

Eastside

Chapter 4

Environmental Consequences

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Key Terms

Biophysical Template ~ The successional and disturbance processes in combination with landform, soil, water, and climate conditions that formed the native ecosystem within which plants and animals evolved.

Cumulative Effects ~ Impacts on the environment that result from the impact of an action when added incrementally to other impacts of past, present, and reasonably foreseeable future actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time.

Direct Effects ~ Impacts on the environment that are caused by an action and occur at the same time and place as the action.

Ethno-habitats ~ Places socially and/or traditionally important to American Indians/tribes that are recognized and understood through their native culture, and which also related to familiar components of a landscape(s) where culturally significant life forms are found by participants in a culture - habitat places.

Historical Range of Variability (HRV) ~ The natural fluctuation of components of healthy ecosystems over time. In this EIS, refers to the range of conditions and processes that are likely to have occurred prior to settlement of the project area by Euroamericans (approximately the mid-1800s). Historical range of variability is discussed in this document as a reference point only. It establishes a baseline set of conditions for which sufficient scientific or historical information is available, and enables comparison to current conditions.

Indirect Effects ~ Impacts on the environment that are caused by an action, but occur later than or distant from the action, but are still reasonably foreseeable.

Interest Areas ~ A tribe's area of interest typically includes their reservation, any treaty ceded lands, tribal homelands, and adjacent lands where a tribe has maintained traditional land use interests. A tribe's area of interest usually has no discrete boundaries and may overlap those of neighboring tribes.

Irretrievable Commitments ~ A term that applies to the loss of production, harvest, or use of natural resources. For example, some or all of the timber production from an area is lost irretrievably while an area is serving as a winter sports site. The production lost is irretrievable, but the action is not irreversible. If the use changes, it is possible to resume timber production.

Irreversible Commitments ~ A term that describes the loss of future options. Applies primarily to the effects of use of nonrenewable resources, such as minerals or cultural resources, or to those factors, such as soil productivity that are renewable only over long periods of time.

Landscape Structure ~ The mix and distribution of stands or patch sizes across a given land. Patch sizes, shapes, and distributions are a reflection of the major disturbance regimes operating on the landscape.

Late-seral multi-layer ~ Refers to mature and old multi-layer forest as defined in Key Terms and the Desired Range of Future Conditions in Chapter 3.

Late-seral single-layer ~ Refers to mature and old single-layer forest as defined in Key Terms and the Desired Range of Future Conditions in Chapter 3.

Programmatic EIS ~ An EIS that provides a broad overview when a large-scale plan is being prepared for the management of federally administered lands on a regional or multi-regional basis. A programmatic EIS provides a valuable and necessary analysis of the affected environment and potential cumulative effects of the reasonably foreseeable actions under that program or within that geographical area. Analyses of lesser scope or more site-specificity may be tiered to the analysis in a programmatic EIS.

Terrestrial communities ~ Groups of vegetation cover types with similar moisture and temperature regimes, elevational gradients, structures, and use by vertebrate wildlife species.

Viable Populations ~ Populations that are regarded as having the estimated numbers and distribution of reproducing individuals to ensure its continued existence is well-distributed in the project area.

Introduction

This chapter discloses the environmental consequences of implementing each alternative (described in Chapter 3). It describes direct, indirect, and cumulative effects of Forest Service or BLM management on the existing conditions and affected environment (described in Chapter 2). The environmental consequences displayed here are based on the *Evaluation of EIS Alternatives by the Science Integration Team* (Quigley et al. 1997). The Science Integration Team analyzed effects of the alternatives in both the Eastside and UCRB planning areas, constituting the cumulative effects.

This chapter forms the scientific and analytical basis for the relative comparison of effects presented towards the end of Chapter 3.

How the Chapter is Organized

The subject area categories to be discussed in this chapter include: Physical Aspects of the Ecosystem (Soils, Air Quality); Terrestrial Aspects (Forestlands, Rangelands, Population Viability); Aquatic Aspects (Hydrology, Watershed Processes, and Riparian Areas and Wetlands; Aquatic Species Distribution and Viability); Landscape Health; Human Uses and Values; American Indian Tribes; and Ecological Integrity and Social/Economic Resiliency. The key effects are presented first under each subject area, followed by the assumptions used by the Science Integration Team and the Environmental Impact Statement (EIS) Team in conducting the evaluation of alternatives, the causes of the effects, how the effects were estimated, and the expected effects of the alternatives. The last section in the chapter provides a cost analysis of the alternatives.

The analysis of effects presented for each subject area depended on the scale that the data were collected, the scale at which the Science Integration Team was best able to analyze the data, and/or the scale most appropriate for displaying differences among

alternatives. Consequently, effects are described by one or more of the following:

- ◆ Interior Columbia Basin Ecosystem Management Project Area (project area);
- ◆ Eastside EIS Planning Area;
- ◆ Ecological Reporting Units (ERUs);
- ◆ Forest or Range Clusters;
- ◆ Terrestrial Vegetation Communities;
- ◆ Potential Vegetation Groups (PVGs);
- ◆ Riparian Areas; or
- ◆ Counties

Relationship to the Science Integration Team's Evaluation of Alternatives

The Science Integration Team (SIT) was directed by the Project Charter to assess the tradeoffs, consequences, outcomes, and interactions associated with each alternative, on the basis of best information available. The evaluation followed concepts described in the *Framework for Ecosystem Management in the Interior Columbia Basin and Portions of the Klamath and Great Basins* (Haynes et al. 1996).

The Eastside and Upper Columbia River Basin EIS Team developed the array of alternatives. The EIS Team also developed a set of evaluation criteria based on the Purpose and Need statement, issues, and goals, to help guide the evaluation of alternatives. The EIS Team and the SIT then jointly agreed on a set of indicator variables (quantitative measures of ecologic, economic, and social conditions), many of which were graphed for each alternative. The SIT considered them in the evaluation, and the EIS Team used them to show a relative comparison of how well each alternative met the evaluation criteria. See the Comparison of Alternatives section near the end of Chapter 3

for the graphs and for more information on the evaluation criteria and indicator variables.

The Science Integration Team analyzed the effects and practicality of implementing each alternative management strategy in the *Evaluation of Alternatives*. The SIT's evaluation was based on the alternatives as they were initially developed in February 1996. In an effort to provide greater assurance that some or all of the alternatives met the intent of the Endangered Species Act, Clean Water Act, Clean Air Act, and federal trust responsibilities to tribes; and to address concerns among the Forest Service and BLM's partners (federal, state, and county agencies; tribal governments; and Resource Advisory Councils); some of the objectives and standards were clarified or modified. The Science Integration Team re-examined the outcomes and effects for the revised alternatives, then provided the EIS Team with suggested revisions and input on changes that would likely occur as a result of the revised alternatives. A discussion of this process is contained in the *Evaluation of Alternatives*. Because the alternatives were only clarified and not completely rewritten, the SIT did not fully re-evaluate them (for example, neither the terrestrial species panels nor the social panels were reconvened); however, all material was examined to consider its appropriateness with the revised alternatives.

Outcomes of each alternative were evaluated relative to (a) maintaining and/or restoring forest, rangeland, riparian, and aquatic health and productivity; (b) maintaining economic, social, and cultural systems; and contributing to meeting federal trust responsibilities to American Indian tribes. The *Evaluation of Alternatives* describes the likely outcomes and cumulative effects from the alternatives across the entire project area and was the basis for this chapter. In those few cases where SIT assumptions, models, or simulations did not accurately reflect the intent of the alternatives, the EIS Team further analyzed and disclosed

the effects of the alternatives and provided rationale for deviating from the SIT evaluation. It is this final EIS Team analysis that is presented here and summarized in the Comparison of Alternatives section in Chapter 3. Unless otherwise specified, the tables in this chapter were adapted from the *Evaluation of Alternatives*.

How the Effects of the Alternatives Were Estimated

Source and Nature of Data and Databases

More than 170 Geographic Information System (GIS) data layers were compiled or created in support of the *Scientific Assessment* (Quigley et al. 1996a,b) and EISs. More than 20 databases were created to characterize historical to current conditions and predict possible alternative futures. Appendix 4-1 lists and describes the GIS data layers compiled by theme (generalized categories) and scale or resolution of data, and describes the major databases developed for the Interior Columbia Basin Ecosystem Management Project (ICBEMP).

Current vegetation cover types and structural stages were classified from the Advanced Very High Resolution Radiometer satellite imagery data (1 square kilometer raster, or approximately 250 square acres, data resolution) in consultation with ecologists throughout the project area. Historical vegetation maps were compiled showing major vegetation cover types and structural stages for the mid-1800s. This effort drew from historical journals, photos, early surveys, and knowledge of scientists studying historical vegetation

The *Evaluation of EIS Alternatives* by the Science Integration Team (Quigley et al. 1997) is available from the Pacific Northwest Research Station, P.O. Box 3890, Portland, OR 97208-3890. Publications phone number: (503) 326-7128.

within the project area. Sixth-field Hydrologic Unit Codes (subwatersheds were subsampled using aerial photography to provide finer resolution and validate the satellite classification process. Stream survey data were compiled into a common database. Fish population parameters were drawn from existing databases and from knowledge of fish biologists within the project area. Economic and social information was drawn from existing sources including the U.S. Census, state, county, Forest Service, and BLM records. Information on terrestrial wildlife species was taken from existing literature and knowledge of biologists.

Principal Analytical Techniques

The Science Integration Team and the EIS Team evaluated alternatives on the basis of the data and relationships described in the *Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins* (AEC; Quigley and Arbelbide 1996b). This included published and unpublished research, studies, and reports on ecosystem functions and processes, conservation biology, ecosystem health, and viable populations and social and economic systems. Conclusions regarding future conditions were partly based on computer models that were constructed to simulate historical, current, and projected future conditions of the project area. Inferences were based on available information and model results. The models, like all models of complex biological, physical, or economic systems, necessarily simplify reality. The models, which are limited by current knowledge, represent a synthesis of the knowledge of scientists familiar with the subjects of concern, and provide a way to quantify outcomes of implementing each alternative.

Computer models were used primarily to simulate future conditions in terrestrial and aquatic environments. The model used extensively for projections of landscape conditions, disturbances, terrestrial habitats, and biophysical relationships was the Columbia River Basin Successional Model, or CRBSUM

(Hann et al. 1996). This model simulates vegetation succession and disturbance processes for each potential vegetation type in the Eastside planning area. It assumes that succession proceeds along pathways that are altered by disturbance events, such as fire. While the predictions are expected to be accurate for each potential vegetation type and potential vegetation group, they are not spatially explicit, which means that the exact location of future disturbances cannot be determined.

Panels of scientists were used to help determine likely outcomes to terrestrial and aquatic species habitats and long- and short-term risks to species populations. These outcomes were determined based on anticipated broad-scale habitat changes, which were projected through simulation models, reviews of pertinent literature, and knowledge of ICBEMP scientists and species experts.

A panel of social science experts, drawn from a wide variety of interested people and groups within the project area, addressed potential outcomes from implementing the alternatives related to social variables, cultural significance, and impacts perceived by panel members. The *Evaluation of Alternatives* more fully documents the analysis methods and provides detailed discussions of outcomes, consequences, and interactions.

Incomplete and Unavailable Information

Requirements, Conclusions

The Council on Environmental Quality (CEQ) regulations for implementing procedural provisions of the National Environmental Policy Act (NEPA; 40 CFR 1502.22) require federal agencies to identify relevant information that may be incomplete or unavailable for an evaluation of reasonably foreseeable significant adverse effects in an EIS. If the information is essential to a reasoned choice among alternatives, it must be included or addressed in the EIS.

Knowledge is, and always will be, incomplete regarding many aspects of terrestrial and aquatic species, forestlands, rangelands, the economy, and communities and their interrelationships. The ecology, inventory, and management of ecosystems is a complex and developing discipline. However, central ecologic relationships are well established, and a substantial amount of credible information about ecosystems in the project area is known. The alternatives were evaluated using the best available information.

The data collection effort for this decision is unprecedented and can generally be categorized into five basic groups:

- ◆ Databases (more than 20 were acquired or developed);
- ◆ GIS themes (more than 170 were compiled or created);
- ◆ expert panels/workshops (approximately 40 were convened);
- ◆ contract reports (more than 130 were used); and
- ◆ current literature reviews.

While additional information may add precision to estimates or better specify relationships, new information is unlikely to significantly change the understanding of the relationships that form the basis of the evaluation of effects. Although new information is welcome, no missing information was deemed essential to making a reasoned choice among the alternatives being considered at this scale and at this time.

Scale of Decision

This analysis addressed large, regional-scale trends and/or major changes in: ecological processes; landscape patterns and structures; succession and disturbance regimes; and habitat availability for threatened, endangered, and sensitive plant and animal species and communities. The analysis specifically focused on issues that require integrated management across broad landscapes. The analysis also addressed regional-scale trends and changes in the social and economic needs of people,

cultures, and communities related to ecological trends and changes. The analysis did not identify site-specific effects because such information is not essential to determining broad-scale management direction.

Subsequent Analysis Before Projects

This EIS displays management alternatives and likely outcomes for broad-scale management direction. Before site-specific actions are implemented and an irreversible commitment of resources made, information essential to those fine-scale decisions should be obtained by the local managers. Localized data and information should be used to supplement or refine regional-level data and identify methods and procedures best suited to local conditions in order to achieve the objectives in this EIS. Further analyses may be necessary to deal with site-specific conditions and processes. These subsequent analyses will be used to bridge the gap between broad-scale direction and site-specific decisions. Some of this work, referred to as a step-down process, will be done by ICBEMP staff prior to publication of the Final EISs.

Monitoring and Review

Appendix 3-1 provides frameworks for implementation, monitoring, and adaptive management. Assumptions to which environmental consequences are most sensitive will be given priority for monitoring. Should there be new scientific information or a change in conditions not projected under the selected alternative, there are provisions for changing programmatic management decisions to reflect new information and management practices. This process is part of adaptive management, and is guided by monitoring, research, and interagency oversight. Adaptive management, combined with the NEPA requirement to consider significant new information related to the effects of ongoing actions, reduces the likelihood that a current lack of information will either lead to unacceptable consequences or be considered essential.

For example, precise relationships between the amount and quality of habitat and future species populations are uncertain. There is a certain level of risk inherent in the management of forestlands and rangelands, even based on conservative application of those relationships. If the relationship between habitat and population were significantly different historically from the way it seems currently, the population and long-term viability of affected species would be at greater risk than that estimated in this document.

Cumulative Effects

Cumulative effects, also called cumulative impacts, are those environmental consequences that result from the incremental effects of an activity when added to other past, present, and reasonably foreseeable future actions regardless of which agency or person undertakes them (see 40 CFR 1508.7).

The analysis and disclosure of cumulative effects alert decision-makers and the public to the context within which effects are occurring, and to the environmental implications of the interactions of known and likely management activities. Similarly, programmatic EISs, such as the Eastside DEIS, provide a broad analysis of large areas that encompass many environmental interactions, which would be disclosed as cumulative effects in more site-specific NEPA documents.

The alternatives analyzed in this Draft EIS would establish management direction that allows for many activities on lands administered by the Forest Service or the BLM. Possible cumulative effects that could result from consistent federal actions across the project area would be mitigated through the implementation of Alternatives 3 through 7. During subsequent analyses for site-specific activities, local cumulative effects should be important considerations in the design of site-specific alternatives and mitigation measures.

