbations affecting fisheries which are beyond our jurisdiction, the scattered nature of our ownership, and the baseline protection provided by legal requirements and the RMS. In areas with a substantial amount of grazing, current land impacts would continue. Goldeye and largemouth bass habitats would be largely unaffected due to these species' tolerance for turbidity and higher temperatures.

Effects of BETA, GAMMA, ZETA and OMEGA

West of the Continental Divide in areas of contiguous ownership (such as the Stillwater and Swan State Forests) we expect improvements to bull trout and westslope cutthroat trout habitats under Beta, Zeta and Omega, with slightly more improvement under Gamma. In areas of scattered ownership, we anticipate no effect on or slight improvement in fisheries conditions due to management activities by other owners, the effects of introduced species, and angler demand. East of the Continental Divide, we expect the current level of impacts to westslope cutthroat trout to continue because riparian grazing standards apply to classified Forest land only. We anticipate no impact on goldeye or largemouth bass habitat.

Effects of DELTA and EPSILON

West of the Continental Divide in areas of contiguous ownership (such as the Stillwater and Swan State Forests) we foresee slight impacts to bull trout and westslope cutthroat trout, with Epsilon having the greatest potential for impact. In areas of scattered ownership, we expect no effect or slight impact due to numerous perturbations beyond our control. East of the Continental Divide, we anticipate that current levels of impacts to westslope cutthroat trout would continue because riparian grazing standards apply to classified Forest land only. We anticipate no impact on goldeye or largemouth bass habitats.

SUMMARY

Resource Management Standards are quite similar for all alternatives because of the legal requirements associated with water quality and protection of beneficial uses, such as fisheries. The RMS also call for improvement to existing conditions under many alternatives, a result of stricter riparian grazing standards, watershed inventories, provisions for fish passage, and commitment to meet both the bull trout standards recommended by the Flathead Basin Commission and the Immediate Actions from the Bull Trout Restoration Team.

There are some differences in RMS between alternatives. Generally Gamma, Beta, Zeta and Omega provide more protection to SMZs than Alpha, Delta, and Epsilon. Alpha does not contain improved riparian grazing standards. Gamma and Beta provide for recovery of threatened and endangered species. Under Omega, we would participate in recovery efforts. Other alternatives concentrate on not "taking" threatened and endangered species. Gamma, Beta, Zeta and Omega make a stronger commitment to sensitive species than Delta, Alpha, or Epsilon.

Management intensity varies between alternatives. Ground disturbance activities, primarily timber harvest, are greatest under Epsilon, followed by Omega, Delta, Alpha, Beta, Zeta, and Gamma, in descending order. The degree of protection afforded by the RMS, combined with the level of management activity, leads to logical ranking of relative levels of impact for the alternatives. When all descriptors are combined and weighted, the ranking of alternatives from lowest impact to highest is Gamma, Zeta, Beta, Omega, Alpha, Delta, and Epsilon. Perhaps the difference between the four top-ranked alternatives (Gamma, Zeta, Omega and Beta) and the bottom three (Alpha, Delta, and Epsilon) is more important than the differences between individual alternatives. In other words, the differences between the top four as a group and the bottom three as a group may be very important, while it may be unreasonable or impractical to assume differences within the two groups.

The potential impacts to fish habitat from management activities on state lands comprise only a portion of the perturbations affecting fisheries. The effects of adjoining owners' water management or introduction of non-native species are beyond our jurisdiction or control. Habitat modification on our own ownership is under our control, but much of our land is scattered, and we are generally a minority owner within a watershed. Impacts from other owners can overshadow any impacts or benefits that we provide. Because of these factors, we predict that implementing any of the alternatives would not have a substantial effect on the status of bull trout and westslope cutthroat trout as species of special concern. Stillwater and Swan State Forests, where we have extensive ownership in watersheds inhabited by bull trout and westslope cutthroat trout, are exceptions, as described in the previous section.

No impacts are expected to warmwater fish or habitat as a result of selection of any alternative. Mechanisms are already in place to minimize the impacts to water quality, SMZs, and riparian vegetation. As stated earlier, goldeye and largemouth bass, as well as other warmwater fish, are more tolerant of finer bed particles and higher levels of turbidity. The warmwater fishery will be given the same level of protection during timber management operations as the coldwater fishery. Problems are not expected to arise in the eastern part of the state due to highly scattered ownership and limited management potential.

CULTURAL AND AESTHETIC ENVIRONMENT

HISTORICAL AND ARCHAEOLOGICAL SITES

As outlined in the Montana State Antiquities Act (§ 22-3-421--22-3-442, MCA), all state agencies are responsible for being thoughtful stewards of significant historic and prehistoric resources on state-owned lands. Stewardship is intended to include systematic identification and evaluation of sites, buildings, and districts (groups of related buildings or sites) within a proposed project's potential impact area. Subsequently, stewardship includes systematically considering the possibility and feasibility of preserving, avoiding, and/or mitigating potential adverse effects to those sites identified within a proposed project area. Under all alternatives, information will be gathered by qualified personnel regarding the presence of heritage properties (cultural resource sites) as projects are proposed and implemented. Stewardship considerations and/or actions will be applied to all sites identified.

VISUAL CONCERNS

Future visual quality on state lands will be directly correlated with the amount and methods of timber harvesting and road building under each alternative, as well as unplanned events such as wildfires or major insect and disease damage. The Forest Vegetation section of this chapter discusses the anticipated effects of timber management and suggests the likelihood of fire, insect, and disease occurrences under each alternative. The following portions of the Forest Vegetation section are particularly relevant to future visual quality:

- the estimated levels of timber harvest and use of different cutting methods under "The Effects Assessment";
- the discussions of expected future conditions for Stand Size Classes, Stand Age Distribution, Old-Growth, and Patch Sizes and Shapes; and
- the summary discussion of forest health effects.

FINANCIAL AND ADMINISTRATIVE ENVIRONMENT

ADMINISTRATIVE ORGANIZATION

METHODOLOGY

Any of the alternatives would substantially influence our organization, staff size, and programmatic activities. The philosophy and management emphasis incorporated in each alternative would determine the staff expertise, size, and distribution of personnel necessary to accomplish the alternative's programmatic goals. However, the staffing of a state agency such as DNRC often reflects the demands of the state's population, social trends, and the public's willingness to fund programs as authorized by the State Legislature in addition to the goals established by the agency.

In the evaluation below, we have estimated the minimum personnel and organizational changes needed to fully implement the programmatic goals of each alternative. However, any of the alternatives could be implemented at some level of production with current staff size. The estimates were developed as our best estimate of the FTE (full time equivalent) needed in the future, given current trends in demand of state land use, management complexity, and changing issues. We derived these estimates to assist us in the economic analysis of the alternatives. They allow us to consider the changes in personnel and costs of implementation that could be expected as a result of the programmatic direction of each alternative. The estimates are not intended to represent budget requests. Actual program development, workload, and the State Legislature's willingness to provide funding will ultimately determine the Department's staff size and budget.

EFFECTS BY ALTERNATIVE

EFFECTS OF ALPHA

Forest Product Sales

Under this alternative we would attempt to maintain an annual timber harvest of 20-40 million board feet. The goals of the Forest Product Sales Program would remain similar to those that currently exist. We do not expect any substantial personnel changes in the program. There would be an incremental increase in budget for contracting timber sale preparation activities, but this is not expected to substantially exceed levels budgeted in FY 1995-96.

State Lands Administration

We would continue to issue licenses and leases for activities on forested state land other than timber harvest. We expect licenses issued for grazing activities to remain at recent levels. The continued development of private lands in and around forested trust lands should increase the number of requests for right-of-way easements across state tracts. The administrative workload associated with the recreational use of state lands would probably increase as enforcement of recreational use rules increases participation and public awareness improves. The recent trend towards more public awareness of state land special use opportunities is expected to continue. Special Use License requests have increased by 100 percent since 1992. However, with the development of policies addressing special uses and the trend towards higher license fees, we expect the demand to level off.

Overall we expect a minimum increase of 4.5 FTE in the State Lands Administration Program. These people would be needed to conduct activities associated with greater demand for special uses on state land. The FTE would be evenly distributed among staff and field personnel.

Forest Improvement

This alternative would cause minor changes in Forest Improvement activities. The need for brush disposal, planting, and thinning would correlate with our harvest level estimate of 20-40 million board feet, which is consistent with past levels. We expect the subdivision of private properties adjacent to state land to create additional workload for those in charge of access acquisition funded with Forest Improvement monies. In addition, the need to address road maintenance problems on existing roads would create additional workload and require more personnel.

We expect that the Forest Improvement Program would require a minimum increase of 1.5 FTE and a 20 percent increase in contracting authorization to conduct a higher level of access acquisition and road maintenance activities.

Inventory

We would continue to need comprehensive data on a variety of ownerships to conduct cumulative effects analyses. The complexity of the analyses would increase due to development surrounding state land, coupled with advancements in technology, and this would result in a moderate increase in Inventory Program personnel. The need to complete the stand level inventory as a foundation for analysis and forest management planning is evident.

We expect the Inventory Program to require an increase in staff personnel of 1.5 FTE for GIS and computer applications.

Resource Management

Resource Management Staff would continue to address the complexities of cumulative effects on the various resources. In order to meet the timber harvest level estimate of 20-40 million board feet annually we anticipate a need to bolster the number of Resource Specialists at field locations.

We estimate we would need three more FTE in Resource Management to maintain harvest levels and provide appropriate consideration of trust resources.

EFFECTS OF BETA

Forest Product Sales

The Forest Product Sales Program under this alternative would attempt to manage the forest intensively to promote a biologically diverse and therefore more productive healthy forest. The estimated harvest level of 15-35 million board feet represents a slight reduction of harvest volume from historic levels. However, the management goal of promoting diversity should require more field time during sale preparation, resulting in slightly less productivity per FTE in meeting the timber sale goals. These factors balance each other, so we do not expect any changes in Forest Product Sales personnel under this alternative.

State Lands Administration

This alternative would require additional personnel in State Lands Administration. We anticipate the number of grazing leases issued would be reduced by 30-35 percent; however, administration and monitoring of those leases would intensify. We would emphasize the development of recreational sites to provide trust income, new cabinsites would be developed and leased, and we would attempt to consolidate our lands through exchange proposals.

We project that the State Lands Administration Program would require a minimum of 5.5 additional FTE under this alternative.

Forest Improvement

The intensive management philosophy in the timber sale program implies a need for a more active Forest Improvement Program. Pre-commercial thinnings, tree plantings, more active weed management, and the development of a comprehensive road management program all would contribute to increased personnel needs in the Forest Improvement Program.

We anticipate needing a minimum of 3.5 more FTE plus a 20 percent increase in contracting funds to accomplish site specific projects.

Inventory

The emphasis on landscape analysis and the continuing need for comprehensive data to conduct cumulative effects analyses would require inventory staffing increases of approximately 1.5 FTE.

Resource Management

This alternative's emphasis on ecosystem management and biodiversity would require expertise in ecology that currently does not exist in field offices. The active timber sale program would continue the participation of resource management specialist in the review and development of harvest proposals. De-emphasizing big game habitat concerns would reduce our dependence on Department of Fish, Wildlife, and Parks personnel for input. The aggressive pursuit of water rehabilitation projects and concern over impacts on fisheries would also require staff expertise currently not available within the department.

Overall, we would expect a minimum increase of 5 FTE in the Resource Management Program.

EFFECTS OF GAMMA

Forest Product Sales

This alternative would cause a substantial reduction in the Forest Product Sales Program. Timber sales would be conducted to restore and maintain ecosystem integrity in areas that have already been disturbed, but harvest levels overall would be very low. We estimate at least a 75 percent reduction in timber harvest volume, which would correspond to a loss of an estimated 25 of the current 35 FTE in the Forest Product Sales Program.

State Lands Administration

We estimate the number of grazing leases issued under this alternative would approximate 50 percent of the number issued in FY 1994. However, administration of those leases would be much more intensive and would require a field evaluation every two years instead of every 10 years as we currently do. We would maintain current cabinsite leases. The emphasis on providing dispersed recreational opportunities would require additional field personnel.

Overall, we expect Gamma would require an additional 2.5 FTE in State Lands Administration.

Forest Improvement

The decrease in Forest Product Sales would in turn reduce the need for tree planting projects, brush disposal, and precommercial thinning. However, trail maintenance and road rehabilitation projects would create some additional work.

We expect the Forest Improvement Program would reduce its personnel by 10 FTE under this alternative.

Inventory

The reduction in timber sales activities sharply reduces the need to analyze cumulative effects and monitor annual inventory changes. The inventory staff instead would conduct landscape analysis and monitor the status of forest ecosystems. The result would be no change in number of inventory personnel.

Resource Management

Resource Management Specialists would spend much less time providing input on timber sale proposals and more time evaluating impacts on adjacent landowners and attempting to coordinate their activities with our management. The Department would require different expertise at the field offices than currently exists. Dispersed recreational planning, trail location, and campsite development would require new expertise, and field offices would have to add forest ecologists. Under alternative Gamma, we would expect to see an increase of approximately 10 FTE in the Resource Management Program.

EFFECTS OF DELTA

Forest Product Sales

Under Delta, timber product sales would fluctuate according to market conditions. We would establish an annual base-level timber harvest program at a fairly modest annual volume. Harvest volumes would then increase as market conditions approached high points in pricing cycles. We would emphasize managing the most productive timber sites to provide the best return on our investment. We would expect to decrease our permanent full-time Forest Product Sales personnel, but increase seasonal, short-term or contracted personnel. Overall we would not expect a change in the average number of personnel authorized in Forest Product Sales.

State Lands Administration

We estimate the number of grazing licenses on forested lands would drop by 70 percent due to conflicts with other uses or values. We would continue the practice of evaluating those licenses every 10 years, but would take a more active role in the management of grazing resources by investing in improvements that would clearly pay dividends to the trust. We would try to improve the legal access to state lands to bolster our marketing options. We would increase the number of cabinsites and develop recreational and commercial opportunities where economically feasible. These activities would require a minimum of 6 additional FTE in the Lands Administration Program.

Forest Improvement

Traditional Forest Improvement activities such as planting, thinning and cull tree removal would be concentrated on the best sites where the investment is justified. We would accomplish hazard reduction to meet the minimum standards acceptable under the law. Our hazard reduction workload would fluctuate with the market-driven harvest schedule and therefore would necessitate the use of contract, short term, or seasonal personnel. We would actively maintain our road network using Forest Improvement Funds. Overall, our average personnel requirements are not expected to change under this alternative.

Inventory

The demands on the Inventory Program would be somewhat different than at present. We would need to provide data for cumulative effects analysis on timber harvest proposals as well as on recreational or commercial development projects. The need to develop marketing strategies would require an expansion of the inventory data to include other resources that have management value. We expect the Inventory Program would need an additional 1.5 FTE.

Resource Management

The composition, expertise, and size of the Resource Management Program staff would change substantially under this alternative. We would need specialists and expertise that the Department currently does not have. The market-driven timber harvest program would require staff personnel to monitor the housing and lumber markets to predict stumpage price trends. Development of commercial facilities may require engineering or architectural design specialists on staff or available by contract. Marketing and promotional specialists would be an important component of the staff to attract investors to state developments. As a result, we would expect a minimum increase in Resource Management staff of eight FTE.

EFFECTS OF EPSILON

Forest Product Sales

Forest Product Sales would be the primary program under this alternative. We would attempt to offer a steady sustainable supply of forest products and increase our timber harvest 20-50 percent over current levels. The estimated annual harvest of 35-55 million board feet would require an additional eight FTE of field personnel in the Forest Product Sales Program.

State Lands Administration

Under the Epsilon alternative, we would reduce the number of grazing licenses issued by approximately 15 percent due to conflicts with timber management activities. The cabinsites under current lease would be continued, but new ones would not be developed. However, the increased emphasis on securing permanent access to our forested tracts would require the addition of 2.5 FTE in the State Lands Administration Program.

Forest Improvement

The greater timber harvest in Epsilon would require more hazard reduction activity. This alternative's emphasis on intensive forestry would also generate additional planting, thinning, and tree improvement activities. We estimate the Forest Improvement Program would require a minimum of 5.5 additional FTE to handle the intensified program. Authorization in contracted service expenditures would also need to be increased an estimated 20 percent.

Inventory

Completion of the stand level inventory would be a high priority in order to intensify our management and move toward a regulated forest condition. More frequent harvests, plantings, and thinnings would generate work just to maintain up-to-date data. Data requests for cumulative effects analyses on watershed issues and threatened and endangered species would increase. We estimate needing an additional 3 FTE in the Inventory Program.

Resource Management

The estimated higher harvest levels would require more site-specific soils and hydrologic input on proposed harvests, so more soils specialists would be needed at some land offices. Existing staff specialists would provide support to an intensified sales program, but would also conduct a less comprehensive level of cumulative effects analysis due to the secondary role of other resources in the management philosophy. Overall we estimate a need for 3 additional FTE in the Resource Management Program under the Epsilon alternative.

EFFECTS OF ZETA

Forest Product Sales

The sale of forest products would be secondary under this alternative, and we would not attempt to offer a steady supply of timber. We estimate the average annual harvest volume would be reduced by 50 percent to 10-20 million board feet, which would result in an estimated loss of 18 FTE in the Forest Products Sales program. However, there would be increased use of contracting funds to complete specific, intermittent projects.

State Lands Administration

The primary income-producing activities under this alternative would fall within the State Lands Administration program or could possibly lead to the development of a new Recreation Administration program. The number of grazing leases issued would decrease an estimated 20 percent due to conflicts with recreational developments and the emphasis on riparian habitat management. We would locate, develop, and lease additional cabinsites along with other commercial recreational developments. The management of exclusive outfitting and hunting leases is a possibility. We also would increase our efforts to secure permanent access to state tracts with management potential. This alternative would require considerable expertise that the Department currently does not have. As a result, an estimated 8 additional FTE would be required in the State Lands Administrative Program.

Forest Improvement

The reduction in forest product sales would cause a corresponding reduction in forest improvement activities. However, the emphasis on wildlife habitat improvement, increased road maintenance, and weed control would have an offsetting effect on the Forest Improvement staff. The result would be no substantial change in Forest Improvement personnel, although they would be conducting different types of activities.

Inventory

We would still need to maintain inventory data under this alternative. The type of data, however, may be somewhat different. A comprehensive inventory of recreational opportunities would be a priority, for example. Consequently, we estimate a modest increase of 1.5 FTE in the Forest Inventory Program.

Resource Management

This alternative would require expertise in the Resource Management Program that does not currently exist. The emphasis on big game management and fisheries, plus the development of recreational sites, would require more FTE. We would need to develop a marketing and promotional program to maximize the revenue potential of recreational sites. Overall we would expect an increase of 6 FTE in the Resource Management Program to support the activities conducted by State Lands Administration.

EFFECTS OF OMEGA

Forest Product Sales

Under this alternative, we would attempt to manage the forest intensively to promote a biologically diverse and therefore, more productive, healthy forest. Timber harvests would serve as the primary tool for producing desired and diverse stand structures as well as generating income. The estimated annual harvest of 30-50 million board feet represents a substantial increase from recent historic harvest volume levels and would require a corresponding increase in FTE. Additionally, the goal of promoting diversity may direct activities to stands that are in need of treatment from a landscape perspective but produce less than optimum merchantable volume or distributes the harvest volume over larger acreages. We therefore expect sale preparation to require more field time and be less productive when evaluated on a MMBF/FTE basis.

Consequently, we anticipate needing an additional 12 FTE in Forest Products Sales under the Omega Alternative.

State Lands Administration

Activities conducted in State Lands Administration programs would increase under this alternative. We anticipate the number of grazing leases issued would be reduced by 30-35% however the administration of the remaining leases would intensify substantially. Under this alternative we would also emphasize the development of recreational sites to provide trust income, develop and lease new cabinsites and attempt to consolidate lands through exchange proposals.

We project that the State Lands Administration Program would require a minimum of 5.5 additional FTE under this alternative.

Forest Improvement

This alternative's intensive management philosophy would generate more pre-commercial thinning, planting, weed management and road management activities which would require additional personnel. Increase harvest levels would also generate increase brush disposal activities.

We estimate an additional 4.5 FTE in Forest Improvement would be needed under this alternative.

Inventory

The emphasis on landscape analysis, evaluating forest conditions over multiple ownerships and cooperative resource planning would generate inventory and data management workload. We would also expect to increase use of remote sensing and GIS technology.

We anticipate a inventory staffing increase of 3.5 FTE would be required.

Resource Management

This alternatives emphasis on ecosystem management and biodiversity could require expertise in ecology that currently does not exist in field office. The increased timber harvest activities would require active participation of resource management specialists in the review and development of harvest proposals. The aggressive pursuit of water rehabilitation projects and concern over impacts on fisheries would also require staff expertise currently not available within the department.

Overall, we expect a minimum increase of 5 FTE in the Resource Management Program under the Omega Alternative.

SUMMARY

Table IV-AD1 below summarizes the personnel changes we expect to result from each management alternative. We expect alternatives Epsilon, Beta, Delta, Omega and Alpha to require hiring additional personnel, while Gamma and Zeta may require personnel reduction. Some of the alternatives may cause changes in the type of expertise we need, as well as in the status of some employees. Gamma, Delta, and Zeta place a higher priority on management activities that were less important or not done in the past, and would require expertise in the Resource Management Program that does not currently exist. Under Delta, the market-driven nature of our activities would probably result in the need to hire more contract, short-term, or seasonal personnel.

Table IV-AD1
PREDICTED FORESTRY PERSONNEL CHANGES BY ALTERNATIVE
(Existing FTE = 77.36)

Alternative	Estimated Change in FTE	Predicted Future FTE
ALPHA	+10.5	87.86
BETA	+15.5	92.86
GAMMA	-22.5	54.86
DELTA	+15.5	92.86
EPSILON	+22.0	99.36
ZETA	-2.5	74.86
OMEGA	+30.5	107.86

All of the alternatives would probably cause some shifts within the Department of Natural Resources and Conservation as a whole, making some programs larger within the overall framework, and some smaller, in terms of percentage of FTE allocated to each one. Table IV-AD2 shows the expected shifts as a percentage of the total number of employees predicted for each alternative. These changes reflect the different management philosophies of each alternative. For example, Resource Management would be the single largest program in terms of FTE under Gamma, whereas Forest Product Sales would have the most FTE under Omega.

Table IV-AD2
PERCENTAGE OF FTE ALLOCATED BY PROGRAM AND BY ALTERNATIVE[11]

Program	Current Levels	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
Forest Products	45%	40%	38%	18%	38%	43%	23%	44%
Lands Admin.	17%	20%	20%	29%	21%	16%	28%	17%
Forest Improvement	25%	24%	24%	17%	21%	25%	26%	22%
Inventory	4%	5%	5%	5%	5%	6%	6%	6%
Resource Mgmt.	9%	11%	13%	31%	16%	10%	17%	11%

[11] Totals may not equal 100 percent due to rounding.

ECONOMICS

INTRODUCTION

Our assessment of economic consequences centers on effects on the school trusts and effects on the regional economy. We used the following five measurable descriptors to characterize these effects:

Percent of School Funding from Forested Trust Lands
Net Present Value of Expected Trust Revenues
Present and Future Value of Standing Timber Asset
Number of Jobs Supported
Total Annual Income Generated

This chapter is divided into four parts: school funding, net present value determinations, regional economic effects, and an interpretation and summary of our results. Within each part, we explain how that particular topic is relevant to our decision, the methodology we used, how we arrived at our results, what the results are, and what the results mean with respect to our decision.

The recreation sub-section of our net present value discussion is much longer than all other sub-sections, partly because we do not have a developed program now and consequently had to estimate categories of use, use levels, and prices; information that is readily available for our grazing and timber programs. We also found that research data on trends in recreation use levels and future prices was much less available than comparable information on grazing and timber. Therefore, we had to do substantially more background work to place recreation on an equal footing with grazing and timber as a legitimate potential revenue generating use of state trust lands.

ECONOMIC CONSEQUENCES

PART I: SCHOOL FUNDING

Importance To Our Decision

Montana's state constitution requires that state lands be managed so as to raise revenue for the support of public schools and state universities. The next section, Net Present Value of Trust Revenues, will present details on the amount of revenue we would expect to raise under each alternative. The importance of this section to our decision is to give an idea how changes in our contribution would affect overall school funding. That is, we would expect our decision to be of greater importance to public schools if we contributed 80 percent of total school funding than if we contributed only 5 percent.

Forest Lands Share of Total School Funding

DNRC's recent past contributions have represented about 10 percent of total school funding and forest land activities have contributed about 27 percent of that 10 percent DNRC share. This means that forest land activities have contributed roughly 2.7 percent of total annual public school funding.

If we assume that education revenues derived from all other sources will remain constant, we can make an estimate of the future share of public school funding that would come from forested state lands under each alternative.[12] According to the Table IV-E1 High Output scenario, the share of school funding from forested-land management would range from a low of 0.8 percent under Gamma, to a high of 4.2 percent under Epsilon. Under the Low Output scenario, the share would range from zero (calculated as a negative 0.4 percent) under Gamma, to 1.8 percent under Epsilon.

If leased recreation values are higher than estimated in our baseline calculations, of if timber prices increase more rapidly, the percentage shares of school funding would increase but the relative ranking of alternatives would remain the same. At the higher timber price trend, under the High Output scenario, shares would range from a low of 0.9 percent under Gamma to 5.1 percent under Epsilon.

In summary, under any alternative and any combination of output levels and price assumptions, the share of total school funding expected to come from management of forested state lands would range from near zero to a maximum of about five percent. This compares to slightly under three percent during the recent past.

Table IV-E1
ANNUAL FORESTED LANDS SHARE OF TOTAL SCHOOL FUNDING (%)

Total School Funding: $410,785,198								
HIGH OUTPUT	1992-94	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
Baseline	2.8%	3.3%	2.9%	0.8%	3.9%	4.4%	1.9%	4.1%
Leased Rec @ $1.59	2.8%	3.3%	2.9%	0.8%	3.9%	4.4%	2.0%	4.1%
Timber Trend @ 2.6%/yr	2.8%	4.0%	3.5%	1.0%	4.7%	5.4%	2.3%	5.0%
LOW OUTPUT								
Baseline	2.8%	0.7%	0.3%	-0.4%	0.3%	1.9%	0.0%	1.4%
Leased Rec @ $1.59	2.8%	0.7%	0.3%	-0.4%	0.3%	1.9%	0.0%	1.5%
Timber Trend @ 2.6%/yr	2.8%	1.0%	0.5%	-0.3%	0.5%	2.5%	0.2%	2.0%

*Figures adjusted to compare with calculation that included T&L interest.

[12] We make this assumption because we have no way of knowing how other sources of school funding will change. If we recognize that our findings are only valid for comparing between alternatives for managing forested lands, and not for drawing any other conclusions about overall school funding, then we will be on safe ground.

PART II: NET PRESENT VALUE OF TRUST REVENUES

Importance to Our Decision

If all other circumstances were equal, then net present value returned to the school trusts should be the basis for selecting an alternative to become our management direction. That is, if all alternatives had exactly the same environmental consequences, satisfied the wishes of the public to the same degree, and resulted in exactly the same future condition of forest health, then we should select the alternative that would produce the largest net present value.

However, environmental consequences, public satisfaction, and future forest health would not be the same under all alternatives. Not only do these things differ among alternatives, but there are also differences in the way people interpret them under any single alternative. Consequently, we must not ignore other factors besides financial gain that are important both to us as professional forest land managers, and to members of the public with their diversity of interests and opinions.

We must balance our constitutional mandate to generate money for the benefit of public schools with other statutory and management obligations to ensure long-term health of the forest, and to generate revenue in ways that are most consistent with the desires of Montana's citizens. Net present value then, becomes an important factor, but not the only factor, in making our decision.

Methodology

We foresee three potential sources of revenue from management of state lands: grazing, recreation, and timber.[13] For each potential revenue source, we have estimated (1) current and future use levels, and (2) current and future prices. We have estimated overall costs for all programs, combined. By discounting all revenues and costs to their present value equivalents, and subtracting total costs from total revenues, we arrived at net present value for each alternative.

Many of the tables report High and Low output levels. These represent the upper and lower values of the output scenarios described in the introduction to this chapter. There is no assurance that we would actually produce a High or a Low level of output; however, the management philosophy of a particular alternative leads us to believe that there is a strong likelihood that actual output under the alternative would fall somewhere between the High and Low values.

Some of the tables also display net present values under three different price assumptions, for both High and Low output levels. The "Baseline" prices are those we accepted as most suitable for our analysis (Table IV-E14). However, due to the considerable uncertainty surrounding the market value of leased recreation opportunities, we did a separate set of net present value computations in which dispersed recreation leasing was valued at a higher rate (Table IV-E15, labeled "Leased Recreation @ $1.59 vs. $0.66). Finally, to address the possibility of more rapid growth in timber values, we considered a higher trend rate of real stumpage prices (Table IV-E16, labeled "Timber Trend @ 2.6%/yr vs. RPA of 1.2%/yr.).

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[13] The "recreation" category also includes some non-recreation uses (e.g. utility site leases) that are not related to timber or grazing.

We will explain our other work in subsequent sections on Grazing, Recreation, Timber, Program Costs, and NPV Computations. Appendix ECN provides additional detail on the economic assessment process.

Grazing

Use Levels and Trends

We interpreted the philosophy, specific intent, and resource management standards associated with each alternative to arrive at estimated future grazing levels on forested trust lands. Their estimates and supporting reasoning are presented in Appendix SCN. The Table IV-E2 Grazing Use Schedule is based on these estimates with the classified Forest component expanded to give a high/low range of 50 percent above and 50 percent below the base levels.