Cumulative Effects on Federal Lands

In total there are approximately 144 million acres within the Interior Columbia Basin Ecosystem Management Project area, of which approximately 75 million are administered by either the Forest Service or the BLM. Approximately 30 million acres of Forest Service- or BLM-administered lands lie within the Eastside EIS planning area.

The alternatives provide land and resource management direction across lands administered by the Forest Service or BLM within the project area. This consistent management direction of Alternatives 3 through 7 within the Eastside and Upper Columbia River Basin EIS planning areas, combined with subsequent site-specific NEPA analysis and planning, provides a coordinated land and resource management structure that would be more comprehensive than most other efforts. Subsequent analyses will help to assure that the incremental and interactive effects on Forest Service- and BLM-administered lands in the project area would continue to be considered in the implementation of the selected alternative. Adverse cumulative impacts could be further minimized or avoided through subregional coordination among the partners (tribes; federal, state, and local agencies; and Resource Advisory Councils) as the selected alternative is implemented.

In light of the broad geographic scope and spatial resolution, the analysis in this EIS did not address all possible cumulative effects that may result at specific sites. Therefore, ground-disturbing actions will be conducted only after site-specific NEPA analysis, which will also analyze the effects of the activity on adjacent lands and resources. Thus, managers will design, analyze, and choose site-specific activities that minimize cumulative environmental effects which cannot be described at the scale of this EIS.

Cumulative Effects on Non-Federal Land

For the purposes of this analysis, non-federal lands include lands owned and/or managed by individuals, corporations, American Indian tribes, states, counties, or other agencies. The lead agencies in this EIS (the Forest Service and BLM) do not have the authority to regulate any activities or their timing on lands other than those they administer. However, when an action takes place on federal land, it may cause direct, indirect, or cumulative effects on non-federal lands.

The principal anticipated effects on non-federal lands that can be evaluated at the broad scale are changes in non-federal timber harvest patterns and intensities. Other cumulative effects are likely to occur on non-federal lands, such as shifting priorities for habitat and resource protection, and changes in types and intensities of current land uses (including recreation, grazing, and residential development). However, these effects cannot be rigorously evaluated at the broad scale, and moreover, are primarily driven by shifts in demographics, population changes, changes in technology, and other social and economic processes rather than by federal land management policy.

Future timber harvest levels on non-federal lands are expected to be similar under all alternatives, except for Alternative 7 in which it is predicted that non-federal harvest levels would increase by as much as 20 percent in response to a 40 to 60 percent decline in federal harvest levels. Such an increase would probably be short-lived because of the current and likely future age distributions of trees on private lands.

Timber harvest on non-federal lands is controlled by state forest practices acts and a number of state and federal regulations and incentives to protect the productivity and environmental quality of land, water, air, and biological resources. The amount of non-federal forest and rangelands vary, as well as the individual state regulations. In general, there is a smaller proportion of non-federal forest lands within the project area than, for instance, on the west side of the Cascade range.

Due to variations in market conditions, the mix of federal and non-federal forest and rangelands, and differences in state regulations, it is difficult to predict effects on non-federal habitats from decisions in any of the EIS alternatives. These would probably be more noticeable at local levels than at the broad scale.

If, for instance, a high market situation existed, and Alternative 7, which represents a significant reduction in timber harvest, were selected, there could be at least a short-term increase of harvest on non-federal lands that could affect habitat in some places. With so many factors influencing outcomes, however, these kinds of effects are difficult to estimate.

Cumulative Effects from Non-Federal Actions

This Draft EIS also considers the likely effects on federally administered lands from reasonably foreseeable management actions occurring on non-federal land. There are potentially direct impacts from management of non-federal land on terrestrial and aquatic wildlife species that move between federal and non-federal habitats during the year or during their life cycle. The role of management of non-federal lands was considered in the *Evaluation of Alternatives* on those species and ecosystems, and is presented in the Terrestrial Species and Aquatics sections of this chapter.

Localized actions on non-federal lands often affect local environmental conditions on nearby federal land and may also affect federal management decisions. For example, non-federal road construction and harvest in a watershed with both federal and non-federal lands could result in a decision by federal managers to postpone harvest to avoid further watershed degradation. An endemic species whose range and habitat are located on federal and non-federal lands might be forced to rely on the federally managed portion of its range if the non-federal portion were altered to the point of unsuitability. Access to timber on non-federal land may require roads on federal land. Each federal action is subject to site-specific NEPA analysis before it may occur, and cumulative effects of non-federal conditions and actions are

part of such analysis. However, such impacts cannot be accurately identified or mitigated in this EIS given its broad scope.

Cumulative Effects in Subsequent Environmental Analysis

Ground-disturbing activities on federally managed lands are conducted only after site-specific NEPA analysis has been completed. Such analyses are required to describe the cumulative impacts of the site-specific alternatives on adjacent lands and resources, and on the watershed. This provides opportunities to detect and minimize cumulative environmental effects that cannot be specifically determined at the broad level of this EIS.

Other Environmental Consequences

The Council on Environmental Quality (CEQ) regulations require discussion of adverse environmental effects which cannot be avoided should the proposal be implemented, the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources which would be involved in the proposal should it be implemented (40 CFR 1502.16). These topics are addressed, as necessary, as part of the discussion of environmental consequences for each component of the environment.

Assumptions

The assumptions included at the beginning of each of the following sections were derived from the *Evaluation of Alternatives* (Quigley et al. 1997) and from the EIS Team. They represent the major assumptions considered by the EIS Team to be essential to the reader's understanding of how the alternatives were

evaluated. A complete set of assumptions specific to the evaluation by the Science Integration Team is available in the *Evaluation of Alternatives*. In the few instances where relevant inconsistencies or inaccuracies in the SIT's assumptions were found, or where clarifications were needed, they are noted. Assumptions generally refer to Alternatives 3 through 7 unless otherwise noted.

Several assumptions were required by the SIT to analyze the alternatives as they are presented in Chapter 3. These included assumptions and conclusions regarding:

- ◆ Scientific understanding of ecological processes.
- ◆ Anticipated outcomes of prescribed management actions with respect to ecological processes.
- ◆ Interpretation of the intent and implementation of themes, objectives, and standards for each alternative.

General assumptions related to intent and implementation of the alternatives include the following:

- ◆ For Alternatives 1 through 7, it was assumed that nothing was designed or implied that precludes or nullifies existing management agreements, recovery plans, and biological opinions that provide site-specific or species-specific strategies for sensitive endemic species. Likewise, species federally listed as threatened or endangered receive protection through Section 7 requirements in the Endangered Species Act, existing biological opinions, and critical habitat designations, regardless of direction specified in the Draft EIS.
- ◆ For Alternatives 1 through 7, it was assumed that the same alternative would be selected and implemented for both the Eastside and Upper Columbia River Basin planning areas.
- ◆ For Alternatives 1 through 7, the evaluation of effects was based on intent as articulated in alternative descriptions, themes, desired range of future conditions, objectives, activity tables, and rule sets, in conjunction with the required actions specified by the standards.

- ◆ For Alternatives 1 through 7, standards (in Table 3-5) were considered to be required actions that would be implemented as specified, and guidelines (in Appendix 3-2) were considered to be suggested techniques (not required) to achieve objectives.

Where necessary, the EIS Team made additional assumptions to prepare the

Environmental Consequences chapter; these assumptions are described in the following sections. One key EIS Team assumption was that the SIT used the concept of “historical range of variability” as a reference point for comparison of alternatives, even though the historical range of variability does not in itself represent management goals and is not necessarily an indicator of ecosystem health.

Effects of the Alternatives on Physical Aspects of the Ecosystem

This section presents the effects of alternatives on soils and air quality. Each subject area is discussed in the following order: the overall causes for the effects, the methods for

determining effects, and the analysis of effects of the alternatives.

Soils

Assumptions

The following assumptions were made by the SIT and the EIS Team:

- ◆ Soil loss from road construction activities will continue to cause declines in soil

Summary of Key Effects and Conclusions

- ◆ In forestlands, Alternative 6 has the highest likelihood of reducing soil disturbances from current, followed closely by Alternatives 4 then 3, then by Alternatives 5, 2, 7 and 1. Because of the uncertainty associated with Alternative 7, reduction of soil disturbance could range from low to high, and could trend towards high in the long term. In rangelands, Alternative 3 has the highest likelihood of reducing soil disturbance from current, followed closely by Alternatives 5 and 6, then 4. Alternative 7 has a moderate likelihood of reducing soil disturbance from current, followed by Alternative 2. Alternative 1 is likely to increase soil disturbance from current levels, due largely to the increase in exotic plant invasion. Alternative 7 would have the highest likelihood of restoring floodplain and riparian soil functions in rangelands because the level of grazing disturbance would be about half that of the other alternatives. Actual effects on soil productivity from soil disturbance will depend on the type, extent, and method of disturbance, and existing condition of the soil and vegetation — all factors that cannot be adequately characterized at this scale.
- ◆ Alternatives 4 and 6 would have a higher likelihood of restoring and conserving organic matter and woody material to the soil ecosystem than the other alternatives because of the required minimum levels of coarse woody debris, and standing and downed large trees. Alternative 7 (inside reserves) would have highly variable levels of organic matter and wood because of unpredictable fire effects, but levels are expected to approach minimum requirements, particularly in the long term. Alternatives 3 and 5 are less likely to restore and conserve organic matter and woody material needed for sustainable soil productivity because of lower required minimums and the lack of large standing and downed trees. Amounts of organic matter and wood in Alternatives 1 and 2 are generally unspecified, and areas where soil productivity has declined due to loss of organic matter and coarse wood may continue to decline because of overall lack of consideration of soil requirements.
- ◆ Vegetation conditions similar to natural or historical range of variability, are more likely to maintain a stable and available nutrient supply, and thus sustain soil productivity and reduce risk of nutrient loss from uncharacteristic fire. Alternatives 3, 4, 5, and 6 are likely to result, more quickly, in achieving vegetation conditions similar to the historical range of variability, both in the short term and long term. An exception is Alternative 3, which may show greater departure of some forested landscapes from the historical range of variability. Alternatives 1, 2, and 7 have less emphasis than the other alternatives in achieving vegetation conditions similar to the historical range of variability, and consequently are less likely to result in sustainable soil and nutrient conditions; while Alternative 7 is fairly similar to Alternatives 3 through 6 in rangelands, it would not be as effective in reducing exotic weeds. Alternatives 1 and 2 would likely result in continuing and increasing departures of forested landscapes from the historical range of variability in forestlands and would not be effective in arresting the spread of exotics in rangelands.
- ◆ Alternative 4 provides the highest levels of watershed restoration and road closures that would restore hydrologic and soil function. Alternative 3, followed by Alternative 6, then Alternative 5 have fairly high levels of restoration focused at restoring hydrologic and soil function. Alternative 7 has high levels of road closures, but because it takes a more passive approach to restoration, it is anticipated that the majority of closures would only block access and, therefore, may present a higher risk to soil and hydrologic function in the short term than if they remained open. Alternative 5 would result in less watershed restoration and road closures that restore hydrologic and soil function than Alternatives 3, 4, 6, and 7; Alternatives 1 and 2 would have much lower levels than the other alternatives. Consequently, Alternatives 1 and 2 are not expected to improve soil and hydrologic function where it has declined. Where watershed and road restoration is focused in riparian areas, and where riparian vegetative cover is increased, floodplain and riparian area soils are most likely to improve.

productivity and accelerate erosion. Mechanical disturbance during vegetation management may cause declines in soil productivity, varying by type of activity and mitigation applied. However, mitigation and use of Best Management Practices (BMPs) can substantially reduce these declines.

- ◆ Compaction and organic matter removal are the two most important contributors to site degradation and loss of soil productivity.
- ◆ Standing and downed wood is a necessary component of ecosystem function and sustainability, and must be restored and preserved for soils to be productive.
- ◆ The levels of coarse woody debris for Alternatives 4 and 6 are the minimum levels required to restore, maintain, or conserve soil productivity until ecosystems are closer to the desired range of future conditions, based on Graham, Harvey, and Page-Dumroese's research (Graham et al. 1991).
- ◆ The higher the proportion of coarse woody debris retained in the larger diameter size classes, the more likely soil productivity, processes, and functions will be restored and conserved. Larger diameter wood has a more favorable moisture regime and slower decomposition rate to ensure sustainable nutrient supply, and is less likely to be consumed by fire than smaller pieces of wood.
- ◆ Removal of large wood (such as boles greater than 20 inches) and overall vegetation loss in riparian areas are significant contributors to loss of riparian soil function and decreased water quality.
- ◆ Changes in vegetation composition, structure, and density have resulted in changed soil properties.
- ◆ Stands that are within or trending towards the historical range of variability are more likely to have productive soils and a sustainable supply of nutrients necessary for soil and site productivity.

Causes of the Effects of Each Alternative on Soils

- ◆ Road construction and related activities increase amount of bare soil or soil loss.

- ◆ Activities that remove organic matter, large tree boles, and coarse woody material below levels under which the soils for that site evolved can cause further decline in soil productivity and function.
- ◆ Retention of coarse wood on site will aid in restoration of soil productivity and nutrient cycling in areas where wood has been removed.
- ◆ Watershed and riparian restoration will benefit soil ecological function.
- ◆ Movement of vegetation towards or away from historical range of variability influences ecological functioning of soils.

Methodology: How Effects on Soils Were Estimated

Four main indicators of soil productivity and function were used:

- ◆ Reduction in soil disturbance (change from current as compared to historical);
- ◆ Levels of woody material retained on site (applicable to forested environments only);
- ◆ Vegetation conditions representative of forestland and rangeland structure and composition under which soils evolved;
- ◆ Watershed restoration and road closures that restore hydrologic and soil function.

The environmental consequences of the alternatives are based on landscape information from the *Evaluation of Alternatives* (Quigley et al. 1997), and on information provided by the soils expert panel and discussions with local scientists (J. Clayton, Soil Scientist, Intermountain Research Station; A. Harvey, Silviculturist, Intermountain Research Station; R. Graham, Intermountain Research Station; D. Page-Dumroese, Soil Scientist, Intermountain Research Station; D. Martens, Soil Scientist, Payette National Forest; B. Meurisse, Soil Scientist, Pacific Northwest Region, Forest Service; C. Faning, Soil Scientist, BLM, Oregon; B. Ypsilantis, Soil Scientist, BLM, Idaho).

Soil disturbance was estimated as reduction of soil disturbance for rangeland and forestland. Predicted trends in forestland and rangeland vegetation conditions were used to determine

the likelihood for nutrients to be available and sustainable through time. Riparian soil productivity and function were also evaluated as part of the Effects on Aquatic Systems section.

Effects of the Alternatives on Soil Productivity and Function

Effects on Soil Disturbance

Alternatives that propose greater soil disturbance would have a higher likelihood of impairing soil function and productivity. Acres of potential soil disturbance are displayed in Table 4-1. Soil loss, organic matter reduction or removal, loss of microbiotic crusts, decreased infiltration, and other degradation of soils could occur. The soil disturbance reduction indicator, used for both forestlands and rangelands, is predicted based on the interrelationships of: 1) the amounts of different types of vegetation disturbance (wildfire, prescribed fire, timber harvest, timber thinning, exotic plant invasion, wild ungulate and livestock grazing, and range improvements), 2) the forest or rangeland potential vegetation group, 3) the kind of succession/disturbance regime (type and frequency of disturbance as influenced by vegetation resiliency) and 4) the management

prescription models (CRBSUM) for the alternatives within the EIS planning area. Base values were derived from measured amounts of bare soil using plot data. However, unvegetated or bare soil does not necessarily equate to actual soil disturbance. Actual soil disturbance can include erosion, compaction, puddling, etc., and therefore is only represented by the use of the indicator.