The scenario estimates assumed each alternative was fully implemented. In reality, there would be a gradual adjustment from current use levels to the full implementation level of any alternative. We assumed that the adjustment would take place at a rate not exceeding 1,000 AUMs per year until the new level was reached, with use levels remaining constant thereafter, for the rest of the 25 year planning period.

In order to create a range of plausible high and low levels of grazing use, we expanded the above use estimates to a range of high values, 50 percent above the core estimates, and a range of low values, 50 percent below the core estimates. Table IV-E2 shows the resulting schedule of AUMs on forested lands.

Table IV-E2
ESTIMATED GRAZING USE SCHEDULE
(AUMs per Year)

Scenario		1995	2000	2005	2010	2015	2020
HIGH	ALPHA	26,776	30,765	34,753	34,753	34,753	34,753
	BETA	26,776	26,577	26,377	26,377	26,377	26,377
	GAMMA	26,776	24,782	22,788	22,788	22,788	22,788
	DELTA	26,776	24,896	23,016	23,016	23,016	23,016
	EPSILON	26,776	27,175	27,574	27,574	27,574	27,574
	ZETA	26,776	24,896	23,016	23,016	23,016	23,016
	OMEGA	26,776	26,577	26,377	26,377	26,377	26,377
LOW	ALPHA	26,776	22,788	18,799	18,799	18,799	18,799
	BETA	26,776	21,392	16,007	16,007	16,007	16,007
	GAMMA	26,776	21,776	16,776	14,811	14,811	14,811
	DELTA	26,776	21,776	16,776	13,444	13,444	13,444
	EPSILON	26,776	21,591	16,406	16,406	16,406	16,406
	ZETA	26,776	21,776	16,776	13,444	13,444	13,444
	OMEGA	26,776	21,392	16,007	16,007	16,007	16,007

Prices

Our current price for grazing is $4.09 per AUM, set by the State Land Board of Commissioners according to a formula based on the previous year's beef price. Our price is substantially below the current market price of $8.00 estimated by Duffield (1993).

According to information in the Duffield report (pages 55 and 62), real grazing market prices have declined from 1.5 to 3 percent per year over the last several decades. The 1990 RPA update used a real price increase of 0.6 percent per year between 1989 and 2000, increasing to 1.15 percent per year between 2000 and 2040. Based on these observations, we assumed that real market prices for grazing would increase at 0.6 percent per year over the planning period of 1995-2020. We used Duffield's average of $8.00 per AUM as the current market price for grazing.

We assumed that upward political pressure on state land grazing fees would continue. After a lawsuit in the early 80's, Oklahoma lease rates doubled, and current lease prices range from 75 to 135 percent of average market rates (Duffield, p. 64). In Nebraska, rates average 60 to 100 percent of market rates (vs. 50 percent in Montana). Given these circumstances, we assumed that DNRC grazing fees would reach 80 percent of market value by the year 2010.

We arrived at the following schedule of estimated grazing prices.

Table IV-E3
ESTIMATED GRAZING FEE SCHEDULE
(Constant dollars)

	1995	2000	2005	2010	2015	2020
$ per AUM	4.09	5.03	5.95	7.00	7.21	7.43

*Based on a 1994 DNRC minimum rate of $4.09/AUM, and a current market rate of $8.00/AUM.

Discounted Present Value of Grazing Revenues

Combining the above use levels and prices leads us to the Table IV-E4, a schedule of discounted grazing revenues for each alternative.[14]

Table IV-E4
PRESENT VALUE OF GRAZING REVENUES
(Thousands of Dollars)

Alternative	High Output	Low Output
ALPHA	3029	1952
BETA	2463	1763
GAMMA	2221	1741
DELTA	2236	1689
EPSILON	2544	1790
ZETA	2236	1689
OMEGA	2463	1763

Recreation

Estimating the environmental and economic effects of recreation management under each alternative presented the challenge of predicting future recreation use levels and potential revenues on school trust lands in the absence of:

- a well-developed current recreation program with known patterns of use;
- data on current levels of dispersed recreation use on trust lands;
- research studies on future participation rates in Montana as a whole, or on state lands in particular; and
- research or experience-based estimates of prices and revenue collection mechanisms applicable to dispersed recreation use of state lands.

Methodology

We responded to the challenge of predicting recreation effects by taking the following steps:[15]

1) Grouping activities whose environmental effects tend to be similar and which lend themselves to a similar means of fee collection.

2) Estimating current use levels within each group.

3) Predicting future use levels within each group, under each alternative.

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[14] The numbers in Table IV-E4 are supported by six Grazing Revenue Spreadsheets (one for each alternative) in Appendix ECN - Economics.

[15] Full details on our analysis procedure can be found in Appendix ECN and in the Project Record.

4) Estimating prices currently charged by DNRC, within each group.

5) Estimating current market prices within each group (DNRC prices are often below current market prices).

6) Predicting future prices within each group.

7) Using the above schedules of predicted use levels and predicted prices by activity group, time period, and alternative; to calculate future revenues.

8) Discounting all revenues to their present value equivalents.

Activity Groupings

Working from recreation activity types commonly specified in the research literature, we selected those activities likely to occur on forested state lands. Clustering those activities by nature of environmental effects and type of fee collection mechanism, we arrived at the following five activity groups:

Group I: Developed Site Recreation

Visiting museums, historic sites, or information centers
Camping in developed campgrounds
Downhill skiing
Organization camps
Home sites and cabinsites
Commercial lodges

Group II: Dispersed Recreation Typically Involving Use of Specialized Equipment or Facilities, and/or Immediate Road Access

Camping in primitive campgrounds
Bicycle riding
Picnicking
Community recreation sites
Hunting
Commercial outfitter licenses
Fishing
Fishing access sites
Horseback riding
Shooting sport sites
Collecting firewood
Visiting prehistoric sites
Driving vehicles or motorcycles off-road
Snowmobiling

Group III: Dispersed Recreation That Requires a Minimum of Equipment and Is Relatively Independent of Road Access

Wildlife observation, photography, and nature study
Walking, running
Day hiking
Backpacking
Collecting berries or mushrooms
Canoeing, kayaking, or rafting
Cross-country skiing and snowshoeing
Driving for pleasure and sightseeing[16]

Group IV: Non-Recreation Special Uses with Impacts Similar to Those of Group I

Electronic and utility sites
Public facility sites
Non-recreation commercial uses
Parking lots

Group V: Dispersed Recreation Leases

Hunting
Fishing
Outfitting
Other dispersed use rights
Rights to enjoyment by limiting competing uses

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[16] DRIVING FOR PLEASURE AND SIGHTSEEING is included in this group because its environmental impacts are relatively minor if the following two assumptions are met:
1) activity is confined to existing roads, with no new road construction or maintenance; and
2) riders do not get out of their cars.

Current and Future Use Levels

Using methods and assumptions described in Appendix ECN, we arrived at the schedule of use levels shown in Table IV-E5.

Table IV-E5
RECREATION USE LEVELS

Units: Groups I & IV = No. of leases
Groups II & III = User days
Group V = No. of acres

	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
1995-2000							
Group I	673	711	613	758	657	786	711
Group II	108471	115317	101365	114509	108471	116207	115317
Group III	188976	204798	216397	193426	188976	202019	204798
Group IV	52	56	49	56	52	57	56
Group V	0	0	0	0	0	0	0
2000-2005							
Group I	704	780	585	874	672	930	780
Group II	112991	126683	98778	125067	112991	128463	126683
Group III	198758	230402	253600	207658	198758	224845	230402
Group IV	54	61	48	61	54	63	61
Group V	5348	8020	10694	16041	5348	37428	8020
2005-2010							
Group I	735	850	556	991	686	1073	850
Group II	117512	138049	96192	135625	117512	140720	138049
Group III	208539	256007	290802	221889	208539	247670	256007
Group IV	56	67	46	67	57	70	67
Group V	10694	16041	21387	32081	10694	74855	16041
2010-2015							
Group I	766	919	528	1107	701	1217	919
Group II	122032	149415	93605	146183	122032	152976	149415
Group III	218321	281611	328005	236121	218321	270496	281611
Group IV	58	72	45	72	59	76	72
Group V	16040	24061	32081	48122	16040	112283	24061
2015-2020							
Group I	797	988	499	1223	716	1361	988
Group II	126552	160781	91019	156741	126552	165232	160781
Group III	228103	307215	365208	250353	228103	293321	307215
Group IV	61	78	44	78	61	83	78
Group V	21387	32081	42774	64162	21387	149710	32081

Current and Future Prices

Using methods and assumptions described in Appendix ECN, we arrived at the schedule of baseline prices shown in Table IV-E6.

Table IV-E6
RECREATION PRICE SCHEDULE

GROUP	1995-00	2000-05	2005-10	2010-15	2015-20	$PER
Group I						
(DNRC)	768	1086	1404	1404	1404	Lease
(Market)	(1755)	(1755)	(1755)	(1755)	(1755)	
Group II						
(DNRC)	0.20	0.85	1.50	1.51	1.52	User Day
(Market)	(1.48)	(1.49)	(1.50)	(1.51)	(1.52)	
Group III						
(DNRC)	0.33	1.45	2.57	2.60	2.64	User Day
(Market)	(2.49)	(2.53)	(2.57)	(2.60)	(2.64)	
Group IV						
(DNRC)	400	400	400	400	400	User Day
(Market)	(400)	(400)	(400)	(400)	(400)	
Group V						
(DNRC)	0.04	0.36	0.67	0.67	0.68	Acre
(Market)	(0.66)	(0.66)	(0.67)	(0.67)	(0.68)	
	(1.59)	(1.60)	(1.61)	(1.62)	(1.64)	

Discounted Present Value of Recreation Revenues

Combining the above use levels and prices leads us to Table IV-E7, a schedule of discounted recreation revenues for each alternative.[17]

Table IV-E7
PRESENT VALUE OF RECREATION REVENUES
(Thousands of Dollars)

Alternative	High Output		Low Output	
	Baseline	W/Alt. Group V	Baseline	W/Alt. Group V
ALPHA	31,449	31,648	10,483	10,549
BETA	37,201	37,501	12,400	12,500
GAMMA	29,908	30,306	9,969	10,102
DELTA	39,524	40,123	13,175	13,374
EPSILON	30,179	30,379	10,060	10,126
ZETA	43,514	44,910	14,505	14,970
OMEGA	37,201	37,501	12,400	12,500

Timber

Timber Harvest Levels

We made independent estimates of probable future timber harvest levels. We considered recent estimates of current harvest potential made by our Area Managers, actual harvests in the recent past, newly updated timber inventory data, and the philosophy of each alternative.

17 The numbers in Table IV-E7 are supported by six Recreation Revenue Spreadsheets (one for each alternative) in Appendix ECN - Economics.

Through group discussion of our independent estimates, and subsequent review by other planning team members, and allowing a five-year period to adjust from recent past levels to probable future levels under each alternative, we arrived at the schedule shown in Table IV-E8.

Table IV-E8
ESTIMATED ANNUAL TIMBER HARVEST SCHEDULE
(MMBF sold per year)

	ALPHA		BETA		GAMMA		DELTA		EPSILON		ZETA		OMEGA	
PERIOD	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO
1995	40	20	40	20	40	20	40	20	40	20	40	20	40	20
1996	40	20	39	19	34	17	41	19	43	23	36	18	42	22
1997	40	20	38	18	28	14	42	18	46	26	32	16	44	24
1998	40	20	37	17	22	11	43	17	49	29	28	14	46	26
1999	40	20	36	16	16	8	44	16	52	32	24	12	48	28
2000	40	20	35	15	10	5	45	15	55	35	20	10	50	30
2001-2020	40	20	35	15	10	5	45	15	55	35	20	10	50	30

Current and Future Timber Prices

There were two choices for real timber price trend, the 1990 RPA trend and regional trends based on research at the University of Montana. In order to remain consistent with our baseline trends for grazing and recreation, we chose to use the RPA trend of 1.2 percent per year for the baseline timber calculations. An alternative trend is based on the Table IV-E9 projections compiled in 1994 by Darius Adams of the University of Montana Forestry School. Details are on file in the Project Record.

Table IV-E9
REAL STUMPAGE PRICE TRENDS
(Adams Projections)

	1995-00	2001-05	2006-10	2011-15	2016-20
Percentage/Year	10.60%	-0.33%	-1.60%	3.80%	2.80%

Because the large (10.6%) annual trend for the first five years of Adams' series had such a large short-term effect on NPV calculations, we decided to convert these numbers to their uniform 25 year equivalent trend of 2.6 percent per year.

Future stumpage prices based on the above real price trend estimates were strongly influenced by our choice of "current" stumpage price. Prices fluctuated widely over the past several years, and DNRC rates differed substantially from USFS rates. Consequently, a simple average of recent past stumpage prices may not have been the best way to establish our "current" stumpage price.

Using DNRC annual summaries of total volume cut and associated dollar value received, and adjusting to constant 1994 dollars, we arrived at a ten-year (1985-94) average value of $157 per MBF (thousand board feet). Using only the most recent five years (1990-94), we got $213 per

MBF, and using the most recent five years with the lowest and highest year dropped, we got $192 per MBF.

For comparison, during the period 1989-1992, USFS Northern Rockies Region stumpage averaged $81 per MBF, compared with $168 per MBF for DNRC timber during the same period. Based on projected prices, the USFS average for the past five years, with high and low value dropped, would be $91 per MBF.

Given these circumstances, we decided to use $192 per MBF, DNRC's most recent five years with highest and lowest value dropped, as a credible "current DNRC stumpage value" for projecting future prices. These assumptions lead us to the Table IV-E10, a schedule of timber prices over the planning period.

Table IV-E10
TIMBER PRICE SCHEDULE[18]

Year	Baseline (1.2%/yr)	Alternative (2.6%/yr)
1995	$192.00	$192.00
2000	$203.80	$218.29
2005	$216.32	$248.18
2010	$229.62	$282.17
2015	$243.73	$320.81
2020	$258.71	$364.74

[18] For convenience of presentation, we show expected timber prices at five-year intervals. Computations are based on continually changing timber prices, from one year to the next.

Discounted Present Value of Timber Revenues

Combining the above use levels and prices leads us to the Table IV-E11, a schedule of discounted timber revenues for each alternative.[19]

Table IV-E11
PRESENT VALUE OF TIMBER HARVEST REVENUES
(Thousands of Dollars)

	HIGH OUTPUT		LOW OUTPUT	
	Baseline	Alternative	Baseline	Alternative
ALPHA	142,766	168,224	71,383	84,112
BETA	126,812	149,140	55,249	65,028
GAMMA	47,040	53,718	23,520	26,859
DELTA	158,721	187,309	55,429	65,028
EPSILON	190,630	225,478	119,246	141,366
ZETA	78,949	91,887	39,474	45,943
OMEGA	174,675	206,393	103,292	122,281

19 The numbers in Table IV-E11 are supported by twelve Timber Revenue Spreadsheets (one for each alternative) in Appendix ECN - Economics.

Timber Asset Value

We recognize that our inventory of standing timber also has a value, separate from its annual yield of timber harvest. Standing timber is an asset that, theoretically, could be sold and the money invested elsewhere. Therefore, the value of that asset should be considered in our assessment of the financial consequences of implementing each alternative.

We determined the residual timber asset value under each alternative by multiplying the predicted merchantable inventory at the end of the planning period by the projected stumpage price at that time. The resulting dollar values were discounted to their present value equivalents. Table IV-E12 displays the results of those calculations.

Table IV-E12
PRESENT VALUE OF RESIDUAL TIMBER ASSET
(Thousands of Dollars)

	HIGH OUTPUT		LOW OUTPUT	
	Baseline	Alternative	Baseline	Alternative
ALPHA	276,750	390,175	334,978	472,267
BETA	291,307	410,698	349,535	492,790
GAMMA	364,092	513,313	378,649	533,836
DELTA	262,193	369,652	349,535	492,790
EPSILON	233,079	328,605	291,307	410,698
ZETA	334,978	472,267	364,092	513,313
OMEGA	247,636	349,128	305,864	431,221

Our estimates of merchantable inventory at the end of the planning period allows for differences in timber harvest levels under different alternatives. These projections used current average growth and mortality rates. However, we were not able to precisely estimate differences in mortality risk under different alternatives. Lower harvest levels would generally be associated with less extensive forest management, and consequently, with wider areas of dense residual stands with smaller trees. These types of stands would be at higher risk of mortality loss with proportionately reduced likelihood of actually realizing the values specified in Table IV-E12. (See the Forest Vegetation section of this chapter for a discussion of these risks.) We believe this risk of lost value would be highest under Gamma and Zeta; moderate under Alpha, Beta, and Delta; and lowest under Epsilon and Omega.

Subject to the preceding qualifier, the timber asset values in Table IV-E12 show that the low output scenarios result in higher residual asset values because less timber has been cut. Similarly, those alternatives with the largest harvest estimates lead to the lowest residual asset values.

Summary of Price Trends Used

In Table IV-E13, we summarize the real price trends we assumed to arrive at out projected grazing, recreation, and timber revenue values.

Table IV-E13
Price Trends Used
(% Increase Per Year)

Grazing	0.60	(RPA)
Recreation		(RPA)
Group I	0.00	
Group II	0.14	
Group III	0.30	
Group IV	0.00	
Group V	0.14	
Timber	1.20	(RPA)
	2.60	(Adams)

Program Costs

Trying to predict costs for individual programs (timber, recreation, grazing) raised many questions for which we could not develop credible, consistent answers. For example, one intractable question was that of allocating administrative overhead costs without exerting bias in favor of or against particular programs. Our solution was to estimate total cost for all programs that would be affected by the Plan, without attempting to isolate costs for individual programs. We then subtracted total discounted costs for each alternative from total discounted revenues, as predicted for individual programs, to get net present value.

We arrived at total program costs by estimating changes in FTEs (Full-Time Equivalent employees) assigned to each affected program in order to fully implement the alternative. We assumed that costs would increase linearly throughout the planning period. Table IV-E14 displays our projected FTE changes and Table IV-E15 displays our associated total program costs.

As a point of clarification, there are no direct links between our High and Low output estimates for each alternative and the Table IV-E14 and IV-E15 estimates. Each of the alternatives would substantially influence the organization, staff size, and programmatic activities described in Chapter III: Administrative Organization. The philosophy and management emphasis of a given alternative would determine the expertise, number, and distribution of people needed to accomplish its goals. However, the staffing of a state agency such as DNRC often reflects other factors in addition to agency goals; factor such as popular demand, social trends, or willingness and ability to fund programs.

We have estimated the minimum number of personnel and organizational changes needed to fully implement each alternative. (Any of the alternatives could be implemented at some level of production with current staff size.) These are our best-guess estimates of the FTE (Full Time

Equivalents) we would need, given current trends in state land use, management complexity, and changing issues. However, our High and Low scenario outputs are a range. We cannot realistically have a "range" of FTEs in a given year. We have assumed a certain size and mix of staff. The output they are able to produce will depend on annual appropriations, market conditions, environmental space and time constraints, and our philosophy for managing within this given framework. Outputs will not be in direct proportion to FTEs.

Table IV-E14
FTE CHANGES FOR FULLY IMPLEMENTED ALTERNATIVES
(1995-2020)

Alternative	Forest Product Sales	Resource Mgmt.	Land Admin.	Forest Improv.	Forest Inventory	Total	% +/- 1994
ALPHA	0.0	+3.0	+4.5	+1.5	+1.5	+10.5	+13.6%
BETA	0.0	+5.0	+5.5	+3.5	+1.5	+15.5	+20.0%
GAMMA	-25.0	10.0	+2.5	-10.0	0.0	-22.5	-29.1%
DELTA	0.0	+8.0	+6.0	0.0	+1.5	+15.5	+20.0%
EPSILON	+8.0	+3.0	+2.5	+5.5	+3.0	+22.0	+28.4%
ZETA	-18.0	+6.0	+8.0	0.0	+1.5	-2.5	-3.2%
OMEGA	+12.0	+5.0	+5.5	+4.5	+3.5	+30.5	+39.4%

Table IV-E15
ASSOCIATED ANNUAL PROGRAM COSTS AT FULL STAFFING LEVEL
(Based on 1994 Costs Totaling $3,359,540 for 77.36 FTE)

Alternative	Total Cost ($1000)
ALPHA	$3816
BETA	$4031
GAMMA	$2382
DELTA	$4031
EPSILON	$4314
ZETA	$3252
OMEGA	$4684

Our estimated cost per FTE is $43,427. This includes personal services, operating costs, and capital expenditures. It does not include unallocated administrative costs.

We did not know how to assign administrative costs to individual programs in a way we can be sure does not exert biases for or against particular programs. We accepted this difficulty by reasoning that administrative costs will remain relatively constant for all alternatives so that including or not including them would not change the relative profitability of one alternative compared to another. However, this means the resulting net present values can not be taken as hard numbers, they will only be meaningful as a basis for comparing one alternative with another.

The reasoning in support of our estimated changes in FTE staffing levels for each alternative is documented in the Project Record. The associated cost estimates presented in Table IV-E15 are based on 1994 costs of $3,359,540 for 77.36 full-time equivalent (FTE) employees. The numbers represent total annual cost at the staffing level expected under each fully-implemented alternative.

Net Present Values

We calculated net present values for each alternative by combining discounted revenues for grazing, recreation, and timber; and subtracting discounted total program costs. The results appear in Tables IV-E16 (baseline prices), IV-E17 (alternative price for exclusive recreation leasing), and IV-E18 (alternative timber price escalation).

Table IV-E19 is an abbreviated form of the Net Present Value summary that presents all the information on one page.

Table IV-E16
NET PRESENT VALUE SPREADSHEET
($1000)

(Baseline)

HIGH	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
Grazing	3,029	2,463	2,221	2,236	2,544	2,236	2,463
Recreation	31,449	37,201	29,908	39,524	30,179	43,514	37,201
Timber	142,766	126,812	47,040	158,721	190,630	78,949	174,675
Total Revenue	177,244	166,476	79,169	200,481	223,353	124,699	214,339
Total Cost	58,981	60,458	49,127	60,458	62,396	55,104	64,945
Net Present Value	118,263	106,018	30,042	140,023	160,957	69,595	149,394
Equivalent Annual Return	7,570	6,786	1,923	8,963	10,303	4,455	9,563
Ending Timber Asset Value	276,750	291,307	364,092	262,193	233,079	334,978	247,636
Sum: NPV plus Asset Value	395,013	397,325	394,134	402,216	394,036	404,573	397,030
LOW	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
Grazing	1,952	1,763	1,741	1,689	1,790	1,689	1,763
Recreation	10,483	12,400	9,969	13,175	10,060	14,505	12,400
Timber	71,383	55,429	23,520	55,429	119,246	39,474	103,292
Total Revenue	83,818	69,592	35,230	70,293	131,096	55,668	117,455
Total Cost	58,981	60,458	49,127	60,458	62,396	55,104	64,945
Net Present Value	24,837	9,134	(13,897)	9,835	68,700	564	52,510
Equivalent Annual Return	1,590	585	(890)	630	4,398	36	3,361
Ending Timber Asset Value	334,978	349,535	378,649	349,535	291,307	364,092	305,864
Sum: NPV plus Asset Value	359,815	358,669	364,752	359,370	360,007	364,656	358,374

* Current Timber Asset Value ($1000): $484,615
(2,524,038 Mbf @ $192/Mbf = $484,615,296)

HIGH + LOW AVERAGES	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
Net Present Value	71,550	57,576	8,073	74,929	114,829	35,080	100,952
Sum: NPV plus Asset Value	377,414	377,997	379,443	380,793	377,022	384,615	377,702

Table IV-E17
NET PRESENT VALUE SPREADSHEET
($1000)

(Leased Recreation @ $1.59 vs. $0.66)

HIGH	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
Grazing	3,029	2,463	2,221	2,236	2,544	2,236	2,463
Recreation	31,648	37,501	30,306	40,123	30,379	44,910	37,501
Timber	142,766	126,812	47,040	158,721	190,630	78,949	174,675
Total Revenue	177,443	166,776	79,567	201,080	223,553	126,095	214,639
Total Cost	58,981	60,458	49,127	60,458	62,396	55,104	64,945
Net Present Value	118,462	106,318	30,440	140,622	161,157	70,991	149,694
Equivalent Annual Return	7,583	6,806	1,949	9,001	10,316	4,544	9,582
Ending Timber Asset Value	276,750	291,307	364,092	262,193	233,079	334,978	247,636
Sum: NPV plus Asset Value	395,212	397,625	394,532	402,815	394,236	405,969	397,330
LOW	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
Grazing	1,952	1,763	1,741	1,689	1,790	1,689	1,763
Recreation	10,549	12,500	10,102	13,374	10,126	14,970	12,500
Timber	71,383	55,429	23,520	55,429	119,246	39,474	103,292
Total Revenue	83,884	69,692	35,363	70,492	131,162	56,133	117,555
Total Cost	58,981	60,458	49,127	60,458	62,396	55,104	64,945
Net Present Value	24,903	9,234	(13,764)	10,034	68,766	1,029	52,610
Equivalent Annual Return	1,594	591	(881)	642	4,402	66	3,368
Ending Timber Asset Value	334,978	349,535	378,649	349,535	291,307	364,092	305,864
Sum: NPV plus Asset Value	359,881	358,769	364,885	359,569	360,073	365,121	358,474

* Current Timber Asset Value ($1000): $484,615
(2,524,038 Mbf @ $192/Mbf = $484,615,296)

HIGH + LOW AVERAGES	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
Net Present Value	71683	57776	8338	75328	114962	36010	101152
Sum: NPV plus Asset Value	377547	378197	379709	381192	377155	385545	377902

Table IV-E18
NET PRESENT VALUE SPREADSHEET
($1000)

(Timber Trend @ 2.6%/yr vs. RPA of 1.2%/yr)

HIGH	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
Grazing	3,029	2,463	2,221	2,236	2,544	2,236	2,463
Recreation	31,449	37,201	29,908	39,524	30,179	43,514	37,201
Timber	168,224	149,140	53,718	187,309	225,478	91,887	206,393
Total Revenue	202,702	188,804	85,847	229,069	258,201	137,637	246,057
Total Cost	58,981	60,458	49,127	60,458	62,396	55,104	64,945
Net Present Value	143,721	128,346	36,720	168,611	195,805	82,533	181,112
Equivalent Annual Return	9,200	8,216	2,351	10,793	12,534	5,283	11,593
Ending Timber Asset Value	390,175	410,698	513,313	369,652	328,605	472,267	349,128
Sum: NPV plus Asset Value	533,896	539,044	550,033	538,263	524,410	554,800	530,240
LOW	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
Grazing	1,952	1,763	1,741	1,689	1,790	1,689	1,763
Recreation	10,483	12,400	9,969	13,175	10,060	14,505	12,400
Timber	84,112	65,028	26,859	65,028	141,366	45,943	122,281
Total Revenue	96,547	79,191	38,569	79,892	153,216	62,137	136,444
Total Cost	58,981	60,458	49,127	60,458	62,396	55,104	64,945
Net Present Value	37,566	18,733	(10,558)	19,434	90,820	7,033	71,499
Equivalent Annual Return	2,405	1,199	(676)	1,244	5,814	450	4,577
Ending Timber Asset Value	472,267	492,790	533,836	492,790	410,698	513,313	431,221
Sum: NPV plus Asset Value	509,833	511,523	523,278	512,224	501,518	520,346	502,720

* Current Timber Asset Value ($1000): $484,615
(2,524,038 Mbf @ $192/Mbf = $484,615,296)

HIGH + LOW AVERAGES	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
Net Present Value	90,644	73,540	13,081	94,023	143,313	44,783	126,306
Sum: NPV plus Asset Value	521,865	525,284	536,656	525,244	512,964	537,573	516,480

Table IV-E19
NET PRESENT VALUE and REMAINING TIMBER ASSET VALUE UNDER THREE SETS OF ASSUMPTIONS ($ Thousand)

High Output Ranges		Baseline	Leased Rec at $1.59/ac	Timber Price at 2.6%/yr
ALPHA	NPV	118,263	118,462	143,721
	Timber Asset	276,750	276,750	390,175
	Total	395,013	395,212	533,896
BETA	NPV	106,018	106,318	128,346
	Timber Asset	291,307	291,307	410,698
	Total	397,325	397,625	539,044
GAMMA	NPV	30,042	30,440	36,720
	Timber Asset	364,092	364,092	513,313
	Total	394,134	394,532	550,033
DELTA	NPV	140,023	140,622	168,611
	Timber Asset	262,193	262,193	369,652
	Total	402,216	402,815	538,263
EPSILON	NPV	160,957	161,157	195,805
	Timber Asset	233,079	233,079	328,605
	Total	394,036	394,236	524,410
ZETA	NPV	69,595	70,991	82,533
	Timber Asset	334,978	334,978	472,267
	Total	404,573	405,969	554,800
OMEGA	NPV	149,394	149,694	181,112
	Timber Asset	247,636	247,636	349,128
	Total	397,030	397,330	530,240
Low Output Ranges		Baseline	Leased Rec at $1.59/ac	Timber Price at 2.6%/yr
ALPHA	NPV	24,837	24,903	37,566
	Timber Asset	334,978	334,978	472,267
	Total	359,815	359,881	509,833
BETA	NPV	9,134	9,234	18,733
	Timber Asset	349,535	349,535	492,790
	Total	358,669	358,769	511,523
GAMMA	NPV	(13,897)	(13,764)	(10,558)
	Timber Asset	378,649	378,649	533,836
	Total	364,752	364,885	523,278
DELTA	NPV	9,835	10,034	19,434
	Timber Asset	349,535	349,535	492,790
	Total	359,370	359,569	512,224
EPSILON	NPV	68,700	68,766	90,820
	Timber Asset	291,307	291,307	410,698
	Total	360,007	360,073	501,518
ZETA	NPV	564	1,029	7,033
	Timber Asset	364,092	364,092	513,313
	Total	364,656	365,121	520,346
OMEGA	NPV	52,510	52,610	71,499
	Timber Asset	305,864	305,864	431,221
	Total	358,374	358,474	502,720

PART III: REGIONAL ECONOMIC EFFECTS

Importance to Our Decision

The decisions we make regarding management of forested state lands will have some influence on regional jobs and incomes. As we make more marketable outputs available, we will cause at least slight increases in the level of spending in the economy. Some of that increased spending would come from outside the region thereby increasing total wealth in the region.