Reduction of soil disturbance is displayed in Figures 4-1 and 4-2, as percent change from current compared to historical. This figure depicts the trend towards historical levels of soil disturbance from current. In general, current levels of soil disturbance have resulted in declines of soil productivity and function. The greater the deviation from current towards historical, the more likely the alternative will resemble natural soil disturbance levels, and restore or maintain soil productivity and function. These values are most useful as a relative comparison among alternatives for the long term. For further information on disturbances, assumptions, and methodology, refer to the *Landscape Dynamics* (Hann et al. 1996) chapter of the *Assessment of Ecosystem Components*.

Not all disturbances have the same actual effect on soil productivity and function. For example, wildfire can reduce soil productivity, but unless all the organic matter, grass residue, needles,

Table 4-1. Soil Disturbance Acres, Eastside Planning Area.

Potential Vegetation Group	Alternative						
	1	2	3	4	5	6	7
	<i>in thousands of acres</i>						
Dry Forest	654	708	570	569	569	565	586
Moist Forest	255	263	196	194	203	193	216
Cold Forest	33	31	31	31	31	31	26
Forest Total	942	1,002	797	794	803	789	828
Cool Shrub	133	120	137	131	139	130	128
Dry Grass	321	310	305	303	309	303	314
Dry Shrub	1,495	1285	892	821	1028	861	935
Riparian Shrub and Woodland	248	247	273	242	276	245	139
Range Total	2,197	1,962	1,607	1,497	1,752	1,539	1,516
Woodland	10	8	8	7	8	7	8

Source: ICBEMP GIS data (1km² raster data).

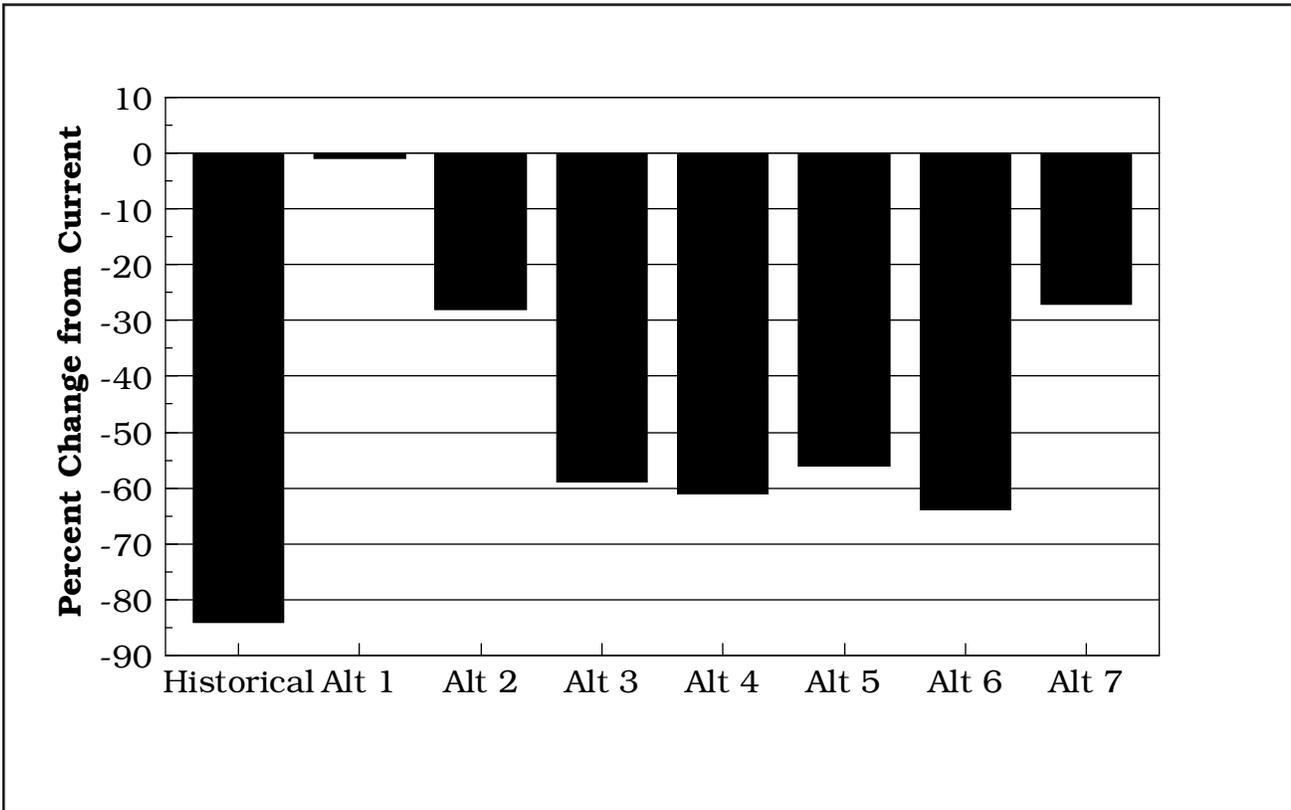


Figure 4-1. Forestland: Change in Soil Disturbance from Current.

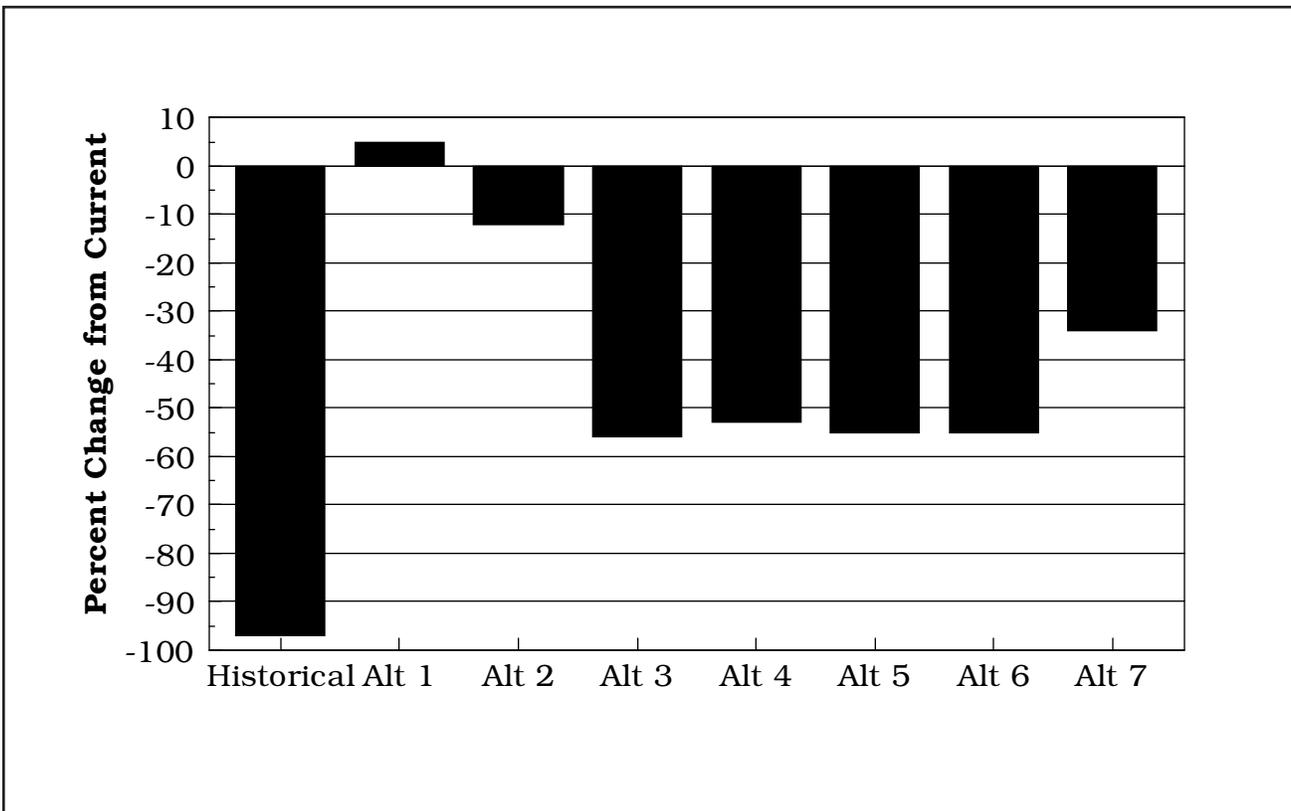


Figure 4-2. Rangeland: Change in Soil Disturbance from Current.

branches, and boles are consumed, loss of soil productivity may not be as high as it would be if soils were compacted and whole trees were removed from the site. Severe wildfire can result in water-repellent soil conditions, and increased soil erosion can occur if intense rainstorms also occur. Because of the mosaic pattern that wildfire produces, and the residual wood that is left on site, disturbance from wildfire usually has fewer implications for loss of soil productivity and function than disturbances which remove soil organic matter and decrease bulk density as well. Both water-repellent soil conditions and compacted soils can decrease soil functions (such as water infiltration, nutrient uptake, biological activity), and can increase erosion, but the severity and longevity of declining soil productivity is generally greater under compacted soil conditions. Disturbance from roading activities also reduces soil productivity and function, and can comprise significant percentages of a watershed. This disturbance type was not incorporated into potential soil disturbance because data was not adequate at the broad scale, but it was evaluated through the watershed/road restoration indicator. Future disturbance from road construction and reconstruction was not quantitatively evaluated. It was qualitatively included based on EIS objectives and standards specifying that road construction and reconstruction avoid landscapes with high hazards for disruption of hydrologic processes.

Disturbances from grazing can be highly variable depending on the time of year, disturbance intensity, soil type, and other factors, but grazing generally results in a decrease in overall vegetation cover and change in plant composition and structure. The transition from native perennial-dominated plant communities to exotic species-dominated plant communities is partially a result of grazing disturbances. Although understanding is limited with regard to exotic plants and soil productivity changes, there is evidence that the presence and persistence of exotic vegetation results in the loss of structural layering of above- and below-ground plant components. This simplification of above- and below-ground structural layering has a ripple effect in that it leads to a simplification of total diversity of organisms on site, which is suspected to lead to loss of microorganisms in the soil that are integral to normal functioning of the soil and the carbon and nutrient cycles; the end result

is a suspected loss of soil productivity. Soil disturbance from grazing also includes compaction of soils in areas of high use or on water-saturated soils, and disturbance from grazing and exotics can increase susceptibility of soil loss from wind and water erosion. The result of increased fire frequency on rangelands dominated by the exotic annual grasses, cheatgrass and medusahead, is more frequent bare soil and greater susceptibility to erosive events.

Forestland

Alternative 6 proposes reduction of soil disturbance associated with projected management activities at a level most like historical soil disturbance. Alternatives 4 and 3 are similar, reducing slightly less soil disturbance than Alternative 6, followed by Alternatives 5, 2, 7 and 1. Since Alternative 7 has less active management, most of the disturbance is attributed to prescribed fire and wildfire, which have less impact on soil productivity than activities that remove whole trees and alter physical soil properties. Also, there is a high degree of uncertainty on how wildfire would occur across landscapes, therefore Alternative 7 could result in a range from low to high reduction of soil disturbance, with a tendency toward high in the long term.

Rangeland

Alternatives 3, 5, and 6 propose the highest reduction in soil disturbance associated with projected management activities. Alternative 4 follows closely in level of reduction. Alternative 7 proposes moderate reduction of soil disturbance from current. Alternative 2 proposes the least reduction from current. Alternative 1 proposes an increase from current levels of soil disturbance, related to invasion of exotic plants. However, there is a high degree of uncertainty on how exotic plants and wildfire would occur across the landscape, therefore Alternative 7 could result in moderate to high reduction of soil disturbance, especially over the long term.

Levels of Woody Material

Work done by Graham et al. (1994) provides initial recommendations for managing coarse woody debris for different forest types within the Rocky Mountains. Coarse woody debris is defined as any woody residue larger than three

inches in diameter (Graham et al. 1994). Coarse woody debris volumes that are between 10 and 40 tons per acre for all forest types are the minimum necessary to provide a high overall likelihood that soil productivity is restored and maintained (Graham, personal communication). These minimum values provide conservative interim levels of coarse woody debris until levels appropriate for the stand type and existing condition of the site can be determined locally (Harvey, personal communication). Additionally, where substantially more or less than 50 percent of total organic matter comes from sources of plant material less than three inches in diameter (such as grasses, litter, needles) these recommended levels of coarse woody debris may actually be too low for restoration, maintenance, and conservation of soil productivity and function. Lower amounts have been measured on undisturbed sites and may be appropriate to protect and maintain soil productivity of some specific site types (Page-Dumroese, personal communication). Other research indicates that where soil organic matter has been lost, retention of woody material on the soil for one to two years prior to fire, can significantly increase soil organic matter levels and enhance soil productivity.

Loss of soil organic matter and coarse wood was a condition identified by the Science Integration Team (SIT) as a major cause of decreased and degraded soil productivity, which is pervasive across the project area. Declining soil productivity tends to be highest where past management has been the most intensive and extensive. Organic matter removal is one of the most important contributors to site degradation. Where organic matter levels, both amount and size distribution, can be restored and conserved, soil productivity has the highest likelihood of sustainability. Downed bole wood is an integral constituent of many forest ecosystems because it serves a multi-functional role in carbon and nutrient cycling, habitat availability, stream channel morphology, and natural wildfire. While it is well known that large amounts of downed wood accumulate where temperatures are mild and precipitation is abundant, large quantities can also accumulate in drier ecosystems in response to natural disturbance. High levels of fuel buildup in dry climates can increase the spread and intensity of wildfire. However, their consumption under dry conditions can prolong

fire duration, and can increase the temperature and depth of soil heating and thereby cause volatilization of soil carbon and nutrients. Implicit in all discussions of downed boles is their potential to augment nutrient and carbon storage and therefore long-term productivity. The release of nutrients, carbon, and moisture retention from decaying wood is essential for maintaining the fertility of forest soils (Page-Dumroese 1996).

Alternatives 4, 6, and 7 (outside reserves) would have a high likelihood of restoring and maintaining organic matter levels necessary for soil productivity and function because of the interim levels of coarse woody debris and standing and downed large trees, required on disturbed and undisturbed sites. Alternatives 3 and 5 are less likely to restore and maintain organic matter levels because of less stringent standards for coarse woody debris protection. Alternatives 1 and 2 would have no required coarse woody debris levels; therefore there is little likelihood of restoring and maintaining proper organic matter levels.

Other data (photo series guides) quantifying forest residues and downed woody fuels (Fisher 1981, Maxwell and Ward 1980), indicate that the minimum interim levels of coarse woody debris in Alternatives 4, 6, and 7 may be higher than levels found in natural conditions for certain forest types, especially in dry forest types. The photo series guides were developed to determine fuel levels in different vegetation types for aid in fuel inventory and design of prescribed fire treatments; some of the sites are representative of conditions with natural frequencies of fire disturbance. The minimum interim levels of coarse woody debris in Alternatives 3 and 5 are based on this research. These data suggest that the minimum interim levels in Alternatives 4, 6, and 7 may pose a wildfire risk in some situations.