The findings reported in this section should not be read as anything approaching exact numbers. They are generated by simply applying economic response coefficients to our estimated output levels under each alternative.[20] The timber coefficients are probably the most accurate and the recreation multipliers the least accurate. Our output estimates also contain uncertainty. We estimated outputs to give us a rough idea how the environment might be affected under each alternative, not to make firm predictions. Consequently, these estimates of employment and income effects are nothing more than rough approximations to give us some idea of the scale of impacts each alternative would have on the regional economy.

Employment and Income Effects

Our economic response coefficients for timber, grazing, and recreation are shown in Table IV-E20. These response coefficients cannot be meaningfully ranked. They represent "responses" per unit of output and we cannot directly compare millions of board feet of timber harvest with animal unit months of grazing.

Table IV-E20
ECONOMIC RESPONSE COEFFICIENTS
(per each unit of output)

	Units of Output	Total Jobs Supported	Total Income Generated
TIMBER	Million Board Feet	27.68	$1,763
GRAZING	Million AUMs	1137	$12.43 million
RECREATION	Dollars of Direct Spending	n/a[21]	$2.40

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[20] Response coefficients are derived by converting spending multipliers to their equivalent in dollars of spending per unit of output (AUMs, Mbf's, etc.). Spending multipliers tell us the total number of dollars spent in the economy as the result of some initial expenditure. That is, a thousand dollars of direct spending to purchase unprocessed logs might result in total spending of twenty thousand dollars by the time the logs are sawn, dried, planed, shipped, sold, and used in final construction.

[21] For recreation, we have only an expenditure multiplier.

Table IV-E21 shows the corresponding ranges of estimated outputs for application of the response coefficients.

Table IV-E21
OUTPUT RANGES FOR FULLY IMPLEMENTED ALTERNATIVES[22]

	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
TIMBER (MMBF)							
High	40	35	10	45	55	20	50
Low	20	15	5	15	35	10	30
GRAZING (Thousand AUM)							
High	35	26	23	23	28	23	26
Low	19	16	15	13	16	13	16
RECREATION (Thousand $$)							
High	2013	2381	1914	2529	1932	2786	2381
Low	671	794	638	843	644	929	794

22 For convenience in presentation, output units are rounded. Computations are based on actual output estimates; therefore, employment and income estimates differ slightly from those derived by multiplication of the coefficients and output values shown in the tables.

In Table IV-E22 we show the regional economic effects expected to result from full implementation of each of the alternatives using the baseline price assumptions.

Table IV-E22
ANNUAL REGIONAL ECONOMIC EFFECTS

HIGH OUTPUT ESTIMATES	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
TIMBER							
No. of Jobs	1,107	969	277	1,246	1,522	554	1,384
$1000 Income	70,520	61,705	17,630	79,335	96,965	35,260	88,150
GRAZING							
No. of Jobs	40	30	26	26	31	26	30
$1000 Income	432	328	283	286	343	286	323
RECREATION							
No. of Jobs[23]	442	523	420	555	424	612	523
$1000 Income	4,831	5,714	4,594	6,070	4,637	6,686	5,714
TOTAL JOBS	1,589	1,522	723	1,827	1,978	1,192	1,936
TOTAL INCOME	75,783	67,747	22,507	85,691	101,945	42,232	94,188

LOW OUTPUT ESTIMATES	ALPHA	BETA	GAMMA	DELTA	EPSILON	ZETA	OMEGA
TIMBER							
No. of Jobs	554	415	138	415	969	277	830
$1000 Income	35,260	26,445	8,815	26,445	61,705	17,630	52,890
GRAZING							
No. of Jobs	21	18	17	15	19	15	18
$1000 Income	234	199	184	167	204	167	199
RECREATION							
No. of Jobs	147	174	140	185	141	204	174
$1000 Income	1,610	1,906	1,531	2,023	1,546	2,230	1,906
TOTAL JOBS	722	956	295	616	1,129	496	1,023
TOTAL INCOME	37,104	28,550	10,530	28,635	63,455	20,027	54,994

23 In the absence of a recreation jobs multiplier, we estimated these numbers by assuming the same number of jobs per thousand dollars of total income as observed for grazing.

Relationship to Montana Economy

In order to evaluate the figures in Table IV-E22, we must consider their relationship to the Montana economy as a whole. In 1993, total personal income earned in Montana was slightly over 14.6 billion dollars, and the state's economy supported 326,400 jobs. If we express total projected jobs and incomes generated under each alternative as percentages of total jobs and total income for the entire Montana economy, we arrive at the figures in Table IV-E23.

Table IV-E23
DNRC-GENERATED SHARES OF TOTAL MONTANA JOBS AND INCOME

	Percent of Total Jobs	Percent of Total Income
ALPHA	.22 to .49	.25 to .52
BETA	.29 to .47	.20 to .46
GAMMA	.09 to .22	.07 to .15
DELTA	.19 to .56	.20 to .59
EPSILON	.35 to .61	.43 to .70
ZETA	.15 to .37	.14 to .29
OMEGA	.31 to .59	.38 to .64

PART IV: INTERPRETATION AND SUMMARY

School Funding

Currently, activities on forested trust lands contribute slightly less than three percent of total annual public school funding. Under the highest output scenarios, the alternatives would rank as shown in Table IV-E24 in terms of the range of expected share of annual school funding each would contribute.

Table IV-E24
ALTERNATIVES RANKED BY EXPECTED SHARE OF TOTAL SCHOOL FUNDING
(at High output levels and Baseline price assumptions)

Alternative	Expected Share
EPSILON	4.4% to 5.4%
OMEGA	4.1% to 5.0%
DELTA	3.9% to 4.7%
ALPHA	3.2% to 3.8%
BETA	2.9% to 3.5%
ZETA	1.9% to 2.3%
GAMMA	0.8% to 1.0%

Net Present Value

The tables at the end of Section II (Net Present Value) give us:

Total Revenue: The present value equivalent of all expected grazing, recreation, and timber revenues over the next 25 years.

Total Cost: The present value equivalent of all expected costs associated with generating those revenues.

Net Present Value: The difference between discounted revenues and discounted costs.

Annual Return: The annual net income that would be equivalent to net present value of the alternative.

Asset Value: The present value of each alternative's timber asset remaining at the end of 25 years.

NPV plus A.V.: The present value equivalent that could theoretically be realized by operating under the alternative for 25 years, then ceasing operations and selling the residual timber asset.

We will focus on Net Present Value and the combination of Net Present Value and Remaining Asset Value. The preceding tables gave us values for both High and Low output scenarios, for each of three different price assumptions. They told us the range of financial outcomes that could be expected. However, for clarity in presentation, we reduced the number of combinations displayed here by ranking alternatives on the basis of averages of High and Low scenario values.

Ranking the alternatives from highest to lowest Net Present Value told us their order of preference in terms of expected net income.

Table IV-E25
ALTERNATIVES RANKED BY EXPECTED NET PRESENT VALUE
($1,000)

Alternative	Higher Baseline	Higher Timber Leased Rec.	Price Trend
EPSILON	$114,829	$114,962	$143,313
OMEGA	$100,952	$101,152	$126,306
DELTA	$74,929	$75,328	$94,023
ALPHA	$71,550	$71,683	$90,644
BETA	$57,576	$57,776	$73,540
ZETA	$35,080	$36,010	$44,783
GAMMA	$8,073	$8,338	$13,801

The rankings are less consistent when we factored in the present value of merchantable timber inventory remaining after 25 years of operation under each alternative. Combining Residual Asset Value with Net Present Value gave us a package consisting of a productive asset plus an income stream generated by that asset. The numbers in Table IV-E26 told us the amount of cash we would have in hand if we accumulated the income for 25 years and then *immediately* sold the timber asset.

Table IV-E26
ALTERNATIVES RANKED BY (NPV PLUS REMAINING ASSET VALUE)
($1,000)

Alternative	Higher Baseline	Higher Timber Leased Rec.	Price Trend
ZETA	$384,615	$385,545 (1)	$537,573 (1)
DELTA	$380,793	$381,192 (2)	$525,244 (4)
GAMMA	$379,443	$379,709 (3)	$536,656 (2)
BETA	$377,997	$378,197 (4)	$525,284 (3)
OMEGA	$377,702	$377,902 (5)	$516,480 (6)
ALPHA	$377,414	$377,547 (6)	$521,865 (5)
EPSILON	$377,022	$377,155 (7)	$512,964 (7)

When we considered both income stream and residual timber asset value, alternative Zeta ranked highest under all three sets of price assumptions, and Epsilon consistently ranked lowest. However, higher stumpage prices caused the rankings of the other alternatives to change.

The values in Table IV-E25 (NPV) should probably be given more weight in terms of ranking because the differences between alternatives are quite pronounced. The residual timber asset value was very large under all alternatives, and much larger than NPV. Consequently, when NPV and Asset Value were combined, the differences between alternatives became rather small, causing the rank ordering to lose some of its credibility. What Table IV-E26 does tell us is that our choice may be more complex than to simply dismiss alternatives Zeta and Gamma because of their low net present value rankings, or to dismiss Epsilon simply because of its relatively low total package value of NPV plus residual asset value. Zeta and Gamma would produce substantially lower income streams, but would leave a larger residual timber asset at the end of the planning period; whereas Epsilon would produce a higher income stream at the cost of a smaller residual asset value.

One may notice that our current timber asset value of just under $485 million exceeds many of the "NPV plus Remaining Asset Value" figures in Table IV-E26. A strict interpretation of this relationship is that, under the lower price assumptions, we would be better off to simply sell all our timber now and invest the money elsewhere. Real timber price trends would have to move upward at a rate of about 2.3 percent per year in order for managing the timber and implementing the other features of each alternative to be clearly the best option.

However, there are additional factors to consider. First, there is some question as to whether there would be buyers for our entire existing inventory of roughly 2.5 billion board feet if it were offered in a short space of time, without substantially depressing stumpage prices. That would depend on market conditions, milling capacities, and the behavior of other major timber sellers.

Second, harvesting at the intensity necessary to sell our inventory in a short space of time would almost certainly cause unacceptable environmental impacts. In 1993, our Area Managers estimated the maximum annual timber harvest we could offer while still meeting at least minimum acceptable levels of environmental protection. Their highest estimate was roughly 50 million board feet per year. Even tripling this estimate to make generous allowance for possible conservative bias, it would take seventeen years to harvest our entire standing timber asset. At 50 million board feet per year, it would take fifty years.

Finally, some people would argue that a tangible, productive asset such as living timber offers a safer long term basis for supporting public schools than an intangible investment in the financial market.

Regional Economic Effects

According to the estimates in Table IV-E23, the largest share of total Montana income we would expect to generate under any alternative would be somewhat less than three-fourths of one cent out of every dollar of total income. The highest level of employment we would expect to support would represent roughly twenty seconds of each hour of full time employment, statewide.

Table IV-E27 is a ranking of the alternatives by average annual share of total statewide income that would be generated by DNRC activities under that management strategy. While the largest share (Epsilon) exceeds the smallest share (Gamma) by a factor of more than 5 times, they are all substantially less than one percent. The rank order is the same when done on the basis of share of total jobs supported.

Table IV-E27
ALTERNATIVES RANKED BY AVERAGE CONTRIBUTION TO TOTAL MONTANA INCOME

Alternative	Contribution
EPSILON	.57
OMEGA	.51
DELTA	.40
ALPHA	.39
BETA	.33
ZETA	.22
GAMMA	.11

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The selected alternative will serve as a programmatic plan, providing policies and guidelines for managing state-owned forest lands. This plan does not address site-specific issues nor does it make specific land use allocations. No decisions regarding actual land use allocations or individual projects are being made as a result of this document. Therefore, the irreversible and irretrievable commitments of resources associated with selection of an alternative are part of a broad, general framework. The commitments will be evaluated more specifically in project-level analysis as the selected alternative is implemented.

The alternatives considered in this plan were designed with maintenance of future management options as an important consideration. Some alternatives provide for more short-term uses that foreclose future options. For example, most road construction is considered an irreversible action because of the long time needed for a road to revert to its natural condition. Lesser commitments are associated with high-use developed recreation sites, building sites, and major skid trails and landings for timber harvest. Some alternatives will mean a greater commitment of soil resources to roads (Epsilon, Alpha, Delta and Omega) or to developed recreation sites (Zeta) than others.

Roads also require the irreversible commitment of rock and gravel, which in most cases are extracted from state land, in their construction. Again, the higher the road density projected for an alternative, the greater the commitment of this resource.

Irretrievable resource commitments would result from localized changes in native vegetation and wildlife habitat from noxious weed control activities (MTDA-EIS 1992). Such changes could take place under all alternatives.

RELATIONSHIP BETWEEN SHORT-TERM USE AND LONG-TERM PRODUCTIVITY

DEFINITION

Short-term use usually refers to uses that occur annually, such as livestock grazing, recreational activities, or timber harvest. Long-term productivity refers to the capability of the land to provide resources; that is, to produce, for example, forage, timber, and high quality water. Soil and water are the primary factors of long-term productivity. Relationships between other resource management objectives and the soil and water resources represent the relationship between short-term uses and long-term productivity.[24]

HOW THE PLAN BALANCES LONG-TERM PRODUCTIVITY WITH SHORT-TERM USE

All alternatives protect the long-term productivity of soil and water resources while providing for short-term uses. The differences among the alternatives are differences in short-term use emphasis and intensity. Zeta, for example, emphasizes recreational short-term uses while Epsilon emphasizes timber production. Soil and water impacts will be greater under some alternatives than others, but the Resource Management Standards that have been developed for all alternatives provide specific direction to ensure that these resources are protected for long-term productivity. Appendix RMS contains these Resource Management Standards in their entirety and a summary of the RMS can be found in the Executive Summary and Chapter II.

Timber production also requires that DNRC balance short-term use with long-term productivity. Under all alternatives, the long-term productivity of the forest will be protected while continually providing short-term outputs of timber products.

Although long-term productivity is protected under all alternatives, some place more emphasis on short-term uses of resources, which means they may have a greater short-term adverse impact on the environment.

Short-term adverse impacts associated with higher timber harvest levels would include increased sediment and nutrient loading, more roads and skid trails, and impacts on wildlife habitat. On the other hand, the low harvest levels of Zeta and Gamma could increase the risk of insect and disease outbreaks and catastrophic wildfire.