The importance of woody material is applicable to rangelands as well as forestlands. This is particularly true in range shrub systems, where availability of woody material is a major component of nutrient and carbon availability and cycling.

Further analysis is needed regarding the retention and recruitment of woody material, especially coarse wood, to maintain and restore soil productivity, and its interaction and

relationship to fire. These interactions are of concern for all forest vegetation types, particularly dry forests where fire frequencies have been extended and where large trees have been removed. There is also a concern for protection, as dry forests are often the closest forest settings to wildland/urban interface areas and federal/private interface areas. Some of the questions that need to be addressed are: What levels of coarse woody debris are needed for soil productivity in forest settings? What levels can be sustained without limiting the use of prescribed fire and increasing total fuel loadings on these sites? and Are there places where potential fire intensities present a greater risk to the ecosystem than to decreased soil function?

These questions will be addressed and recommendations for evaluating the relationships and interactions of coarse wood and fire in various soil and vegetation types will be developed. This work will be done between release of the Draft EISs and completion of the Final EISs by experts in forest soil productivity and fire ecology from throughout the project area.

Vegetation Conditions Trending Towards Historical Range of Variability

Forestland

Work by Clayton (1995) has shown that ponderosa pine stands outside the historical range of variability contain disproportionately larger amounts of foliage, small branches, and litter when compared to mature open stands. This research suggests there has likely been a net redistribution of nitrogen and other nutrients from the soil to the above-ground vegetation. These observations indicate that stands outside of the historical range of variability are more vulnerable to accelerated nutrient loss from management activities or wildfire than are stands within the range.

This requires increased consideration for retention of wood on site, brush disposal, prescriptions following harvest or thinning, and residence time for wood to incorporate into the soil prior to prescribed fire.

Activities that set vegetation structure on a trend toward the historical range of variability,

if carried out without having a net negative impact on soils, are more likely to maintain a stable and available nutrient supply, and thus sustain soil productivity and reduce risk of nutrient loss from uncharacteristic fire.

As indicated in Table 4-2, Alternatives 4, 5, and 6 would result in the greatest overall movement of terrestrial communities into the historical range of variability, in the short term and long term, while preventing further movement away from the range.

Rangeland

Soil morphological characteristics such as thickness of soil horizons, nutrient holding capacity, and depth and amount of organic matter, are useful indicators of site productivity (Munn et al. 1978). For example, in rangeland and prairie soils, thickness of the soil organic layer alone can be used to predict long-term production of vegetation. Thickness of this layer is largely determined by depth and amount of root growth by grasses (Cannon and Nielsen 1984). This research along with study of soil genesis and evolution under prairie conditions (Hole and Nielson 1970), suggest that loss of the deep rooted component of native vegetation has implications for soil productivity and function. Based on these findings and a comparison of work done in forested environments, it is assumed that rangeland vegetation that is closer to the historical range of variability and native vegetation communities provides the highest certainty of sustainable soil productivity. In addition, reduction in the spread of exotic vegetation (as defined in the *Landscape Dynamics* [Hann et al. 1996] chapter of the *Assessment of Ecosystem Components*) is also expected to improve soil productivity and function.

Based on the evaluation of noxious weeds and cheatgrass by the Rangeland staff of the SIT, the trends in exotic vegetation were modified. Negative trends reflect noxious weed control effectiveness, which show that rangeland potential vegetation groups, as a whole, would continue to be infested with noxious weeds and cheatgrass. Positive trends reflect noxious weed control effectiveness which show that the alternative is expected to result in prevention of further spread of noxious weeds and cheatgrass and some reclaiming of the rangeland potential vegetation groups, as a whole (see Table 4-36 later in this chapter).

Table 4-2. Trends in Forest Vegetation, Eastside Planning Area.

	Alt 1		Alt 2		Alt 3		Alt 4		Alt 5		Alt 6		Alt 7	
	10yr	100yr												
Lower Montane (Dry Forest)														
Early	++	++	++	++	++	++	++	++	++	++	++	++	++	++
Mid	0	-	0	-	0	0	0	0	0	0	0	0	0	0
Late-seral multi-story	0	-	-	-	0	0	0	0	0	0	0	0	-	-
Late-seral single-story	--	--	--	--	+	++	+	++	+	++	+	++	--	--
Montane (Dry and Moist Forests)														
Early	++	++	++	++	++	++	++	++	++	++	++	++	++	++
Mid	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Late-seral multi-story	00	++	00	+	+	+	+	+	+	+	+	+	00	00
Late-seral single-story	++	--	++	--	++	--	++	--	++	--	++	--	++	++
Subalpine (Moist and Cold Forests)														
Early	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mid	00	++	00	++	00	00	00	00	00	00	00	00	00	++
Late-seral multi-story	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Late-seral single-story	0	0	0	0	0	0	0	0	0	0	0	0	0	0

This table shows trends in forest vegetation in 10 years and 100 years relative to the historical range of variability for lands administered by either the Forest Service or the BLM in the Eastside planning area.

Currently within HRV: moves out (-); no change (0)

Currently outside HRV: moves in (++) ; moves farther out (--); moves toward (+); no change (00)

Abbreviation used in this table: HRV = historical range of variability

As indicated in Table 4-3, Alternatives 3, 4, 5, and 6 would be the most likely to result in rangeland environments being within the historical range of variability, with greatest improvements being in the upland herbland and upland woodland communities. Alternative 7 would be similar but slightly less in the long term. Upland shrubland communities would not change significantly under any alternative. Alternatives 3 and 4 provide the greatest reduction in the spread of exotics (see the Effects on Rangeland Systems section for more explanation). The combined effects of Alternatives 3 through 6, moving herbland and woodland communities towards the historical range of variability while providing the greatest degree of reduction in exotics, would result in a high likelihood that rangeland soil productivity could be sustained, with Alternatives 3 and 4 being the highest.

Watershed Restoration and Road Closures that Restore Soil and Hydrologic Function

Restoration activity that restores soil properties and the soils' ability to absorb, store, and release water, as well as to provide a healthy medium for plant growth, would aid in the restoration and sustainability of soil productivity. Since roads cause organic matter and mineral soil loss, as well as alter hydrologic networks and patterns, road closures that restore soil and hydrologic function would provide substantial benefits to the soil resource.

Forestland

Alternatives 3, 4, and 7 would provide the highest levels of road restoration. Because Alternative 7 takes a more passive approach to restoration, it is anticipated that the majority of road closures would not be directed at soil and hydrologic function, and therefore in the short term could present a higher risk to soil and hydrologic function than if they remained open.

Table 4-3. Rangeland Vegetation Trends, Eastside Planning Area.

	Alt 1		Alt 2		Alt 3		Alt 4		Alt 5		Alt 6		Alt 7	
	10yr	100yr												
Exotics	--	--	--	--	+	+	+	+	--	--	--	--	--	--
Upland Herbland	++	++	++	++	++	++	++	++	++	++	++	++	++	++
Upland Shrubland	0	0	0	-	0	0	0	0	0	0	0	0	0	0
Upland Woodland	00	+	00	+	++	++	++	++	++	++	++	++	++	+

This table shows trends in rangeland vegetation in 10 years and 100 years relative to the historical range of variability for lands administered by either the Forest Service or the BLM in the Eastside planning area.

Currently within HRV: moves out (-); no change (0)

Currently outside HRV: moves in (++) ; moves farther out (--); moves toward (+); no change (00)

Abbreviation used in this table: HRV = historical range of variability

Rangeland

Alternatives 4 and 7 would provide the highest levels of road restoration in rangeland environments, and Alternative 6 would provide the next highest level. Alternative 7 could increase short-term risks where roads in sensitive landscapes were not actively restored.

Alternatives 3 and 5 would have moderate levels of road restoration, and Alternatives 1 and 2 would have the lowest levels.

Cumulative Effects on Soil Productivity

Alternatives 4 and 6 would have the highest likelihood of restoring, conserving, and maintaining soil productivity and function, which would be sustainable through time in forestlands; Alternatives 3, 4, and 6 would have the highest likelihood in rangelands. This is because soil disturbance would be lowest and coarse wood and standing wood would be adequate in forest lands, and because the

alternatives would: result in many vegetation communities moving closer to the historical range of variability, provide the greatest reduction in the spread of exotics, and have the highest levels of watershed and road restoration. Alternative 7 could also result in restoration and protection of soil productivity in many areas because of the combined benefits of woody material on site, and uncertainty of outcomes for soil disturbance that could cause fewer impacts than disturbances associated with soil compaction. The short-term risks of road-related effects due to little active restoration in Alternative 7 could outweigh the benefits, especially in densely roaded, highly dissected watersheds. Alternative 3 would be fairly effective in restoring, conserving, and maintaining soil productivity except coarse wood levels are below what is considered adequate for forestlands. Alternatives 1 and 2 would be the least likely to restore, maintain, and protect soil productivity and function in both forestlands and rangelands. This is because of the lack of watershed and road restoration, vegetation movement towards historical range of variability is slow, soil levels of coarse wood in forestlands.

Air Quality

Assumptions

Visuals and Smoke

The following assumptions were made by the EIS Team:

- ◆ Wildfires and prescribed fires do not occur at regular intervals throughout the year, but rather occur in patterns of varying intervals between fires or groups of fire events (episodes).
- ◆ For wildfires, a combination of weather conditions and ignition sources (usually lightning) needs to occur. When weather associated with intense fire behavior and multiple ignitions occurs, the result can be multiple large fires, which burn most of the acres burned by wildfire.
- ◆ In the case of management-ignited prescribed fire, weather is a primary factor in determining if an area can be burned under conditions that will meet the objectives of the fire. When weather conditions become favorable for

prescribed burning, the area affected is usually large, resulting in episodes in which large amounts of prescribed fire are occurring.

- ◆ For modeling purposes, prescribed fire would occur during selected representative weather conditions in early spring, late spring, and fall.
- ◆ For modeling purposes, active wildfires would occur during selected representative summer weather conditions.

Other Pollutants

The following major assumptions were made by the Science Integration Team during their evaluation of alternatives:

- ◆ Most air pollutants that affect the BLM- and Forest Service-administered lands come from industrial or agricultural sources, or auto emissions off public lands.
- ◆ Management of BLM- and Forest Service-administered lands can reduce potential effects of both air pollutants and climate change by reducing stress on biotic communities (plants and animals) through managing to promote landscape health and diverse native species.

Summary of Key Effects and Conclusions

- ◆ The dispersion modeling assessment indicates that there may be significantly greater impacts from wildfires than from prescribed burning. However, due to limitations of this analysis, comparison of the model estimates with the National Ambient Air Quality Standards is not possible. Compliance of prescribed burning impacts with the National Ambient Air Quality Standards should be evaluated at a subsequent planning level.
- ◆ Increased haziness (a reduction in viewing distance and ability to detect finer features on the landscape) would likely result from the increases in prescribed burning proposed in Alternatives 3 through 7. Large wildfires result in more of the project area affected by haze. It can be inferred that the higher concentrations of emissions associated with these wildfires would reduce visibility in affected areas more so than the highest levels of prescribed fire. However, a higher frequency of visibility impacts would result from prescribed fire than wildfire.
- ◆ Other criteria pollutants are not likely to have an impact on public health because of the small levels produced and the rapid dilution or modification of these substances within relatively short time frames. However, the potential effects of air pollutants impacting plants and animals on public lands could be mitigated by managing to minimize stress and through monitoring. The effects of alternatives on landscape health provide an indicator for reducing stress on plant and animal habitats with Alternatives 3, 4, 6, and 7 having the greatest ability, and Alternatives 1, 2, and 5 providing almost no improvement in landscape health that would reduce stress. Monitoring and prediction of potential effects with feedback to the EPA would be best addressed under Alternatives 6, 4, and 3 respectively, with 7 and 5 at moderate levels, and 2 and 1 at the lowest levels.

- ◆ Information from monitoring pollutant deposition and effects on BLM- and Forest Service-administered lands can be used to reduce potential for pollutants and to improve the prediction capability of source/receptor relationships through the Clean Air process.

Causes of the Effects of Each Alternative on Air Quality

- ◆ Wildland fires, both wildfire and management-ignited prescribed fire, affect air quality.
- ◆ The impacts of wildfire and management-ignited prescribed fire on air quality vary because of the differences in distribution of acres burned, the amount of fuel consumed per acre (due to fuel moisture differences), and the typical weather conditions in which spring and fall prescribed fires occur.

Methodology: How Effects on Air Quality were Estimated

A model was used to assess the impacts of wildfire and management-ignited prescribed fire smoke on air quality within the project area. Estimates were made of the effects of particulate matter emitted from recent wildfires on health standards and visibility, and from a range of management-ignited prescribed fire that could result from the alternatives under consideration for the EIS.

Wildfires and prescribed fires are compared because of the belief that aggressive fuel treatment can significantly reduce the likelihood of large damaging wildfires, and because prescribed fire is proposed as a major fuel treatment alternative in the project area. The belief that fuel treatment can reduce the impacts of wildfires has been common among fire managers for years, has been witnessed in the field, and has been demonstrated by a study completed in Northeast Oregon (Schaaf 1996).

The dispersion model used to assess the effects of wildland fire on air quality was planned before the alternatives were formulated. When the contract for the analysis was awarded, the

prescribed fire activity levels associated with each alternative had not yet been determined, although it was assumed that it would likely be greater than current levels. Therefore, prescribed fire scenarios that contained estimates of current types and levels of prescribed fire activity and increments of additional burning were modeled. Wildfire scenarios were based on daily acres burned in actual wildfire occurrence scenarios. Analysis of specific levels of prescribed fire proposed in each alternative could not be conducted.

A set of four meteorological databases was constructed by integrating terrain with actual atmospheric conditions experienced during five- to eight-day time periods in 1990 (EPA unpublished). These episodes represented typical weather and smoke dispersion conditions for the spring and fall prescribed fire season and for summer wildfires. The databases included wind fields and other meteorological information that affect smoke dispersion. The episodes were:

- ◆ An early spring episode (March 27 through 31) representing typical prescribed burning conditions in the southern part of the project area below the 46th parallel.
- ◆ A late spring episode (May 4 through 11) representing prescribed burning conditions in the northern part of the project area above the 46th parallel.
- ◆ A summer episode (August 6 through 13) during which a large number of wildfire acres burned.
- ◆ A fall episode (October 14 through 19) representing fall burning conditions for both the northern and southern parts of the project area.

Prescribed Fire Scenarios

For the analysis of spring and fall prescribed fire smoke, eight different emission scenarios were evaluated — a base level representing current prescribed fire activities plus additional increments of prescribed burning. The estimate of a baseline level which represented current prescribed fire levels was made from a count of all the management-ignited prescribed fires in 1990 from Forest Service and BLM units in the project area. Although accurate locations and

vegetation types burned were generally unavailable, previous work (Peterson 1992) estimated the proportion of all prescribed fires that occur in each of four general vegetation types (mixed conifer, ponderosa pine, shrub/grass, and grass) in spring and fall (Table 4-4.) The baseline prescribed fires were allocated to these four vegetation types according to the proportions estimated by Peterson (1992). Using the Geographic Information System (GIS), fires were placed on the landscape by randomly selecting locations of the assigned vegetation type. The efficiency of combustion and hence the amount of smoke produced is characteristically different for pile burns, underburns, and broadcast burns. Every prescribed fire was therefore coded to one of these three fire types according to the proportion of each of these fire types that typically occurs. The fuel loading (volume of downed woody material by size classes, litter, and duff) used for the four vegetation types represented average loadings (Huff et al. 1995).

For the spring and fall prescribed fire meteorological databases, eight different emission scenarios were evaluated — a base level (current levels) of prescribed fire plus additional increments of fire. The base level of prescribed fire included the amount and distribution of fire among fire types and cover types that represent peak levels of weekly prescribed fire activity during early spring, late spring, and fall of 1990. The base scenarios that characterize each period include the number of burned units, unit sizes, vegetation types, and fire types (underburns, broadcast

burns, and pile burns). In each of the two base spring scenarios, 1,586 prescribed fire acres were modeled; for the base fall prescribed burning period, 13,883 acres were modeled. Additional scenarios that were modeled increased increments of prescribed fire up to 16 times the acreage of prescribed fire estimated to burn currently. Sixteen times current spring acreage is approximately 25,400 acres in a six-day period within the ICBEMP area, while for the fall burning period, 16 times current acreage is 222,000 acres.

Wildfire Scenarios

For the summer weather period, nine wildfire scenarios were developed, based on an estimate of daily acreage and types of fuels burned by wildfires from August 8 through 13, 1990; July 27 through August 3, 1994; and August 20 through 27, 1994. In addition, emissions were calculated for these wildfire scenarios assuming that only 50 percent and 25 percent of the actual acres burned, in order to estimate air quality impacts for less active wildfire periods. Data on location, size, and acres burned per day for fires on all ownerships (federal and state) were obtained from records kept at the National Interagency Coordination Center (daily “incident management situation reports”). Only those wildfires 100 acres and larger were used in this analysis because these larger fires make up the vast majority of the wildfire acres burned. Based on best information about location and plant community where the wildfires occurred, each fire was classified as

Table 4-4. Percentage of Prescribed Fires, ICBEMP.

Vegetation Type	Spring Prescribed Fire	Fall Prescribed Fire
	<i>percent</i>	
Grass	13	1
Shrub	19	8
Ponderosa Pine	5	7
Mixed Conifer	62	84

This table shows the estimated percentage of prescribed fire for four general vegetation types for the project area.

Source: Huff et al. (1995).

one of the four vegetation types (mixed conifer, ponderosa pine, shrub/grass, and grass). The origin of the fire was used to place the fire for modeling purposes, and acres burned per day were used to calculate emissions. Cumulative impacts of emissions were modeled for the eight days of meteorological data.

Use of Models

The modeling domain covers an area that is approximately 800 miles by 660 miles. This area includes all of the project area and an appropriate buffer zone around the edges of the area of interest to allow the consideration of recirculating wind flows and boundary effects. The area was divided into 3,445 cells, each approximately 154 square miles (400 square km). Particulate levels and changes in visibility were estimated for each of the grid cells.

Particulate emissions and heat release rates were calculated for each prescribed fire and wildfire source, using the Emissions Production Model (Sandberg and Peterson 1985). CALPUFF, an advanced Lagrangian puff model (Scire et al. 1995), was used to produce estimates of ambient concentrations of particulate matter smaller than 10 microns (PM_{10}), estimates of particulate matter less than 2.5 microns ($PM_{2.5}$), and estimates of related visibility impacts. The concentration estimates were averaged over 24 hours to correspond to the averaging time of the National Ambient Air Quality Standards (NAAQS) and prevention of Significant Deterioration (PSD) Increments for PM_{10} developed under the Clean Air Act. The 24-hour NAAQS for PM_{10} is 150 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$). A NAAQS for $PM_{2.5}$ has not been established, however a value of approximately 60 ($\mu\text{g}/\text{m}^3$) is under consideration. To evaluate the air quality impacts of the prescribed burning and wildfire emissions, threshold values equivalent to these two concentrations were employed, not to serve as an assessment of compliance with the NAAQS, but to provide an indication of whether or not the forest and rangeland burning emissions by themselves may be expected to lead to widespread, regional-scale exceedances of the NAAQS. As described in the section below on strengths and limitations to the analysis, model predictions are not cumulative impacts of all sources, and, therefore, this comparison does not constitute an appropriate evaluation of NAAQS impacts.

Model outputs included maps showing 24-hour average concentrations of particulates for each scenario. Tables for each prescribed fire and wildfire scenario (Tables 4-6 through 4-11) depict the number of grid cells that exceed Clean Air Act standards for PM_{10} , or 150 micrograms per cubic meter ($150 \mu\text{g}/\text{m}^3$). Although there is no currently established standard for $PM_{2.5}$, tables were developed showing number of grid cells that exceed an assumed threshold of 60 micrograms per cubic meter ($60 \mu\text{g}/\text{m}^3$). Caution must be used in interpreting these data, since the background level of particulate matter was not included because of its significant variation across the project area. However, sources for most background particulates are blowing dust and winter woodstove smoke, which are present when there is little prescribed fire activity.

Effects on visibility resulting from smoke production by the various scenarios were assessed using a haziness index, expressed in deciviews (Pitchford and Malm 1994). A change in one deciview corresponds to an approximate 10 percent change in the light extinction coefficient, which is considered a small, but perceptible decrease in visibility. When considering the impacts of smoke production upon visibility, it should be noted that in areas where the air is clean and visibility is good, a relatively small amount of smoke can be perceptible. If an area has relatively poor visibility, a greater amount of smoke is required to create a perceptible change.

Assessing the impacts of a range of land management alternatives on air quality is a complex matter, particularly when performed for an area as large as the interior Columbia Basin project area. This is the first programmatic EIS to attempt quantitative evaluation of the impacts of prescribed burning and wildfire emissions on air quality. At most, other analyses of this scope have estimated aggregate emissions resulting from different land treatments. For this assessment, emissions input were derived from recently developed databases on vegetation types and emissions, and actual wildfire data and smoke management information. The air quality dispersion model used in this analysis, CALPUFF, has been recommended for regional-scale analysis by the Interagency Work Group on Air Quality Modeling. (The Interagency Work Group on Air Quality Modeling is composed of representatives from the

Environmental Protection Agency, the Forest Service, the National Park Service, and the Fish and Wildlife Service. Composed of air modeling experts, the Interagency Work Group was formed to review, identify, and recommend candidate air quality simulation modeling techniques that can be used to estimate pollutant concentrations over long transport distances. The Phase I recommendations of the Group recommended the use of the MESOPUFF II model. The Phase II recommendations [currently under development] are expected to recommend the use of CALPUFF.) CALPUFF was selected for its capabilities to simulate temporally and spatially varying emissions and meteorological conditions, features that make it superior to more commonly used regulatory models. With these features, CALPUFF has the potential to more realistically simulate complex wind flows associated with the mountainous terrain of the project area. Furthermore, CALPUFF was recently modified to include new algorithms for simulating multiple buoyant air sources, which are intended to provide a realistic characterization of the types of sources associated with forest and rangeland burning.

To understand the significance and proper application of the results of these modeling analyses, it is essential to note the limitations of the analysis conducted. CALPUFF's sensitivity and performance have not been evaluated, and the accuracy and potential biases of the model relative to its application to forestry burning sources are unknown. Because no thorough model evaluation has been conducted, the results from this modeling exercise are expected to be less reliable than those developed in typical regulatory evaluations of National Ambient Air Quality Standards attainment. Care should be taken when comparing these modeling results with those conducted for evaluating non-attainment areas. Standard particulate matter NAAQS modeling for non-attainment areas employs worst-case assumptions to provide certainty that health based standards will not be violated.

This modeling analysis evaluated impacts of wildfires and management ignited prescribed fires on a regional scale. Use of a fairly coarse, 20 kilometer receptor grid was required to provide coverage over the entire project area. Because the coarse grid analysis could not define local-scale maximum air quality

impacts, it was intended that a fine-scale analysis using a 100 meter receptor grid also be conducted. However, resource limitations prevented the completion of an adequate fine-scale analysis. While this regional approach is appropriate for a programmatic EIS, it cannot be used to assess impacts of burning on attaining the NAAQS at any individual location.

The quality of ambient air is defined by the cumulative effect of all sources, but this analysis did not evaluate the sources of particulate pollution other than prescribed fire and wildfire. The impacts from stationary sources like factories and pulp mills and major area sources such as automobiles were not included. Cumulative impact estimates could not be made, and the question of NAAQS attainment could not be answered at this regional scale. This analysis does suggest that wildfire impacts are significantly greater in magnitude than prescribed burning impacts, although the relative frequency of such impacts was not modeled.

The general approach used in constructing this air quality impact assessment was to portray typical, as opposed to worst-case, air quality impacts from various levels of prescribed fire and wildfire. The modeling effort used meteorological data that was representative of the prescribed fire and wildfire season. Had worst-case dispersion conditions been used in the model, much higher air quality impacts would likely have resulted.

The emission rates for understory burns were estimated with the Emissions Production Model (EPM). This model was developed by the Forest Service to predict particulate emissions from pile and broadcast burning of harvest residues, not from understory burning. While the application of EPM to understory burning introduces additional uncertainty to the analysis, experts believe the Emissions Production Model should not necessarily be biased in this application, and it therefore is the best tool available for estimating emissions from understory burning. (Research is currently underway to develop an improved technical basis for applying EPM to a wider range of prescribed fire types, including understory burning.)

The analysis assumed that prescribed fires are ignited at 11:00 am, which results in the

release of the bulk of the emissions during the unstable daytime hours when vertical mixing is enhanced and the smoke plume is likely to be diluted relatively quickly. Some prescribed fires are active during the stable nighttime hours and have the potential to produce higher ground level impacts due to lower plume heights and less favorable dispersion conditions. It was also assumed that the size of the source area is equal to the acreage burned, which may tend to overestimate the local dilution of pollutants, particularly during the early portion of the fire. It is thus possible that this analysis underestimates the amount of particulate matter and subsequent air quality impacts associated with each prescribed burning scenario.

Smoke and effect on visuals were evaluated in the *Evaluation of Alternatives*. Similar methods were used for comparison of wildfire and prescribed fire scenarios. In addition, the CRBSUM model was used to compare overall levels of smoke production.

Effects of the Alternatives on Air Quality

Prescribed fire is the only planned action that would affect air quality at the broad scale. When wildfires occur, visibility would decrease substantially more than during prescribed burning. However, prescribed burning would affect air quality more frequently. In the long term, wildfires may decrease in frequency for alternatives which implement high levels of prescribed burning. Results of the analysis of prescribed fire are compared to the effects of wildfire on air quality. The effects of the alternatives on two different aspects of air quality were assessed — effects on the amount of particulate matter released (a component of the National Ambient Air Quality Standards), and the effects of the alternatives on visibility. Results presented are for the entire project area.

The midpoint of the total amount of prescribed fire proposed for each alternative in Tables 3-6 and 3-7, were compared to the current level of prescribed fire represented in Alternative 1 (see Table 4-5).

The level of management-ignited prescribed fire would be the highest in Alternative 4. The ratio

of prescribed fire in Alternative 4 to current levels is 3.05. The prescribed fire scenarios that were modeled are for individual weeks of representative activity, but they include increments up to 16 times current levels. Because the highest level in any alternative is only three times current levels, we can assume that the smoke modeling that was conducted likely encompasses the highest level of management-ignited prescribed fire.

Criteria Pollutants

Ozone and carbon monoxide are criteria pollutants also produced by wildland fire. Ozone is a byproduct of prescribed burning, but these fires are generally spatially and temporally dispersed, so potential ozone exposures from prescribed fire are infrequent (Sandberg and Dost 1990). Carbon monoxide is rapidly diluted at short distances from a prescribed burn and poses little or no risk to community health (Sandberg and Dost 1990). Other non-criteria, but potentially toxic, pollutants are emitted by prescribed burning.

Effects of other pollutants were evaluated based on the review in the *Landscape Ecology* chapter of the *Assessment of Ecosystem Components*, correlation with landscape health, and emphasis on monitoring and prediction. In particular, alternatives that would provide management emphasis on a diversity of habitats and species which would be less susceptible as a biotic community to air pollutant effects were given higher ratings.

Predicted Air Quality Impacts

The modeling conducted for this analysis was intended to compare the regional impacts of different land management practices over millions of acres of land. The size of the area of concern and the scope of the programmatic changes discussed in this EIS dictate the use of a large modeling domain and a relatively coarse grid of receptors where impacts are estimated. Because many air quality impacts, such as compliance with the NAAQS, are predominately determined by localized conditions, a modeling analysis used to evaluate programmatic changes cannot really answer whether NAAQS will be attained or violated. At best, analysis at this level can give a general assessment of relative impacts from prescribed burning and wildfires, by alternative.

Table 4-5. Proposed Prescribed Burning Activity, ICBEMP.

	Alternative					
	2	3	4	5	6	7
Ratio (Alt X: Alt 1)	1.0	2.25	3.05	1.82	2.73	1.81

Source: Tables 3-6 and 3-7 in Chapter 3.

None of the 154 square mile grid cells exceeded threshold values ($150 \mu\text{g}/\text{m}^3$) for 24-hour averages of PM_{10} concentrations in any of the prescribed fire scenarios. None of the prescribed fire scenarios exceeded the assumed threshold of $60 \mu\text{g}/\text{m}^3$ for $\text{PM}_{2.5}$. However, the wildfire scenarios estimated concentrations above both of these threshold values.

The predicted number of cells that exceed the PM_{10} threshold are shown in Table 4-6 for the three wildfire scenarios based on actual occurrence during July 27 through August 3, 1994. Emissions based on actual acres burned (100 percent of acres burned) had 190 grid cells that exceed the PM_{10} threshold value — the highest number of grid cells with PM_{10} violations of any of the three wildfire episodes. When levels of wildfire activity were reduced, the number of grid cells that exceeded the PM_{10} threshold also decreased. For a wildfire scenario based on 50 percent of actual acres burned, 45 grid cells exceeded the selected threshold. When the wildfire activity level considered was reduced to 25 percent of the

actual acres burned, 4 grid cells exceeded the threshold.

The wildfire scenario based on the actual location and acres burned from August 6 through 13, 1990 (Table 4-7) resulted in 443 grid cells burned that exceeded the $\text{PM}_{2.5}$ threshold, the greatest number of any of the three scenarios. When it is assumed that only 50 percent and 25 percent of the actual acres burned, the $60 \mu\text{g}/\text{m}^3$ threshold is exceeded for 207 and 83 grid cells, accordingly.

All three levels of simulated wildfire activity (100 percent, 50 percent, and 25 percent) for the third wildfire scenario, based on the location and daily acreage burned for the period from August 20 through 27, 1994, also produced at least some days for which particulate levels exceeded the selected threshold. This threshold value was exceeded in 81, 13, and 3 grid cells for the 100 percent, 50 percent, and 25 percent simulations of actual acres burned, respectively.

Table 4-6. Summer Wildfires Scenario 7/27 through 8/3/94, ICBEMP.