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[24] Definitions taken from USDA Forest Service Flathead National Forest Plan Draft Environmental Impact Statement, 1983.

CHAPTER V

PROPOSED CATEGORICAL EXCLUSIONS

DEFINITION AND CATEGORIES OF CATEGORICAL EXCLUSIONS

Categorical exclusions are types, or categories, of actions that normally do not have the potential to cause significant environmental effects. Unless the Department determines otherwise, these actions will not require an Environmental Assessment (EA) or an Environmental Impact Statement (EIS).

The following categories of excludable actions have already been created by Department rules implementing the Montana Environmental Policy Act (MEPA), 75-1, MCA.

A) Emergency Situations

1) The agency may take or permit action having a significant impact on the quality of the human environment in an emergency situation without preparing an EIS. Within 30 days following initiation of the action, the agency shall notify the Governor and the EQC as to the need for the action and the impacts and results of it. Emergency actions must be limited to those actions immediately necessary to control the impacts of the emergency (ARM 26.2.659).

2) "Emergency actions" include, but are not limited to (ARM 26.2.642):

a) Projects undertaken, carried out, or approved by the agency to repair or restore property or facilities damaged or destroyed as a result of a disaster when a disaster has been declared by the governor or other appropriate government entity.

b) Emergency repairs to public service facilities necessary to maintain service.

c) Projects, whether public or private, undertaken to prevent or mitigate immediate threats to public health, safety, welfare, or the environment.

B) Other Categories defined by rule (ARM 26.2.643):

In addition, Department rules implementing MEPA provide that the agency is not required to prepare an EA or EIS for the following categories of action:

1) Actions that qualify for a categorical exclusion as defined by rule or justified by a programmatic review. In the rule or programmatic review, the agency shall identify any extraordinary circumstances in which a normally excluded action requires an EA or EIS.

2) Administrative actions: routine, clerical or similar functions of a department, including but not limited to administrative procurement, contracts for consulting services, and personnel actions.

3) Minor repairs, operations, or maintenance of existing equipment or facilities.

4) Investigation and enforcement: data collection, inspection of facilities or enforcement of environmental standards.

5) Ministerial actions: actions in which the agency exercises no discretion, but rather acts upon a given state of facts in a prescribed manner.

6) Actions that are primarily social or economic in nature and that do not otherwise affect the human environment.

EXTRAORDINARY CIRCUMSTANCES

Any additional categorical exclusions, other than those previously defined by Rule, would apply only when there were no extraordinary circumstances. Extraordinary circumstances are situations that may create a potential for significant impacts and include, but are not limited to, activities affecting one or more of the following:

1) Steep slopes or highly erodible soils.

2) Federally listed threatened and endangered species or their critical habitat as designated by the U.S. Fish and Wildlife Service. Critical habitat is defined in the Endangered Species Act (Section 3[5]) as areas that are essential to the conservation of the species. As yet, there are no critical habitats designated in Montana.

3) One hundred year recurrence flood plains, wetlands, riparian areas, SMZs, municipal watersheds, or stream or lake beds; except for modification or replacement of bridges and culverts and crossings of Class 3 stream segments where specifically identified elsewhere in these categorical exclusions.

4) State natural areas.

5) Native American religious or cultural sites, archaeological sites, or historic properties or areas.

6) Species listed as "sensitive" by Region 1 of the USFS.

7) Several related projects that individually may be subject to categorical exclusion but that may occur at the same time or in the same geographic area. Such related actions are subject to environmental review even if they are not individually subject to review. For example, several small, categorically excluded timber sales could not be substituted for one or more larger projects designed to meet timber harvest objectives.

8) Violations of any applicable state or federal laws or regulations, or deviations from State Forest Land Management Plan Resource Management Standards.

Some of the proposed new categorical exclusions include additional extraordinary circumstances that would apply to that exclusion in particular.

METHODOLOGY

We propose to categorically exclude certain additional activities from MEPA documentation because we expect that, in the absence of any extraordinary circumstances such as those listed above or in individual proposed exclusions, the environmental effects of those actions would be very minor. Consequently, our assessment of their probable effects focuses mainly on what these actions would not do. It also recognizes ties, where they exist, with the issues raised in Chapter I.

The environment that would be affected by actions that are categorically excluded is described in Chapter III. When we speak of potential environmental impacts in the following discussion, we assume that any resulting changes would be changes from the baseline conditions described in Chapter III.

In the following pages, we will state each proposed new categorical exclusion, then present our reasons for thinking that actions in the category described would not have significant environmental impacts. When appropriate, our discussion will pay particular attention to:

1) The following items listed in ARM 26.2.645(3)(d):

   Terrestrial and aquatic life and habitats
   Water quality, quantity, and distribution
   Geology
   Soil quality, stability, and moisture
   Vegetation cover, quantity and quality
   Aesthetics
   Air quality
   Unique, endangered, fragile, or limited resources
   Historical and archaeological sites
   Demands on land, water, air and energy

2) The following items listed in ARM 26.2.645(3)(e):

   Social structures and mores
   Cultural uniqueness and diversity
   Access to and quality of recreational and wilderness activities
   Local and state tax base and tax revenues
   Agricultural or industrial production
   Human health
   Quantity and distribution of employment
   Distribution and density of population and housing
   Demands for government services
   Industrial and commercial activity
   Locally adopted environmental plans and goals
   Other appropriate social and economic circumstances

3) The issues listed in Chapter I as areas of public concern regarding management of forested state lands.

PROPOSED NEW CATEGORIES

By process of this programmatic review, pursuant to ARM 26.2.643(5)(a), the Department of Natural Resources and Conservation, Trust Land Management Division, is authorized to adopt the following additional categorical exclusions for activities conducted on state forest lands. "Categorical Exclusion" refers to a type of action that does not individually, collectively, or cumulatively require an EA or EIS unless extraordinary circumstances occur (ARM 26.2.642(5)). This programmatic review will list types of actions that qualify for categorical exclusion and will define extraordinary circumstances when the categorical exclusion will not apply. Extraordinary circumstances include the general extraordinary circumstances listed above in addition to those described in the individual categorical exclusions. The categorical exclusions include activities on state forest lands conducted by others under authority from the Department as well as activities conducted by the Department itself.

1) TEMPORARY USES WITH NEGLIGIBLE EFFECTS

Definition: Minor temporary uses of land involving negligible or no disturbance of soil or vegetation and having no long-term effect on the environment, provided that federally listed Threatened and Endangered species are not likely to be present in the immediate area during the time of use. Examples include but are not limited to:

a) Approving the use of land for a one-time group event.

b) Approving the intermittent use by a state-licensed outfitter, or other guided service, that does not include over-night camping.

Impacts: This category of actions would have no potential for significant impacts.

This categorical exclusion could increase recreational opportunities by making it easier for some temporary activities to be permitted. Fees would be assessed for permits or licenses issued for these activities, returning revenue to the trust. Multiple use of state lands would be enhanced, and local tourism and recreation industries could be benefitted.

2) PLANS AND POLICIES

Definition: Plans or modifications of plans adopted or approved by the Department that would not essentially pre-determine future individual department actions affecting the physical or biological environment. Examples include but are not limited to:

a) Preparing annual listings of proposed timber harvests to be investigated for sale feasibility.

b) Surveying or listing of resource opportunities to be evaluated or investigated for potential development.

c) Area planning that does not commit the Department to site-specific land use allocations.

Impacts: Planning is necessary to direct the Department's efforts in developing proposed projects, but does not commit the Department to any particular project. Therefore, developing and modifying plans and policies are actions that, by themselves, do not have environmental impacts. Impacts may come when the plans or policies are implemented. Site-specific actions taken under plans or policies, unless categorically excluded, would require the preparation of an EA or EIS.

3) LEASES AND LICENSES

Definition: The issuance, renewal, or assignment of a lease or license of land when the uses of the land authorized under the lease or license will remain essentially the same. Examples include but are not limited to:

a) Issuance of a new lease for the same use.

b) Renewal of a lease or license with contract terms that are essentially the same.

c) Assignment of a lease or license under the same terms.

Impacts: Issuance, renewal, or assignment of a lease or license that merely continues authorization for existing uses and involves no change in the status quo other than ownership of the leasehold interest. If any of the terms of a lease or license considered under this categorical exclusion were to change, an EA or EIS could be needed to determine potential changes in impacts.

4) ACQUISITION OF LAND OR INTEREST IN LAND

Definition: Acquisition of fee title, easements, rights-of-way, or other interests in land that does not tend to commit the Department to other actions. Examples include but are not limited to:

a) Accepting donation of land or interests in land.

b) Acquiring right-of-way easements or permits for existing roads.

Impacts: The act of acquiring land or an interest in land would be unlikely to affect the environment and so would not need an environmental review. Impacts may occur when the land is put to some use. When a use is proposed for the land, an EA or EIS may need to be prepared to determine the potential impacts of the proposed use.

5) ROAD MAINTENANCE AND REPAIR

Definition: Maintenance and repair of existing roads that are open to motorized use by the public, unless the road has become impassable to highway vehicles. Examples include but are not limited to:

a) Blading, reshaping, or resurfacing the road surface to its original condition.

b) Cleaning culverts.

c) Clearing the roadside of brush without use of herbicides.

Impacts: The activities included in this categorical exclusion would disturb land that has been disturbed before. These activities would improve the usefulness of existing roads and reduce the overall impact of that use on the environment.

Public access to state forest land and the opportunity for motorized recreation could be enhanced by keeping existing roads in good condition. The quality of primitive recreation could decrease if many roads are kept open and maintained.

Coordinating road maintenance with adjacent landowners could reduce costs for both the Department and the adjacent landowners. Excluding these kinds of maintenance activities from site-specific environmental review would streamline coordination.

Maintained roads that are open to motorized use could reduce security for game animals and fragment the habitats of many terrestrial wildlife species, making the habitat less useful to the animals. On the other hand, properly maintaining roads and not allowing them to deteriorate could prevent damage to nearby aquatic habitats and protect water quality by reducing erosion and sedimentation.

Weeds are easily spread by motorized vehicles using open roads, as well as by other means. Roads also provide access for weed control activities.

6) BRIDGES AND CULVERTS

Definition: Reconstruction or modification of an existing bridge on essentially the same alignment, or replacement of a culvert, including temporary diversion or channelization of the stream, if done in accordance with all applicable state and federal laws and regulations and with best management practices to minimize sedimentation.

Impacts: The activities included in this categorical exclusion would disturb land and streambeds that have been disturbed before. These activities would improve the usefulness of existing roads and bridges and reduce the overall impact of their use on the environment.

Public access to state forest land and the opportunity for motorized recreation could be enhanced by keeping bridges safe and in good condition. The quality of primitive recreation could decrease if many roads are kept open by having bridges and culverts in serviceable condition.

Maintained bridges can keep roads open to motorized use which could, in turn, reduce security for game animals and fragment the habitats of many terrestrial wildlife species. On the other hand, properly maintaining bridges and culverts and not allowing them to deteriorate, or become plugged, could prevent damage to aquatic habitats and protect water quality by reducing erosion and sedimentation.

7) CROSSING CLASS 3 STREAMS

Definition: Crossings of "class 3 stream segments" by means of culvert, bridge, ford, or other means, in accordance with best management practices. "Class 3 stream segment" means a portion of a stream that does not support fish; normally has surface flow less than six months of the year; and rarely contributes surface flow to another stream, lake, or other body of water (ARM 26.6.601).

Impacts: Impacts are likely to be minimal when crossings of a class 3 stream are constructed or used when the stream is dry. Since class 3 streams do not contain fish and do not feed other bodies of water, fish habitat would not be damaged, any soil erosion would be contained, and sedimentation of other water bodies would not occur.

8) TEMPORARY ROAD USE PERMITS

Definition: Issuing permits for temporary use of existing roads designated as open to motorized public use.

Impacts: Temporary road use permits would be issued at infrequent intervals for short time periods. At most, there could be minimal disturbance of land that has been disturbed before.

Temporary road use permits are issued primarily to allow use of an existing road for a particular purpose, such as hauling logs across state land from adjacent private or federal land. Such permits could improve coordination of activities with adjacent landowners. Since the roads are open to motorized public use, these permits would not affect existing public access.

9) ROAD CLOSURE

Definition: The closure of existing roads including installation of gates, berms, debris, or other facilities necessary to close existing roads to motorized public use.

Impacts: Road closures would cause minimal disturbance of land that has been disturbed before.

Road closures would restrict motorized public access to state lands and possibly to lands of other ownership. Members of the public who enjoy motorized recreation would experience a decline in the quality of recreation on state land. People who prefer more primitive forms of recreation could find the quality of their experience improved.

Road maintenance costs would be reduced. Road closure devices are often vandalized, so money saved on road maintenance could be needed to maintain road closures.

Security for game animals would improve somewhat since they would likely encounter fewer people. Habitat quality could improve if closed roads were allowed to revegetate.

10) BOUNDARIES

Definition: Surveying, posting, and painting landline boundaries.

Impacts: Posting landlines, especially when they are boundaries between state land and other ownerships, would allow recreationists and adjacent landowners to know the location of state land tracts, reducing trespass problems.

A few trees could be removed in some cases to permit surveyors to sight along landlines.

Boundary signs and paint markings could have a slight negative effect on aesthetics.

11) MATERIAL STOCKPILES

Definition: Removal of materials that have been stockpiled from previous excavation.

Impacts: Removing stockpiled material involves land that has already been disturbed, often after prior environmental review. Impacts would likely be minimal, or nonexistent, provided appropriate best management practices are used.

12) BACKFILLING

Definition: Filling of earth into previously excavated land with material compatible with the natural features of the site.

Impacts: Backfilling involves repairing previously disturbed land. Any impacts would likely be beneficial, provided appropriate best management practices are used.

13) GATHERING FOREST PRODUCTS FOR PERSONAL USE

Definition: Gathering small quantities of forest products for personal use, such as firewood, Christmas trees, or posts.

Impacts: Permitting the gathering of forest products would provide public access and trust income. These activities are often considered to be recreational as well.

Gathering firewood could reduce the number of snags and large fallen logs that are important habitat features for some wildlife species and components of some ecosystems. These impacts would probably be limited to areas near open roads.

14) REGENERATION

Definition: Regeneration of an area to native tree species, through planting or other means, including site preparation that does not involve the use of herbicides or result in conversion of the vegetation type.

Impacts: Past department experience has shown that these timber regeneration activities are normally of short duration and are applied to areas of small size. Disturbance to the land and other resources would be minimal.

Some wildlife species could benefit from regeneration of timber stands to provide thermal and security cover.

Timber regeneration could help to provide a more stable, long-term timber supply and aid in sustained-yield timber management.

Ecosystem integrity could be improved, for example, by planting native tree species that have declined or been lost locally because of disease, past management practices, or normal ecological processes.

15) NURSERY OPERATIONS

Definition: Seed procurement, growing, lifting, and distributing nursery stock, and associated non-chemical disease and pest control. The use of pesticides is covered elsewhere in this section.

Impacts: Most of the activities in this category would occur in artificial nursery situations and would not be likely to impact the natural environment. Collection of seed from forested areas would be unlikely to be heavy enough to deplete local species gene pools.

16) WATER WELLS

Definition: Drilling of water wells for domestic use and for irrigation of lawns and gardens for existing cabinsites or home sites.

Impacts: Drilling water wells under these conditions could result in minor redisturbance of land that has been disturbed before. A water right permit from the Department of Natural Resources and Conservation would be needed before drilling could proceed if the well's capacity would exceed 100 gallons per minute.

17) HERBICIDES AND PESTICIDES

Definition: Herbicide or pesticide treatments, done in accordance with registered label instructions and uses, for control of pests or nuisance vegetation, using spot applications on less than 160 acres within a 640-acre section, during a calendar year.

Impacts: Herbicide or pesticide use would be limited in extent and duration and would be performed according to established safety and application standards, so impacts would be minimal.

Weed management could be enhanced by allowing quick and early treatment of new weed infestations before they become serious problems. Extensive and intensive treatment of larger weed infestations could still require the preparation of an EA or EIS.

18) OTHER HAZARDOUS MATERIALS

Definition: The handling of hazardous materials for fire suppression or other purposes (e.g., fuel for a helicopter seeding project) when done according to specifications of the U. S. Department of Transportation, state and federal regulations, and label specifications.

Impacts: Use of hazardous materials would be limited in extent and duration and would be performed according to established safety and use standards. Impacts would be minimal or nonexistent.

19) FENCES

Definition: Fence construction to improve livestock distribution (which may include cutting minor amounts of live timber), if the fence is no more than 42 inches high and the bottom wire is at least 16 inches from the ground.

Impacts: Grazing would benefit from better distribution of livestock on the range and better use of forage. Localized overgrazing damage could be reduced or prevented. Riparian areas could be protected from livestock use.

Wildlife could benefit in that concentrations of livestock would be reduced along with the habitat damage that such concentrations sometimes cause. Fences with these specifications would allow most big game animals to pass over or under and would present a minor obstacle to movements. Occasionally, a young or enfeebled animal could tangle in the wire and be injured or killed.

20) WATERLINES

Definition: Installation of water pipelines to improve livestock distribution or otherwise benefit grazing allotments.

Impacts: Grazing would benefit from better distribution of livestock on the range and better use of forage. Localized overgrazing damage could be reduced or prevented. Riparian areas could be protected from livestock use.

Wildlife could benefit in that concentrations of livestock would be reduced along with the habitat damage that such concentrations sometimes cause.

21) REMOVAL OF SMALL TREES

Definition: Mechanical removal of trees less than two feet tall that are encroaching on range or non-commercial forest lands, on up to 60 contiguous acres, not to exceed a total of 160 acres within a 640-acre section, during a calendar year.

Impacts: Removal of small trees encroaching on rangeland would improve forage availability by reducing competition. More forage could result in better livestock distribution, less range damage, and increased trust revenue.

Wildlife could benefit from improved forage availability and reduced competition with livestock. Species that rely on grasslands would have their habitat improved. Species that prefer forest edges could lose small amounts of habitat locally.

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Allaman's MT Adventure Trips
Alliance for the Wild Rockies
American Fisheries Society
American Public Land Exchange
American Timber Company
American Wilderness Alliance
American Wildlands
Anaconda Leader
ASARCO Incorporated
Associated Press
Audubon Missouri Bridge
Audubon Society
Back Country Horsemen of Cabinet
Back Country Horsemen of Eureka
Back Country Horsemen -- Last Chance
Back Country Horsemen of Missoula
Back Country Horsemen of Montana
Back Country Horsemen --C. M. Russell
Beaverhead Action Group
Beaverhead County Commissioners
Beaverhead People for the West
Berg Lumber Company
Bigfork Eagle
Bigfork Volunteer Fire Department
Big Sky Upland Bird Association
Billings Gazette
Billings Rod & Gun Club
Bitterroot Audubon
Bitterroot Star
Bitterroot Stock Farm
Blue Ribbon Coalition
Bob Marshall Alliance
Bozeman Daily Chronicle
Brand "S" Corporation
Broken Ass Logging
Cabinet Resource Group
Camp Creek Inn
Canyon Coalition
Carter County Commissioners
Cascade Timber Inc.
Carson County S.D. Board of Commissioners
Champion International Corp.
Citizens for a Better Flathead
Citizens for Awareness of Resources and Environment
City of Whitefish
Clark Fork Coalition
Clinton School Board
Communities for a Great Northwest
Confederated Salish & Kootenai Tribes
Concerned Citizens of Pony
Concerned Citizens of Superior R. D.
Concerned Citizens for Cottonwood
Corvallis Public Schools
County Weed Boards, Montana State Department of Agriculture
Crown Pacific
The Daily Inter Lake
Darby Lumber, Inc.
Darby Public Schools
DAW Forest Products Co., L.P.
Deer Lodge Schools
Defenders of Wildlife
The Denver Post
Eastern Sanders County Sportsmen's Club
Ecology Center
Five Valleys Audubon
Flathead Audubon
Flathead Basin Commission
Flathead Forest Watch
Flathead Wildlife Inc.
Friends of the Bitterroot
Friends of the Wild Swan
Gallatin Wildlife Association
Glacier Two Medicine Alliance
Gold Creek Resource Protection Association
Grassroots for Multiple Use
Great Bear Foundation
Greater Yellowstone Coalition
Great Falls Cross Country Club
Great Falls Tribune
Hagenbarth Livestock
Dwight Harrison Ranch Co.
The Havre Daily News
Helena Forest Conservation Coalition
Helena Independent Record
Hellgate Mineral Society
Hill County Commissioners
Holt Repair
Hungry Horse News
Husted Ranch
Institute for Tourism and Recreation Research
Intermountain Forest Industry Association
Kalispell Area Chamber of Commerce
Keep It Wild
KVGO
Lee State Bureau
Lewis & Clark County Conservation District
Lewistown News-Argus
Libby Rod & Gun Club
Livingston Enterprise
LOE Ranch
Lone Mountain Production Co.
Louisiana Pacific Co.
Lubrecht Experimental Forest
Magic City Fly Fishers
Marchesseault Ranches
Jim McGill Logging
Medicine River Canoe Club
Miles City Star
Mineral County Extension Service
Missoula City Council
Missoula Independent
The Missoulian
Montana 4x4 Association
Montana Association of Conservation Districts
Montana Association of Counties
Montana Association of Land Surveyors
Montana Audubon Council
Montana Coalition for Appropriate Management of State Lands
Montana Conservation Districts Bureau
Montana Department of Agriculture

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Montana Department of Commerce
Montana Department of Environmental Quality
Montana Department of Fish, Wildlife and Parks
Montana Department of Health and Environmental Services
Montana Department of Natural Resources and Conservation
Montana Eastside Forest Practices Committee
Montana Ecosystems Defense Council
Montana Environmental Information Center
Montana Environmental Quality Council
Montana Farm Bureau
Montana Fiscal Forums
Montana Forest Owners Association
Montana Forest Products
Montana Historical Society
Montana House of Representatives
Montana Logging Association
Montana Native Plant Society
Montana Natural Heritage Program
Montanans for Multiple Use
Montana Office of Public Instruction
Montana Outfitters and Guides Association
Montana Pacific Corporation
Montana Snowmobile Association
Montana Society of American Foresters
Montana Standard
Montana State Board of Outfitters
Montana State Leaseholders Association
Montana State Senate
Montana State Senate
Montana State University Lincoln County Extension Service
Montana Stockgrowers Association
Montana Trail Vehicle Riders Association
Montana Water Quality Bureau
Montana Weed Control Association
Montana Wilderness Asssociation
Montana Wildlands Coalition
Montana Wildlife Federation
Montana Wood Products Association
Montanans for Multiple Use
National Wildlife Federation
Native Forest Council
Natural Resources Conservation Service
Nature Conservancy
Northern Plains Resource Council
North Fork Improvement Association
North Fork Preservation Association
Noxon Rod & Gun Club
Over Snow Access
Owens & Hurst Lumber Co.
Peaks & Pines
People for Elk
People for the West
Phelps Dodge Mining Co.
Pikuni Traditionalists Assoc.
Pintlar Audubon Society
PLAAI
Plum Creek Timber Co.
Ponderosa Snow Warriors
Prairie County Extension Service
Protect Glacier Canyon Coalition
Pyramid Mountain Lumber Inc.
Ravalli County Fish & Wildlife Association
Ravalli County Schools
Ravalli Republic
Resources Limited
Rock Creek Advisory Council
Russell County Sportmans Association
R-Y Timber Inc.
Safari Club Intl.
Seeley Lake Public School District
Seven-Up Pete Joint Venture
Shea Ranch, Inc.
Sieben Ranch Co.
Sierra Club of Montana
Skyline Sportsmen's Association
Southeastern Montana Sportsman's Association
Spokane Spokesman-Review
State Bank of Terry
Stimson Lumber Co.
Stoltze-Conner Lumber
F. H. Stoltze Land & Lumber Co.
Stone Container Corp.
Swan Citizens' ad hoc Committee
Swan View Coalition
Target Range Public Schools
Teton County Board of Commissioners
Thompson Falls Land Alliance
Thompson River Lumber Co.
Townsend Star
Travel Montana
Tricon Timber, Inc.
Trout Unlimited--Montana Council
United 4-Wheel Drive Association
University of Montana Dept. of Economics
University of Montana Div. Of Biological Sciences
University of Montana Environmental Studies Department
University of Montana School of Forestry
Upper Missouri Breaks Audubon Chapter
USDA Cooperative Extension Service
USDA Forest Service
USDA Soil Conservation Service
USDI Bureau of Indian Affairs
USDI Bureau of Land Management
US EPA, Montana Office
US Fish and Wildlife Service
Weed and Rodent Board, Lincoln City
Weed Board, Madison County
Weed Control Board, Anaconda-Deer Lodge County
Weed Control District, Broadwater County
Weed Control District, Cascade County
Weed Control District, Carbon County

Weed Control District, Hill County
Weed Control District, Lake County
Weed Control District, Missoula County
Weed Control District, Richland County
Weed Control District, Roosevelt County
Weed Program, Meagher County
Weed Program, Silver Bow County
Western Environmental Trade Association
Western Montana College
Western Montana Wildlife Conservation Association
Weyerhauser
Whitefish County Water & Sewer District
Whitefish Planning Board
W-I Forest Products, L.P.
Wilderness Society
Wild Horizons Expeditions
Wildlands Resource Association
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ACRONYMS

ARM	Administrative Rules Manual
AUM	Animal Unit Month
BMP	Best Management Practices
CLO	Central Land Office, DNRC
COE	U.S. Army Corps of Engineers
DEIS	Draft Environmental Impact Statement
DNRC	Department of Natural Resources & Conservation
DOD	Dissolved Oxygen Deficit
DOE	U.S. Department of Energy
DSL	Montana Department of State Lands
EA	Environmental Assessment
EIS	Environmental Impact Statement
ELO	Eastern Land Office, DNRC
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FTE	Full Time Equivalent
HB 201	House Bill 201, "An Act Requiring that Annual Sustained Yield Be Used as a Factor in the Management of State Forested Trust Lands." MCA 77-5-221-223, 1995
HB 263	House Bill 263 - "An Act Clarifying the Trust Responsibilities of the Board of Land Commissioners; and Amending Section 77-1-202, MCA." 1995
HB 395	House Bill 395 - Amendment to Noxious Weed Control Act (7-22-2101--2103 MCA)
ICC	Interstate Commerce Commission
IGBC	Inter-Agency Grizzly Bear Committee
MCA	Montana Codes Annotated
MDEQ	Montana Department of Environmental Quality
MDFWP	Montana Department of Fish, Wildlife and Parks
MDHES	Montana Department of Health and Environmental Services
MDT	Montana Department of Transportation
MEPA	Montana Environmental Policy Act
MHNP	Montana Natural Heritage Program
MBF	Thousand Board Feet
MMBF	Million Board Feet
MRWA	Montana Riparian/Wetland Association
MWPCA	Montana Water Pollution Control Act
NAAQS	National Ambient Air Quality Standards
NCDE	Northern Continental Divide Ecosystem
NELO	Northeastern Land Office, DNRC
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NPS	National Park Service
NPV	Net Present Value
NRCS	Natural Resource Conservation Service
NWLO	Northwestern Land Office, DNRC
OSHA	Occupational Safety and Health Agency
PCTC	Plum Creek Timber Company
PLAN	State Forest Land Management Plan
PM_{10}	Regional Exceedances of Particulate Matter Less Than 10 microns in Diameter
RMS	Resource Management Standards
ROI	Return on Investment
RUL	Recreational Use License
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SLO	Southern Land Office, DNRC
SMZ	Streamside Management Zone
SOSC	Species of Special Concern
SWLO	Southwestern Land Office, DNRC
T&E	Threatened and Endangered Species
TSS	Total Suspended Solids
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USFS	United States Forest Service
USFWS	United State Fish and Wildlife Service

GLOSSARY

Animal Unit Month (AUM): The number of animals times the number of months they graze. An "animal unit" is a cow with calf; other animals count as different numbers of animal units; e.g. five sheep with lambs count as an animal unit. Number of AUMs is stipulated in grazing leases.

Best Management Practices (BMP): Voluntary guidelines prescribed as minimum water quality protection standards for forestry operations. BMPs, if properly designed and applied, can limit non-point source pollution.

Biodiversity or Biological diversity: The variety of life and its processes. It includes the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur. (From Keystone Center 1991)

Borrow source: A place where gravel or sand have been dug out ("borrowed") to fill in another spot, such as support for a bridge.

Cable harvest: A method of transporting logs from stumps to collection points which utilizes a cable system as the main device for moving them. (Schwarz et al. 1976.)

Categorical exclusions: Kinds or categories of actions that normally do not have the potential to cause significant environmental effects. Unless the Department determines otherwise, these actions will not require an EA or an Environmental Impact Statement.

Clearcutting: A method of regenerating an even-aged stand in which a new age class develops after removal, in a single cutting, of all trees in the previous stand. In "clearcutting with reserves", varying numbers of reserve trees are not harvested to attain goals other than regeneration. (After Silviculture Working Group 1993)

Climax community: That point in the development of a biotic community when the changes that normally occur in ecological succession cease. The main biotic components are not overthrown by new invaders. No new species become dominant in the biotic community. The environmental conditions of the habitat are relatively stabilized. (After Woodbury 1954. In: Schwarz et al. 1976.)

Coarse woody debris, down woody material: Dead woody material such as stems or limbs, generally larger than 3 inches diameter.

Conservation Easement: An easement to assure the permanent preservation of land in its natural state or whatever degree of naturalness the land possesses at the time the easement is granted. (Schwarz et al. 1976)

Cumulative effects or impacts: The impact on the environment that results from the incremental impact on an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such actions. Cumulative effects or impacts can result from individually minor but collectively significant actions taking place over a period of time.