Acres Burned	Number of Grid Cells with PM_{10} Concentrations Above $150 \mu\text{g}/\text{m}^3$								
	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Total
Actual (100%)	1	1	12	55	56	29	26	10	190
50% of Actual	0	0	4	20	16	0	5	0	45
25% of Actual	0	0	0	1	3	0	0	0	4

Abbreviations used in this table:

- PM_{10} - Particulate matter smaller than 10 microns.
- $\mu\text{g}/\text{m}^3$ - Micrograms per cubic meter.

Source: Scire and Tino (1996).

The predicted concentrations of particulate matter for the prescribed fire scenarios are substantially lower than the wildfire scenarios for several reasons: (1) higher fuel moisture levels during management-ignited prescribed fires compared to wildfires, generally result in less fuel consumed per acre of prescribed fire than per acre of wildfire; (2) smoke dispersion conditions during the spring and fall prescribed burn episodes are better; and (3) prescribed fires are dispersed across the landscape, rather than being concentrated in a few locations. Although a compensating factor is the larger buoyancy and potentially higher plume rise of the wildfire plumes compared to the smaller prescribed fire plumes, the wildfire plumes eventually mix down to the ground and result in higher ground-level concentrations of particulate matter.

Visibility

The number of grid cells where the increase in haziness (decrease in visibility) exceeded one deciview (a 10 percent change equals 1 deciview) was computed for each simulation. Tables 4-8, 4-9, and 4-10 show the number of grid cells (of 3,445 total cells) with impaired visibility for each prescribed fire scenario for March, May, and October. The average values show that the visibility impairment is fairly equivalent between the March and May scenarios (Tables 4-8 and 4-9), while the October scenario (Table 4-10) has much greater loss of visibility. Alternative 4 would have the highest level of prescribed fire and the greatest visibility impairment of all the alternatives. This is similar to three times the current level

Table 4-7. Summer Wildfires Scenario 8/6 through 8/13/94, ICBEMP.

Acres Burned	Number of Grid Cells with PM ₁₀ Concentrations Above 150 µg/m ³								Total
	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	
Actual (100%)	0	0	5	41	65	130	157	45	443
50% of Actual	0	0	2	4	24	75	100	2	207
25% of Actual	0	0	1	2	9	42	29	0	83

Abbreviations used in this table:

PM₁₀ - Particulate matter smaller than 10 microns.
µg/m³ - Micrograms per cubic meter.

Source: Scire and Tino (1996).

Table 4-8. March Prescribed Burn Scenario, ICBEMP.

Amount of Prescribed Fire	Number of Grid Cells with Perceptibly Decreased Visibility ¹					
	3/27	3/28	3/29	3/30	3/31	Average
Current Level	21	17	17	5	12	14
2 Times Current	21	33	27	16	20	23
3 Times Current ²	28	38	59	46	28	40
4 Times Current	46	42	64	37	44	47
6 Times Current	46	65	72	42	51	55
8.5 Times Current	84	84	112	79	81	88
11 Times Current	149	92	147	133	125	129
16 Times Current	154	132	183	197	127	159

¹ Out of 3,445 total grid cells.

² Approximately highest level in range of alternatives.

Source: Scire and Tino (1996).

Table 4-9. May Prescribed Burn Scenario, ICBEMP.

Amount of Prescribed Fire	Number of Grid Cells with Perceptibly Decreased Visibility ¹								
	5/4	5/5	5/6	5/7	5/8	5/9	5/10	5/11	Average
Current Level	11	13	9	12	16	14	13	0	11
2 Times Current	20	52	22	39	40	23	0	0	25
3 Times Current ²	44	61	33	35	50	15	0	0	30
4 Times Current	56	52	38	68	58	15	9	0	37
6 Times Current	71	114	72	87	129	26	0	0	62
8.5 Times Current	108	112	80	100	107	64	7	0	72
11 Times Current	119	138	106	145	218	88	10	0	103
16 Times Current	142	249	158	128	210	131	136	0	144

¹ Out of 3,445 total grid cells.

²Approximately highest level in range of alternatives.

Source: Scire and Tino (1996).

Table 4-10. October Prescribed Burn Scenario, ICBEMP.

Amount of Prescribed Fire	Number of Grid Cells with Perceptibly Decreased Visibility ¹						Average
	10/14	3/28	3/29	3/30	3/31		
Current Level	21	17	17	5	12	14	
2 Times Current	21	33	27	16	20	23	
3 Times Current ²	28	38	59	46	28	40	
4 Times Current	46	42	64	37	44	47	
6 Times Current	46	65	72	42	51	55	
8.5 Times Current	84	84	112	79	81	88	
11 Times Current	149	92	147	133	125	129	
16 Times Current	154	132	183	197	127	159	

¹ Out of 3,445 total grid cells.

² Approximately highest level in range of alternatives.

Source: Scire and Tino (1996).

Table 4-11. Summer Wildfire Scenarios, ICBEMP.

Wildfire Episode	Acreage Levels	Number of Grid Cells with Perceptibly Reduced Visibility								
		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Average
8/8-13/90	25% of Acres	9	103	107	281	432	685	910	1061	449
	50% of Acres	19	215	242	470	737	1080	1314	1597	709
	Actual Acres	26	322	402	757	1077	1541	1900	2238	1033
7/27-8/3/94	25% of Acres	88	551	636	792	768	1043	1194	1443	814
	50% of Acres	104	735	1040	1434	1363	1543	1820	2089	1266
	Actual Acres	130	914	1327	1859	1807	2092	2305	2570	1625
8/20-27/94	25% of Acres	82	471	767	878	808	979	1186	1468	830
	50% of Acres	109	599	976	1177	1075	1294	1723	2155	1139
	Actual Acres	159	720	1121	1408	1350	1735	2383	2437	1414

Source: Scire and Tino (1996).

scenario, in which 355 grid cells or approximately 10.3 percent of total cells would have decreased visibility on a single day in October.

Table 4-11 displays the number of grid cells in which visibility decreased by at least one deciview for the nine wildfire simulations. Even the lowest levels of acreage for the three scenarios (25 percent of actual) show a higher average visibility impairment than three times the current level of prescribed fire. The average area with decreased visibility using actual wildfire acreage for the three wildfire episodes exceeds the 16 times current levels of prescribed burning activity in the March, May, and October prescribed fire simulations. However, visibility impacts from prescribed fire are expected to occur more frequently than visibility impacts from wildfire, because the number and size of wildfires varies considerably among years, while prescribed fire activities occur almost every year, during early to late spring, and in the fall.

The results from the CRBSUM modeling of smoke displayed differences among alternatives for total smoke production when wildfire and prescribed fire were combined. Alternatives 4 and 6 would provide the highest levels of smoke reduction through emphasizing planned ignitions of short duration prescribed fires that have high smoke dispersion, using intergovernmental coordination. Alternatives 3 and 5 would provide moderate levels of smoke reduction and Alternatives 7, 1, and 2 would provide the lowest levels of smoke reduction.

Management of BLM- and Forest Service-administered lands can not strongly influence the source of pollutants or climate change. However, the potential effects of air pollutants and climate change on biotic communities can be mitigated through managing to minimize stress on vegetation and through monitoring. Alternatives that would result in rapid transition to healthy, functioning landscapes would provide the best option for reducing potential negative effects. In addition, alternatives that would result in a diversity of species adapted to their appropriate site conditions would have higher potential to sustain productivity. Alternatives that emphasize the recovery of key dominant species that have declined, such as western white pine, whitebark pine, ponderosa pine, aspen,

bluebunch wheatgrass, and native shrub species, would have higher potential for resiliency to air pollution and climate change.

Some species, such as ponderosa pine, are much more vulnerable to air pollution than other species. Alternatives that would promote technology to select genetic varieties of plant species that are resistant to effects from pollution would have higher potential to promote resiliency. Alternatives that would encourage monitoring of deposition and effects of air pollutants, and would help to predict pollution source/receptor relationships and risk of effects would more likely sustain ecosystem diversity and productivity.

The effects of alternatives on landscape health provide an indicator for reducing stress on biotic communities. Alternatives 3, 4, 6, and 7, would have the greatest ability to improve landscape health; Alternatives 1, 2, and 5 would provide almost no improvement in landscape health that would reduce stress. For further information see Effects on Landscape Health later in this chapter. Monitoring and prediction of potential effects (with feedback to the EPA) would be best addressed by Alternatives 6, 4, and 3 respectively, with 7 and 5 at moderate levels, and 2 and 1 at the lowest levels.

Conclusions

Fires emit large amounts of particulate matter and other pollutants relative to other sources of air pollution. Most of the alternatives presented in this EIS would increase the amount of prescribed burning conducted for forest and rangeland management. This analysis has attempted to evaluate the air quality impacts of programmatic increases in prescribed burning.

In general, this analysis reveals that wildfire impacts on air quality may be significantly greater in magnitude than emissions from prescribed burning. In part, this may be attributable to the fact that several states within the project area have smoke management plans that only permit prescribed fires during meteorological periods that are favorable to the dispersion of smoke. However, this analysis only provides a gross relative assessment of the impacts from wildfire and

prescribed fire on air quality. Frequency of the impacts was not considered. Scientific limitations prohibit concluding that wildfires will always pose a greater air quality hazard than prescribed fires.

The air quality modeling also suggests that prescribed burning particulate emissions considered alone may not cause widespread, regional-scale exceedances of the National Ambient Air Quality Standards. However, it is important to remember that evaluation of ambient air and compliance with the NAAQS is based on the cumulative impacts from all sources of air pollution on ambient air. This analysis did not assess the impacts from other sources of particulate matter pollution. The modeling analyses also did not adequately assess the possibility for localized exceedances of the NAAQS caused by prescribed burning

emissions. The modeling results do suggest that regional-scale degradation of visibility is possible due to prescribed burning emissions.

In order to evaluate programmatic changes in land management alternatives, this analysis was conducted on a very broad scale. While this scale of analysis allows a general comparison of alternatives, the broad scale of this analysis may mask subregional and smaller-scale impacts. More detailed air quality analyses should be conducted at subsequent planning levels when emissions can be more accurately quantified and the locations and meteorology associated with a specific planned burn are known.

Effects of other pollutants are best addressed through monitoring and management for landscape health and monitoring.

Effects of the Alternatives on Terrestrial Aspects of the Ecosystem

This section presents the effects of alternatives on forestlands, rangelands, and terrestrial

plant and animal species. Each subject area is discussed in the following order: summary of key effects, assumptions, limitations, causes for the effects, methods for determining effects, and the analysis of effects of the alternatives.

Forestlands

Assumptions

The following major assumptions made by the Science Integration Team during their

Summary of Key Effects and Conclusions

- ◆ Overall, Alternatives 4 and 6 would be most effective in changing forest conditions to a more desirable pattern of forest structural stages and composition. They would reverse these current undesirable trends: high amounts of mid-seral in the dry and moist forests, high amounts of late-seral multi-layer in the dry and moist forests, less late-seral single-layer in the dry forests, fewer large trees and shade-intolerant species. Alternatives 3 and 5 would have slower transitions than Alternatives 4 and 6. They would be less effective in restoring desirable structure and composition on the landscape. Alternatives 1, 2, and 7 would be the least effective overall in reversing current declining trends in forest health.

Effects on Trends on Forestlands

- ◆ All alternatives would reduce the amount of late-seral multi-layer in the dry and moist forests within 100 years. Alternative 1 would result in the greatest reduction in the amount of late-seral multi-layer in the dry and moist forests. In the short and long term under Alternatives 2 and 7, the amount of late-seral multi-layer in the dry and moist forests would be greater than that historically.
- ◆ Alternatives 1 and 2 would lead to reductions in interior ponderosa pine, western larch, and western white pine.
- ◆ Alternatives 3 through 7 (outside reserves) would lead to increases in late-seral single-layer in the dry forests and increases in interior ponderosa pine, western larch, western white pine, and large tree components in the short and long term.
- ◆ Alternatives 3 through 7 would reduce the amount of mid-seral in the moist forests. Alternatives 1 and 2 would have relatively greater increases in this community in the long term.

Effects on Trends Toward Desired Conditions in Forested Potential Vegetation Groups

- ◆ In the long term, forested potential vegetation groups would move toward the desired range of future condition more effectively under Alternatives 3, 4, 5, and 6 than under Alternatives 1, 2, and 7.

Effects on Successional and Disturbance Processes Across the Project Area

- ◆ In Alternatives 1, 2, and 5 (in timber priority areas), young forest structures would tend to be relatively more uniform in spacing and size, with smaller patch sizes and lower representation of large tree components than for Alternatives 3, 4, 6, and 7.
- ◆ Alternatives 4 and 6 would result in young, mid-seral, and late-seral forest structures, composition, and disturbance patterns that are more similar to historical conditions than the other alternatives. These alternative would be the most successful in restoring western larch, western white pine, interior ponderosa pine, whitebark pine, alpine larch, and large tree components.
- ◆ Alternatives 3 and 7 (outside reserves) would result in a mixture of uniform and non-uniform tree size and spacing in the young forest stage. Alternative 7 (inside reserves) would result in uncharacteristically large patch sizes of young forest in the short term.
- ◆ Alternatives 1 and 2 would have more forests move from late-seral to mid-seral, and from mid-seral and late-seral single-layer to late-seral multi-layer forest structure than the other alternatives. These alternatives would result in forest structures and compositions that are most dissimilar to historical conditions.
- ◆ Alternatives 3 through 7 (outside reserves) would have higher transitions of mid-seral and late-seral multi-layer to late-seral single-layer in the dry forests than the other alternatives.

Effects on Insects and Disease

- ◆ Alternatives 1, 2, and 7 would produce forest structure and composition with the highest susceptibility to insects and disease.

Effects on Fire Regimes

- ◆ Under Alternatives 1, 2, and 7 the amount of wildfire in dry and moist forests would be less than historical levels but the amount of crown fire in dry forests would approximate historical levels. Alternatives 3, 4, 5, and 6 would have lower levels of wildfire than the other alternatives in all forest potential vegetation groups.

evaluation of alternatives apply to both forestlands and rangelands. Additional assumptions that apply only to rangelands can be found in the Rangelands section.

- ◆ Priorities for management actions within forest and range clusters and potential vegetation groups follow the themes of the alternatives and the associated Columbia River Basin Successional Model (CRBSUM) prescription mapping. Priorities do not follow the specific simulated response from CRBSUM, which provides differences in trends rather than specific amounts.
- ◆ Because of its broad scale, the Science Integration Team (SIT) did not fully characterize riparian conditions and trends in the *Scientific Assessment* (Quigley et al. 1996a,b); however, to understand riparian conditions and trends, they SIT sampled subwatersheds and described trends related to disturbance and management activities.
- ◆ The modeled amount and intensity of fires may have underestimated actual conditions in areas of high fuel loading and where landscape patterns are significantly different than they were historically. Modeling was not able to account for blow up fire behavior on large blocks of land with contiguous fuels during extreme summer weather conditions. The SIT recognized and compensated for this in a qualitative manner in the *Evaluation of Alternatives*.
- ◆ In general, Alternatives 1 and 2:
 - ◆ Emphasize traditional vegetation management representative of existing plans.
 - ◆ Rely heavily on even-aged timber management strategies emphasizing commodity production with mitigation for other resource values.
 - ◆ Alternative 1 does not have an overall cold water fish or riparian management strategy. Alternative 2 includes PACFISH and INFISH standards.
 - ◆ Reflect an understanding that some forest and rangeland conditions needed improvement. Since then, however, agencies have increased their understanding of the role of nature- and human-induced disturbance regimes and

how these can contribute to more sustainable patterns and structures across the landscapes.