Deferred forest lands: Forest lands on which other land uses, or conditions such as steep slopes, high water tables or inaccessibility, preclude timber harvest.

Drainage basin: The land drained by a river system. See watershed.

Duff: The decaying vegetable matter on the ground in a forest, as leaves, twigs, etc. Duff is important to soil production.

Early-successional species (Seral, or Early-seral, species): A plant species associated primarily with an early stage in the successional development of a biotic community.

Ecological group: As used in this document, a collection of land areas relatively similar in physical environment (as represented by habitat types), typically supporting similar patterns of natural disturbance and stand development, and similar plant communities.

Ecosystem: A complete, interacting system of organisms considered together with their environment, e.g., a marsh, a watershed, a lake, etc. (After Hansen 1962 In: Schwarz et al. 1976.)

Ecotone: A transition zone between two biotic communities. It is a junction zone or tension belt that may have considerable linear extension but is narrower than the adjoining community areas themselves. (Schwarz et al. 1976)

Edaphic: Of or pertaining to soil, especially as it affects living organisms.

Endangered species: A plant or animal species whose prospects of survival and reproduction are in immediate jeopardy. Its peril may result from one or many changes: loss of habitat or change in habitat, overexploitation, predation, competition, disease, or even unknown reasons. An endangered species must have help, or extinction may follow. It must be designated in the Federal Register by the appropriate Secretary as an "endangered species." (Schwarz et al. 1976)

Endangered Species Act (ESA): The Act that required consultation with the Fish and Wildlife Service (Interior) if practices on National Forest System lands may impact a threatened or endangered species (plant or animal). Direction is found in FSM 2670.

Environmental impact statement: A document in which anticipated environmental effects of a planned course or action or development are evaluated. A statute of the Montana Environmental Policy Act (MEPA) requires that such statements be prepared, first in draft and then in a final form. An impact statement includes the following points: (1) the environmental impact of the proposed action, (2) any adverse impacts which cannot be avoided by the action, (3) the alternative courses of action, (4) the relationships between local short-term uses of the environment and the maintenance and enhancement of long-term productivity, (5) a description of the irreversible and irretrievable commitment of resources which would occur if the action were accomplished. (After Schwarz et al. 1976)

Environmental Quality Council (EQC): A 13 member legislative council that coordinates and monitors State policies and activities that affect the quality of the environment.

Equalization fund: A common name for the Public School Equalization Aid Account, which supports public schools in Montana. Annual contributions to the Equalization Fund come, in part, from income taxes, coal severance taxes, mineral royalties, property taxes, lottery revenues, and earnings from trust lands administered by the Department of State Lands.

Even-aged timber management (Even-aged system or cutting method): A planned sequence of treatments designed to maintain and regenerate a stand with one age class. The range of tree ages is usually less than 20 percent of the rotation. (Silviculture Working Group 1993)

Forb: 1. Any herbaceous plant other than those in the Gramineae (true grasses), Cyperaceae (sedges) and Juncaceae (rushes) families--i.e., any nongrass-like plant having little or no woody material on it. (After Amer. Soc. Range Manage. 1964)
2. A palatable, broad-leaved, flowering herb whose stem, above ground, does not become woody and persistent. (Grim and Hill 1974) (Schwarz et al. 1976)

Forest health: A condition for forest ecosystems that sustains their complexity while providing for human needs. In terms of ecological integrity, a healthy forest is one that maintains all of its natural functions. In relation to management objectives, forest health represents a condition which meets current and prospective future management objectives. (After O'Laughlin et al. 1993, Monnig and Byler 1992)

Fuel loading: The amount of flammable organic materials in a forest area; usually measured in tons per acre per diameter class.

Full-time equivalents (FTE): A measure of number of personnel employed. One FTE is equal to one person working a 40 hour week.

Glacial till: Unstratified glacial drift of clay, sand, and gravel, forming poor subsoil impervious to water.

Habitat type: A collection of land areas potentially capable of producing similar plant communities at climax, generally named for the predicted climax community type. (After Pfister et al. 1977)

Hackly: In minerology, having fine, short, and sharp points on the surface, as a hackly fracture.

Herbicide: A substance used to inhibit or destroy plant growth. (Schwarz et al. 1976)

Hydrology: A science dealing with the properties, distribution, and circulation of water, specifically the study of water on the surface of land, in the soil and underlying rocks, and in the atmosphere, with respect to evaporation and precipitation. (After Webster 1963 In: Schwarz et al. 1976)

Integrated pest management: Use of several techniques (for example, burning, grazing, and physical, biological or chemical methods) as one system to control animals or plants where they are unwanted.

Intermediate cutting (Intermediate treatments): A collective term for any treatment designed to enhance growth, quality, vigor, and composition of the stand after establishment of regeneration and prior to final harvest. (Silviculture Working Group 1993)

Intermontane: Among or between mountains.

Landing: A loading point where logs are stacked to be loaded on trucks. Cut trees are skidded from the forest harvest area to the nearest landing for loading.

Large organic debris: Any large piece of woody material that intrudes into a stream channel, whose smallest diameter is greater than 10 cm, and whose length is greater than one meter.

Late-successional species: A plant species associated primarily with a later stage in the successional development of a biotic community.

Leaching: The movement of chemicals through soil by water or the movement of herbicides out of leaves, stems, or roots into the soil or air.

Lop and scatter: Treatment of logging slash by cutting limbs, tree tops, or small trees into shorter lengths and scattering it over the ground, so that it will lie close to the ground and decrease fire hazard.

Multiple Use: Montana policy that decrees the Board of Land Commissioners shall manage state lands so that "they are utilized in that combination best meeting the needs of the people and beneficiaries of the trust. . ." (Montana Code 77-1-203)

Mycorrhizae: A symbiotic association between certain soil fungi (mycorrhizal fungi) and the roots of trees and other green plants. The fungi obtain nutrients such as sugars from the roots of the trees, and improve the ability of the trees to take up nutrients and moisture from the soil. Mycorrhizae functionally improve tree growth by increasing the volume of soil from which nutrients and moisture can be extracted.

NEPA: National Environmental Policy Act of 1969. This is the basic national charter for protection of the environment. It establishes policy, sets goals (Section 101), and provides means (Section 102) for carrying out the policy. (40 CFR 1500.1)

Net present value: Today's dollar equivalent of accumulated future revenues, over the analysis period, less accumulated future costs. For this analysis, we have assumed that a dollar declines in value by 4 percent for each year into the future we must wait for it. That is, we have used a 4 percent discount rate.

"New forestry": An informal term to describe modifications to traditional cutting methods, designed to increase the biological diversity of harvested areas. These practices may include leaving reserve trees, snags, cull trees, or down logs within cutting units.

Non-point pollution source: Pollution without a single, identifiable source, such as that from road construction, cattle grazing, or agricultural practices. (see Point pollution source)

Noxious weed: Plants that conflict with, interfere with, or otherwise restrict land management are commonly referred to as weeds. A plant that has been classified as a weed attains "noxious" status by an act of State legislation.

Old-growth: Forest areas that are in the later stages of stand development. Old-growth forests are generally dominated by relatively large old trees, contain wide variation in tree sizes, exhibit some degree of multi-storied structure, have signs of decadence such as rot and spike-topped trees, and contain standing snags and large down logs. Specific criteria for identifying old-growth vary by environment and forest type.

Patch: A contiguous area of vegetation similar in characteristics of interest, such as tree height and stocking.

Point pollution source: Pollution with a single, identifiable source, such as a sewage pipe or a factory waste system. (see Non-point pollution source)

Prescribed burn: Intentional application of fire to dispose of slash, prepare sites for reforestation, or to reduce fuel loading and the danger of wildfire.

Redd: Nest made in gravel, consisting of a depression hydraulically dug by a fish for egg deposition (and then filled) and associated gravel mounds.

Resource Management Standard (RMS): A specific level of performance that characterizes how various issues and resources will be addressed. In this document, each alternative has its own set of Resource Management Standards consistent with its management philosophy. These standards would guide the management on State forested lands of big game, species of special concern, threatened and endangered species, fisheries, silviculture, biodiversity, watershed, grazing, and roads resources.

Riparian area: Green zones associated with lakes, reservoirs, estuaries, potholes, springs, bogs, fens, wet meadows, and ephemeral, intermittent, or perennial streams. The riparian/wetland zone occurs between the upland or terrestrial zone and the aquatic or deep water zone.

Rotation: The planned interval between establishment and final harvest of an even-aged stand, or of individual trees or groups in an uneven-aged stand.

Salvage cutting: The removal of dead trees or trees being damaged or killed by injurious agents other than competition, to recover value that would otherwise be lost. (Silviculture Working Group 1993)

Scarification: A deliberate, moderate disturbance of soil to remove or mix surface duff with less than 1" of surface mineral soil. Scarification provides bare mineral soils for trees that need it to regenerate. It also promotes oxidation of organic matter and speeds its breakdown into nutrients to enrich soil.

Scoping: An integral part of environmental analysis. Scoping requires examining a proposed action and its possible effects; establishing the depth of the environmental analysis needed; determining analysis procedures, data needed, and task assignments.

Seed tree: A tree purposely left standing at the time of cutting in a forest, for the purpose of producing seed for regeneration of trees in the cut-over area. (Hanson 1962 In: Schwarz et al. 1976)

Seed tree cut: An even-aged regeneration method in which a new age class develops from seedlings after removal of all the previous stand except a small number of trees left to provide seed. Seed trees are removed after regeneration is established, or may be left as reserve trees to attain goals other than regeneration (seed tree with reserves). (After Silviculture Working Group 1993)

Selection cut: A method of creating new age classes in uneven-aged stands, in which individual trees of all size classes are removed more-or-less uniformly throughout the stand (single tree selection), or in small groups with a maximum width twice the height of the mature trees (group selection). (After Silviculture Working Group 1993)

Selective harvest: A non-technical term (not to be confused with "selection cut") that generally encompasses all partial cutting practices, other than clearcutting or seed tree cutting.

Sensitive species: A U.S. Forest Service designation for plant or animal species that are vulnerable to declines in population or habitat capability which could be accelerated by land management activities.

Seral: A biotic community which is a developmental, transitory state in ecologic succession; a pre-climax community. (Schwarz et al. 1976)

Shelterwood: A method of regenerating an even-aged stand in which a new age class develops beneath the partially-shaded environment provided by the residual trees. The sequence of treatments can include three distinct types of cuttings: (1) an optional preparatory harvest to enhance conditions for seed production; (2) an establishment harvest to prepare the seed bed and to create a new age class; and (3) a removal harvest to release established regeneration from competition with the overwood. In "shelterwood with reserves", some or all of the shelter trees are retained, well beyond the normal period of retention, to attain goals other than regeneration. The resulting stand may be two-aged or tend towards an uneven-aged condition. (After Silviculture Working Group 1993)

Silviculture: The art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands. Silviculture entails the manipulation of forest and woodland vegetation in stands and on landscapes to meet the diverse needs and values of landowners and society on a sustainable basis. (Silviculture Working Group 1993)

Site preparation: A hand or mechanized manipulation of a site designed to enhance the success of regeneration. Treatments may include chopping, discing, bedding, raking, burning, and scarifying. All treatments are designed to modify the soil, litter, and vegetation, and to create microclimate conditions conducive to the establishment and growth of desired species. (Silviculture Working Group 1993)

Skidding: A loosely-used term for the transportation of logs from stumps to a collecting point by sliding or dragging along the ground--as opposed to the use of wheels, helicopters, balloons, cables, etc., to keep them totally off the ground. (After Ford-Robertson 1971 In: Schwarz et al. 1976)

Slash: Branches, tops, and other debris from the cutting of trees.

Snag: A dead tree. The term is sometimes used to include live trees with broken tops and heart rot as well.

Spalling: Flaking or chipping of stone.

Species of special concern: A Montana Natural Heritage Program designation for species which may be very rare or locally abundant but occupying a very restricted range. In either case, they are especially vulnerable to extinction.

Stand: A contiguous group of trees sufficiently uniform in age class distribution, composition, and structure, and growing on a site of sufficiently uniform quality, to be a distinguishable unit. (Silviculture Working Group 1993)

Stem exclusion stand: A dense stand, in the "stem exclusion" stage of development, in which all available growing space is occupied by trees. Over time, some trees die from suppression while the remaining trees grow larger. (After Oliver and Larson 1990)

Stocking: An indication of growing-space occupancy relative to a pre-established standard. (Silviculture Working Group 1993)

Streamside Management Zone (SMZ): The zone around a streambank, from 100' to 300' wide, where certain management activities are limited or prohibited to minimize unfavorable impacts on aquatic and riparian environments. The Streamside Management Zone Law (77-5-301 MCA) prohibits certain forest practices along stream channels.

Stumpage: Timber in unprocessed form as it is found in the woods. Normally, it means standing unsevered trees, whether live or dead, but the term can also be applied to timber that is wind-thrown or cut in connection with right-of-way clearing, as long as it is in place and not cut up into logs or other merchantable units. (Davis 1966.)

Succession: An orderly process of biotic community development that involves changes in species, structure, and community processes with time; it is reasonably directional and, therefore, predictable. It results from modification of the physical environment by the community; that is, "succession" is community-controlled even though the physical environment determines the pattern, the rate of change, and often sets limits as to how far development can go. (Schwarz et al. 1976)

Sustained yield: Management of timber resources to provide sustainable, consistent yields of timber and/or other resources.

Taxonomic class: The phyla, species, etc. to which an animal or plant belongs.

Third order watershed: A watershed of approximately 5,000 to 15,000 acres that is a combination of first and second order streams.

Threatened species: Species which are likely to become "endangered species" within the foreseeable future throughout all or a significant portion of their range are designated threatened species in the Federal Register by appropriate Department Secretaries. (Schwarz et al. 1976)

Thinning: A cutting made to reduce stand density of trees primarily to improve growth, enhance forest health, or to recover potential mortality. (Silviculture Working Group 1993)

Timber sale cruising: The procedure of measuring a sample of the number and size of trees in order to obtain an estimate of the amount of timber volume in a timber sale.

Trust mandate: The requirement that State trust lands be managed to provide income for schools.

Uneven-age timber management (Uneven-aged system or cutting method): A planned sequence of treatments designed to maintain and regenerate a stand with three or more age classes. (Silviculture Working Group 1993)

Watershed: The area drained by a river or river system.

Wetlands: Areas that are permanently wet, or intermittently water covered, such as swamps, marshes, bogs, muskegs, potholes, swales, glades, and overflow land of river valleys. Large, open lakes are commonly excluded, but many kinds of ponds, pools, sloughs, holes, and bayous may be included. (Veatch and Humphrys 1966 In: Schwarz et al. 1976)

Windthrow: A tree or trees uprooted by the wind, or the process of trees being uprooted by the wind.

Yarding: The operation of hauling timber from the stump to a collecting point. (Ford-Robertson 1971 In: Schwarz et al. 1976)

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