- ◆ In general, Alternatives 3 through 7:
 - ◆ Rely less on even-aged timber management and focus strongly on reversing the decline in large old trees and late-seral forest structure.
 - ◆ Have a consistent approach to manage aquatic and riparian resources in a landscape context. A primary objective is to maintain or improve aquatic/riparian functions and processes rather than to mitigate commodity production.
 - ◆ Have varying levels of increased emphasis on hierarchically connected landscape analysis for assessment of properly functioning landscape patterns and associated landscape health. This results in differences in levels of restoration of landscape patterns, habitat connectivity, and ecosystem function, process, and structure.
 - ◆ Use treatments and strategies that are based on landscape health rather than driven by the production of commodities.
 - ◆ In the long term, the alternative themes and desired range of future conditions will predominate and the potential conflict of broad-scale themes and desired conditions with fine-scale standards will be resolved.
 - ◆ During each sub-basin review, there would be a rating of risk and opportunities throughout the sub-basins, which would lead to an improved fit of standards to the landscape.

Table 4-12 summarizes major differences in assumptions among alternatives made by the Landscape Ecology staff of the SIT. The table rates each alternative against the following basic assumption criteria:

- ◆ *Landscape Approach* ~ Management of BLM- or Forest Service-administered lands moves towards a landscape approach to provide for connected habitats and flows of resources. Under a landscape approach to planning and management, BLM- or Forest Service-administered lands are managed as

a whole within watersheds, and as connected lands between watersheds. Where forestlands and rangelands are intermingled within watersheds or between watersheds, they are managed for connected flows of resources and habitats. Hydrologic and riparian systems within watersheds are managed as integral networks of forestlands and rangelands. Watersheds dominated by BLM- or Forest Service-administered lands have the highest chance of achieving long-term desired patterns.

- ◆ *Successful Ability to Resemble Conditions/ Represent Processes* ~ Management develops the ability to assess and implement landscape management to more closely resemble desired landscape and plant community conditions and processes both temporally (through time) and spatially (on the ground). Emphasis is on understanding the limitations and options of the current biological and physical conditions and managing within those conditions.
- ◆ *Hierarchical Assessment, Implementation, Monitoring, and Evaluation* ~ Inventory programs and methods will be redesigned to provide an integrated understanding of ecological conditions and resource values at many different scales.
- ◆ *Prioritization and Integration of Activities* ~ Implementation of activities to produce commodities and restore landscape conditions is regionally prioritized during sub-basin review to integrate landscape, aquatic, and terrestrial species, social, and economic needs.
- ◆ *Concentration of Activities Temporally and Spatially* ~ Management activities will tend to be concentrated temporally and spatially.
- ◆ *Road Management* ~ New road construction generally will occur in low sensitivity watersheds or land types, within the context of objectives specifying no net increase in road densities in any forest or range cluster. In moderate to high sensitivity watersheds and land types, the road management priorities are road improvements or road density reductions.
- ◆ *Integrated Fire Management* ~ Fire suppression and fuels are managed together. Fuels in wilderness and semi-primitive areas are actively managed to decrease fuel loading. Wildfires over 100 acres that escape initial attack are managed in the context of broad-scale landscapes and risk to lives, property, and resource investments.
- ◆ *Forestland and Rangeland Integrated Landscape Management* ~ The design and implementation of management activities are integrated. Management emphasis is on ecosystem processes which are in sync with biological and physical conditions of the landscape.
- ◆ *Woodland Potential Vegetation Group* ~ Ecological integrity of woodlands improves through time by addressing conditions relative to the effects of fire exclusion, excessive livestock grazing, and the invasion of exotic forbs and annual grasses (see Rangelands Assumptions).
- ◆ *Dry and Moist Forest Potential Vegetation Groups* ~ Ecological integrity of dry and moist forests improve through time by addressing conditions relative to the effects of tree harvest, roads, fire exclusion, and insects and disease.
- ◆ *Cold Forest Potential Vegetation Group* ~ Ecological integrity of cold forests improves through time by addressing conditions relative to the effects of harvest, roads, fire exclusion, and insects and disease.
- ◆ *Dry Grass, Dry Shrub, and Cool Shrub Potential Vegetation Groups* ~ Ecological integrity of rangeland vegetation improves through time by addressing conditions relative to the effects of fire exclusion, excessive livestock grazing, and invasion of exotic forbs and annual grasses (see Rangelands Assumptions).
- ◆ *Riparian Potential Vegetation Group* ~ Ecological integrity of riparian vegetation improves through time by addressing conditions relative to the effects of excessive livestock grazing, invasion of exotics, fire exclusion, and flooding disturbances.

Table 4-12. Rating of Alternatives to Meet Landscape Integrity Assumption Criteria, ICBEMP.

Landscape Management	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Landscape Approach	L-Does not provide a landscape approach	L-Does not provide a landscape approach	M-Emphasis on local fix of existing Plans. Less emphasis on the ERU and project area context.	H-High emphasis on context and coordination at ERU and project area levels.	M-Emphasis on subregional economic efficiency.	H-High emphasis on context and coordination at ERU and project area levels.	M-Within reserves--no landscape approach. Outside reserves--similar to Alt 3.
Successful Ability to Mimic Conditions/ Represent Processes	L-No emphasis on mimicking conditions of BPT or represent associated processes.	L-No emphasis on mimicking conditions of BPT or represent associated processes.	L-Local fix would not provide for the necessary technology development or transfer and coordination to achieve the assumption.	M-Active mimicking of BPT conditions and associated processes.	L-Emphasis on economic efficiency provides impetus on only subset of landscapes.	H-Adaptive mimicking of BPT conditions and associated processes.	L-Reserves may emphasize wildfires and prescribed fires as primary disturbances while outside reserves would be similar to Alt 3.
Hierarchical Assessment, Implementation, Monitoring, and Evaluation	L-Little emphasis for the necessary larger-scale inventory, monitoring, and modelling.	L-Little emphasis for the necessary larger-scale inventory, monitoring, and modelling.	L-Little emphasis for the necessary larger-scale inventory, monitoring, and modelling.	M-Less complete understanding of BPT conditions and associated processes than Alt 6 but more than Alts 3,5,7 because of a more rapid implementation.	L-Emphasis on economic efficiency provides for larger-scale implementation, monitoring, and evaluation on only a subset of landscapes.	H-Higher emphasis for the necessary larger-scale inventory, monitoring, and modelling.	M-Less complete understanding of BPT conditions and associated processes than Alts 1 through 6 because of potential differences in emphasis for areas within and outside of reserves.
Prioritization and Integration of Activities	L-Emphasis is at the existing plan level.	L-Emphasis is at the existing plan level.	L-Emphasis is at the existing plan level.	H-Emphasis is on landscape elements at all scales.	L-Emphasis on economic efficiency would conflict with priorities for integrity.	H-Emphasis is on landscape elements at all scales.	L-Constraints on prioritization and integration of activities within reserves and same as Alt 3 outside of reserves.
Concentration of Activities Temporally and Spatially	L-Fragmentation of activities both temporally and spatially.	L-Fragmentation of activities both temporally and spatially.	M-Can occur locally at a watershed scale but lower emphasis at larger scales.	H-Emphasis on concentrating activities at several scales.	M-Potential to have higher emphasis on economically efficient elements and areas.	H-Emphasis on concentrating activities at several scales.	M-Within reserves would allow concentration of wildfire and prescribed fire but outside of reserves would tend to have fragmented activities.

Road Management	L-Less emphasis than Alt 3.	L-Less emphasis than Alt 3.	M-Emphasis on correcting local problems but lacks emphasis on connections to larger scales.	H-Emphasis on active corrections of problems at a multi-scale level.	L-Priority problem areas may not be improved at a rate consistent with larger-scale relationships if not economically efficient.	H-Emphasis on active corrections of problems at a multi-scale level; would prioritize to fix conditions which are most in conflict with the BPT first.	M-Areas within reserves will not be developed and outside of reserves would be the same as Alt 3.
Fire Management	L-Less emphasis on integrating fire and fuels management.	L-Less emphasis on integrating fire and fuels management.	M-Achieve improvement by fixing many of the local fire and fuel problems.	H-Emphasize an integrated approach.	M-An integrated approach would be supported in the long term.	H-Emphasize an integrated approach.	L-Less emphasis for active management within reserves and same as Alt 3 outside of reserves.
Forest and Rangeland Integrated Landscape Management	L-Less emphasis to apply an integrated landscape management approach.	L-Less emphasis to apply an integrated landscape management approach.	M-High potential to integrate to achieve local fixes but low potential for achieving broad- and mid-scale fixes which are not a local priority.	H-Activities are consistent with improving landscape conditions in an integrated fashion.	L-Low emphasis on local conditions and elements not related to economic efficiency but moderate potential to achieve integrated objectives and activities.	M-Activities are consistent with improving landscape conditions in an integrated fashion but at a slower rate than Alt 6.	L-High potential to have separate rather than integrated approaches to managing within and outside of reserves. Emphasis for both areas would likely be non-integrated.
Woodland PVG	L-No improvement is expected because of lack of a landscape approach.	L-No improvement is expected because of lack of a landscape approach.	M-May be addressed in some local plans.	H-Active emphasis.	L-Low emphasis.	M-Less active emphasis than Alt 4 but more than Alts 1 through 3, and 7.	L-May not receive emphasis within or outside of reserves.
Dry and Moist Forest PVGs	L-Lack of landscape context.	L-Lack of landscape context.	M-Some emphasis because of local fix of existing plans.	H-Active emphasis at multi-scale landscape level.	M-Potential mixed emphasis for economic efficiency.	M-Less active emphasis at a multi-scale landscape level.	L-Potential lack of active management within reserves.
Cold Forest PVG	L-Lack of emphasis for this PVG, lack of landscape context, and lack of emphasis on whitebark pine recovery.	L-Lack of emphasis for this PVG, lack of landscape context, and lack of emphasis on whitebark pine recovery.	L-Emphasis on local fix of existing plans which would not provide context or emphasis for this PVG.	H-Emphasis on active management and larger-scale context.	L-Less emphasis due to relatively low economic potentials.	M-Emphasis on active management and larger-scale context but at a slower rate than Alts 1 through 5, and 7.	L-Potential lack of active management emphasis in reserves and lack of emphasis outside of reserves.

Table 4-12. Rating of Alternatives to Meet Landscape Integrity Assumption Criteria, ICBEMP.

Landscape Management	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Dry Grass, Dry Shrub, Cool Shrub PVGs	L-Lack of landscape emphasis for rangelands.	L-Lack of landscape emphasis for rangelands.	M-Potential local emphasis for watershed-level improvements.	H-Emphasis on active management and larger-scale context	M-Potential high emphasis on economic efficiency where they make up major part of livestock forage base but low emphasis in other areas.	M-Emphasis on active management and larger-scale context but at a slower rate than Alts 1 through 5, and 7.	L-Potential lack of active management emphasis in reserves and lack of emphasis outside of reserves.
Riparian PVG	M-Moderate emphasis on recovery.	M-Moderate emphasis on recovery.	M-Moderate emphasis on local fixes of existing plans but lacks larger-scale context.	H-Emphasis on active management and larger-scale context.	M-Emphasis on recovery in economically efficient areas but lack of emphasis in other areas.	M-Emphasis on active management and larger-scale context but at a slower rate.	M-Riparian systems within reserves will remain stable or improve with time and riparian systems will be same as Alt 3.

Abbreviations used in this table:
 L = low
 M = moderate
 H = high
 ERU = ecological reporting unit
 BPT = biophysical template
 PVG = potential vegetation group

Limitations

The following limitations were considered in the analysis of effects of alternatives:

- ◆ Projected effects of the alternatives on the extent of terrestrial communities and/or structural stages within potential vegetation groups are broad-scale effects (effects detectable at 1 square kilometer [250 acres] resolution). Hence, these effects do not take into consideration mid-scale or fine-scale landscape patterns. However, projected effects of the alternatives on fire regimes and insect and disease susceptibility were rectified for mid-scale patterns through the use of indices which take into account mid-scale landscape disturbance regimes, mid-scale patterns (inclusions of areas of low insect and disease susceptibility within larger areas of high susceptibility), and fine-scale live and dead vegetation and fuels composition and structure. In the Final EIS, similar adjustments may be made to projections of the extent of terrestrial communities and structural stages by potential vegetation group.
- ◆ For Alternative 3 the CRBSUM simulation used higher levels of management activities (timber harvest, thinning, prescribed fire, watershed restoration) than intended or prescribed in Chapter 3. This discrepancy was accounted for in the evaluation of effects on fire regimes and insect and disease susceptibility, but not in the evaluation of trends in terrestrial communities or structural stages by potential vegetation group. Consequently, effects for Alternative 3 presented here may slightly overestimate or underestimate actual extent of changes to terrestrial communities or structural stages due to the erroneously high rate of simulated management activity levels. Unless otherwise noted, it was assumed that the relative effects of Alternative 3 compared to other alternatives were not substantially affected by this discrepancy.
- ◆ Evaluation and reporting of effects on forest and range ecosystems were done independently. However, approximately 60 percent of the project area is a mosaic of forest and range ecosystems. These forest/range mosaics typically have the greatest diversity in disturbance regimes and vegetation patterns over time and across the landscape. Further evaluation may be made before the Final EIS is published to determine the abilities of the alternatives to

achieve integrated forestland-rangeland-fire-hydrologic-biotic outcomes at a landscape scale.

- ◆ Comparisons between effects on forested potential vegetation groups and desired ranges of future conditions were not made by the Science Integration Team. These comparisons were derived by the EIS Teams from data provided by the Landscape Ecology staff for the projected extent and distribution of forested potential vegetation groups and from the desired range of future conditions developed for seral stages by potential vegetation group as described in Chapter 3.
- ◆ All effects of alternatives on forestlands are for Forest Service- and Bureau of Land Management-administered lands only, unless otherwise noted.

Causes of the Effects of Each Alternative on Forestlands

All alternatives use tree harvest, thinning, prescribed fire, and passive management to some degree to create desired changes on forestlands. The degree and rate at which these activities are applied would differ among alternatives, as would the methods used, and/or objectives addressed.

Trends

Historical trends on forestlands that contribute to the effects of alternatives include:

- ◆ Over 50 years of fire exclusion has resulted in increased amounts of mid- and late-seral multi-layer communities relative to their historical levels. The result is that many landscapes have disturbance regimes and other processes which are inconsistent with their biological conditions.
- ◆ Over 50 years of even-aged timber harvest practices have created large areas of forest and landscape structures that are inconsistent with the biological and physical environment and endemic disturbance regimes.
- ◆ Significant declines in viability of western white pine and whitebark pine have occurred due to white pine blister rust.

- ◆ Biomass (fuel) has accumulated in the forest.
- ◆ Reforestation has established plant communities that are susceptible to stand-replacing wildfire.
- ◆ Flammable exotic weeds have become established and are spreading, particularly in rangelands.

Management Actions

The primary management actions causing changes in distribution, composition, structure, and processes of forest vegetation are listed below for each alternative. “Traditional harvest” refers to the predominant use of even-aged timber management practices. “Ecological harvest” is the use of vegetation management practices to restore or maintain stand structure, stand density, and species composition to levels which are in sync with biological and physical conditions, and the natural processes and cycles of the landscape.

- ◆ *Alternative 1:* Traditional harvest, artificial regeneration, fire suppression, traditional fire management emphasizing fuel reduction, with an emphasis on local input into management decisions.
- ◆ *Alternative 2:* Traditional harvest, fire suppression, artificial regeneration (genetic improvement of planting stock), traditional fire management emphasizing fuel reduction, protection of riparian areas (PACFISH, INFISH) and large trees (Eastside screens), with local emphasis.
- ◆ *Alternative 3:* Ecological harvest, thinning, prescribed fire, artificial regeneration (genetic improvement of planting stock), natural regeneration, with an emphasis on local input into management decisions.
- ◆ *Alternative 4:* Ecological harvest and prescribed fire (resembling ecological processes), artificial regeneration (genetic improvement of planting stock), natural regeneration, landscape approach to management, multi-scale/integrated approach to analysis and implementation, concentration of activities spatially and temporally.

◆ *Alternative 5:* Ecological and traditional harvest, thinning, prescribed fire, artificial regeneration (genetic improvement of planting stock), with emphasis on timber production areas.

◆ *Alternative 6:* Ecological harvest and prescribed fire, artificial regeneration (genetic improvement of planting stock), natural regeneration, emphasis on adaptive management, landscape approach to management, multi-scale/integrated approach to analysis and implementation, concentration of activities spatially and temporally.

◆ *Alternative 7:* Ecological harvest, thinning, prescribed fire (outside reserves), passive management (for example, wildfire within reserves), artificial regeneration (genetic improvement of planting stock).

The trend in the amount and type of wildfire varies among alternatives primarily because of differences in the amounts of prescribed fire, harvest, and thinning that change forest structure. Some amount of fire exclusion would still occur in all alternatives, through wildfire suppression and livestock grazing of fine fuels.

Methodology: How Effects on Forestlands were Estimated

Simulation Strategies

To simulate vegetation composition and structure, and associated disturbance by alternative, the SIT used the spatial and temporal Columbia River Basin Successional Model (CRBSUM). This model predicts disturbance dynamics and vegetation response through time at a landscape level. Differences among alternatives were simulated using combinations of types and rates of management activities that were similar to those described for each alternative. Management activities such as timber harvest, prescribed fire, and fire suppression, interact with natural processes such as wildfire, insect and disease mortality, and drought, to predict a mix of vegetation types and patterns over time across the landscape.

The types and rates of specific management activities or disturbances differ among management prescription models. Each prescription model represents a type of management for the various vegetation types across the project area, as applied to the two EIS planning areas and various management classes. Management classes represent areas of different ownerships and management emphasis within an EIS planning area. On lands administered by the BLM or Forest Service, management classes include roadless, natural-process dominated areas (wilderness and wilderness-like); roadless, human/natural-process dominated areas (typically visually sensitive or semi-primitive areas); roadless, human-process dominated areas (typically non-roaded areas managed for commodities or developed recreation); roaded, human/natural-process dominated areas (recreation areas); and roaded, human-process dominated areas (timber harvest areas).

Fire, Insect and Disease Disturbance Regimes

To improve predictions of net effects on fire and insect and disease disturbance regimes, the Landscape Ecology staff of the Science Integration Team used an index that integrated broad-, mid-, and fine-scale attributes (*Evaluation of Alternatives* [Quigley et al. 1997]). Broad-scale disturbance regime variables were based on knowledge of mid-scale disturbance regime variables, mid-scale patterns, fine-scale live and dead vegetation, and fine-scale fuels composition and structure. The broad-scale index incorporated understanding of vegetation patterns and community composition consistent with the biological, physical, and disturbance characteristics for each management class and type of management.

Effects of the Alternatives on Forestlands

Introduction

The *Landscape Dynamics* (Hann et al. 1996) chapter of the *Assessment of Ecosystem Components* (Quigley and Arbelbide 1996b) for forestlands was organized by terrestrial communities to be consistent with vegetation class stratifications used in the *Terrestrial*

Ecology (Marcot et al. 1996) chapter. Table 4-13 provides a crosswalk between terrestrial communities and potential vegetation groups (PVGs) to facilitate review of effects consistent with discussions in Chapters 2 and 3 of this EIS (see Table 2-8 and Figure 2-6 in Chapter 2 which define and illustrate differences between early-seral, mid-seral, late-seral multi-layer, and late-seral single-layer forest structures). Lower montane, montane, and subalpine terrestrial communities can overlap on the ground, and do not directly relate to the dry forest, moist forest, or cold forest potential vegetation groups. For example, both dry forest and moist forest groups are represented within the montane terrestrial community. Terrestrial communities relate to *existing* forest composition and structure, rather than to *potential* vegetation. In the Final EIS, this discrepancy among chapters will be rectified.

Effects of alternatives on forested potential vegetation groups and terrestrial communities are described by comparison to the modeled historical range of variability (HRV), desired range of future condition (DRFC), and/or current conditions. The Landscape Ecology staff of the SIT based its use of historical range of variability on Morgan et al. (1994). The historical range of variability is a useful benchmark for understanding how the physical and biological conditions, and succession and disturbance regimes can be balanced to produce an ecosystem that quickly recovers from stress and disturbance. It provides insight into native biodiversity relationships and effects on succession/disturbance regimes. For the purpose of this EIS, the historical range of variability provides a reference for assessing the current conditions and future differences among alternatives. Comparisons to the historical range of variability are not intended to imply that historical conditions do or should equate to management goals or the desired range of future conditions, but rather to determine how effectively alternatives would meet management goals.

The effects on forestland are organized into two main sections: (1) effects on distribution, composition, and structure of terrestrial communities and potential vegetation groups; and (2) effects on successional and disturbance regimes.

Table 4-13. Crosswalk Between Forestland Potential Vegetation Groups and Terrestrial Communities.

Terrestrial Community (TC)	Potential Vegetation Group (PVG)
Lower Montane and Montane Forest Early-seral Mid-seral Late-seral multi-story Late-seral single-story	Dry Forest
Lower Montane, Montane and Subalpine Forest Early-seral Mid-seral Late-seral multi-story Late-seral single-story	Moist Forest
Montane and Subalpine Forest Early-seral Mid-seral Late-seral multi-story Late-seral single-story	Cold Forest

Source: ICBEMP GIS data.

Effects on Forest Distribution, Composition, and Structure

Effects of the alternatives on terrestrial community distribution, composition, and structure are described for the EIS planning area or for the entire project area in terms of: (1) geographical extent and trends from historical and current conditions; (2) sub-basin departures from historical ranges of variability; and (3) relative landscape patterns.

Effects of the alternatives on distribution, composition, and structure of terrestrial communities are described for each forested potential vegetation group in the Eastside planning area in relation to trends toward or away from the desired range of future conditions.

Geographical Extent of Forested Communities

Table 4-14 displays the historical and current percent of the Eastside area in each terrestrial community. It then shows the relative amount of change and direction from current conditions in the short (10 years) and long term (100

years). The effects of alternatives on the geographical extent of forested terrestrial communities follow. Causes for observed changes in the extent and trends of these communities between current conditions and those projected for the alternatives can be found in the Effects on Terrestrial Forested Community Successional and Disturbance Regimes section. More detailed discussion can be found in the Landscape Ecology section of the *Evaluation of Alternatives* (Quigley et al. 1997).

The *Evaluation of Alternatives* considered a 20 percent or greater change in geographical extent of a terrestrial community to be an ecologically significant trend. The following communities were projected to increase in area by 20 percent or more relative to current conditions:

- ◆ lower montane early-seral forest, 10- and 100-year projections, all alternatives.
- ◆ lower montane mid-seral forest, 100-year projection, Alternatives 1 and 2.

Table 4-14. Change in Terrestrial Forest Communities, Eastside Planning Area.

Terrestrial Community ¹	Historic ²	Current ³	Alternative 1		Alternative 2		Alternative 3		Alternative 4		Alternative 5		Alternative 6		Alternative 7		
			10yr	100yr													
<i>percent</i>																	
Lower Montane																	
Early-seral	1-4	0	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++
Mid-seral	4-8	8	NC	++	-	++	-	-	-	-	-	-	-	-	-	-	NC
Late-seral	2-4	4	++	++	++	++	-	-	-	-	-	-	-	-	-	+	++
multi-story																	
Late-seral	7-11	3	--	--	--	--	+	++	++	++	++	++	++	+	++	NC	++
single-story																	
Montane																	
Early-seral	6-10	11	-	--	-	--	-	--	-	--	-	--	-	--	-	--	--
Mid-seral	9-10	11	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Late-seral	4-6	9	NC	--	+	-	-	--	-	--	-	--	NC	--	NC	NC	-
multi-story																	
Late-seral	1	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
single-story																	
Subalpine																	
Early-seral	0-1	1	-	--	-	--	-	-	-	-	-	--	-	--	-	--	--
Mid-seral	2-3	1	NC	++	++	++	++	++	++	++	++	++	++	++	++	++	++
Late-seral	1-2	1	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++
multi-story																	
Late-seral	0	0	-	--	-	--	-	--	-	--	-	--	-	--	-	--	--
single-story																	

This table displays historical and current percentages of the Eastside planning area in each terrestrial community. Under the seven alternatives are 10- and 100-year projections of relative degree, and the direction of change from current conditions for each community type.

(++) = greater than or equal to a 20% increase

(+) = up to a 20% increase

(-) = up to a 20% decrease

(--) = greater than or equal to a 20% decrease

(NC) = no change from current

¹ See Table 4-13.

² Predicted historical range modeled over 400 years.

³ Current conditions (0 = 0 to 0.4%).

Source: ICBEMP GIS data (1 km² raster data).

- ◆ lower montane late-seral multi-layer forest, 10- and 100-year projection, Alternatives 1 and 2.
- ◆ lower montane late-seral multi-layer forest, 100-year projection, Alternative 7.
- ◆ lower montane late-seral single-layer forest, 10- and 100-year projections, Alternatives 3, 4, and 5.
- ◆ lower montane late-seral single-layer forest, 100-year projection, Alternatives 6 and 7.
- ◆ subalpine mid-seral forest, 10- and 100-year projection, Alternatives 2 through 7.
- ◆ subalpine mid-seral forest, 10-year projection, Alternative 1.
- ◆ subalpine late-seral multi-layer forest, 10- and 100-year projection, all alternatives.

The following communities were projected to decrease in area by 20 percent or more relative to current conditions:

- ◆ lower montane late-seral single-layer forest 10- and 100-year projections, Alternatives 1 and 2.
- ◆ montane early-seral forest 100-year projection, all alternatives.
- ◆ montane late-seral multi-layer forest 100-year projections, Alternatives 1, 3, 4, 5, and 6.
- ◆ montane late-seral single-layer forest 10- and 100-year projections, all alternatives.
- ◆ subalpine early-seral forest, 10- and 100-year projection, Alternatives 1, 2, 5, 6, and 7.
- ◆ subalpine late-seral multi-layer forest, 10- and 100-year projection, all alternatives.

Aspen cover types are associated with riparian, cold forest, dry forest, and moist forest potential vegetation groups (lower montane, montane, and subalpine terrestrial communities) within the project area. The amount of aspen has decreased from historical times and will likely continue to decrease under Alternatives 1 and 2. Projections indicate that active restoration of aspen would be required in Alternatives 3

through 7 (outside reserves) to reverse a declining trend.

Trends in Forested Communities

In the Eastside planning area, the amounts of lower montane early-seral, lower montane late-seral single-layer, subalpine mid-seral, and all montane forest types are currently outside the historical range of variability. While the historical range is not a management goal, it is useful as a benchmark for understanding relationships between biological and physical conditions and succession/disturbance regimes, as well as the effects of alternatives on these relationships. Causes for observed changes in trends of forested terrestrial communities between current and projected conditions for the alternatives can be found in the subsequent Effects on Terrestrial Forested Community Successional and Disturbance Regimes section.

All alternatives are projected to:

- ◆ move the amount of montane and lower montane early-seral forest back within the historical range of variability;
- ◆ reverse the current trend of increasing montane mid-seral forest;
- ◆ reverse the current trend in decreasing amount of montane late-seral single-layer forest and move it to within the historical range of variability in 10 years. In 100 years the extent of this type would be less than the historical range due to transitions from montane late-seral multi-layer forests;
- ◆ decrease the amount of the montane late-seral multi-layer forest, and move it toward the historical range of variability within 100 years.

Alternatives 3 through 7 are projected to increase the extent of lower montane late-seral single-layer forest, and move it within the historical range of variability within 100 years.

Alternatives 1, 2, and 7 are projected to increase the extent of subalpine mid-seral forest, and move it within the historical range of variability within 100 years.

Alternatives 1 and 2 are projected to continue current declines in the lower montane late-seral single-layer forest, resulting in further divergence from the historical range of variability.

In the Eastside planning area, amounts of lower montane mid-seral, lower montane late-seral multi-layer, subalpine early-seral, subalpine late-seral multi-layer, and subalpine late-seral single-layer forest are currently within the historical range of variability. Alternatives 1 and 2 are projected to increase the extent of the lower montane mid-seral forest beyond the historical range of variability within 100 years. Alternatives 1, 2, and 7 are projected to increase the extent of the lower montane late-seral multi-layer forest beyond the historical range of variability within 100 years. For the other forested types, the alternatives are not likely to result in significant changes from current amounts.

Forested Potential Vegetation Groups

Table 4-15 displays current percentages of the Eastside planning area in early, mid- and late-seral stages for each potential vegetation group as well as the relative amount of change and direction from current conditions in the short (10 years) and long term (100 years). Table 4-16 displays the desired range of future conditions for forested seral stages in the project area by potential vegetation group for Alternatives 3 through 6. For Alternatives 1 and 2, there are no desired ranges of future conditions for forested seral stages by potential vegetation group because current plans and interim direction only generally specify the desired conditions for forested seral stages; hence, effects for these alternatives have been qualitatively estimated. The following section compares effects of alternatives in terms of their relative ability to meet the desired range of future conditions for early-, mid-, and late-seral stages. Desired conditions for Alternative 5 are specified for within and outside timber priority areas, and for Alternative 7, within and outside reserves (Table 4-16). Projected potential vegetation group conditions by alternative were only calculated for the project area as a whole (Table 4-16).

The projected abilities of the alternatives to approach or meet the desired range of future conditions for potential vegetation groups in the

short and long term are due to the themes, management direction, and activity levels for each alternative, and to the difference between current conditions and the desired future conditions. In general, for Alternatives 3 through 7, the desired range of future conditions for forested potential vegetation groups are closest to current conditions in Alternatives 3 and 5.

Dry Forest Potential Vegetation Group

In general, Alternatives 1 and 2 are rated low in their relative ability to improve the ecological integrity in the dry forest potential vegetation group because these alternatives do not require landscape level analysis to integrate management needs. Alternative 3 is rated as moderate to high because it is likely that dry forest conditions will receive increased emphasis by Forest Service and BLM administrative units. Alternative 4 is rated as high because there would be significant emphasis on improving dry forest conditions at a multi-scale level. Alternative 6 would also result in an emphasis on dry forests at a multi-scale level, but is likely to be less successful than Alternative 4 because of the slower rate of activity. Alternative 5 is rated low to moderate because of the resulting mixed priorities across the project area. Alternative 7 is rated low to moderate because of a lack of active management of woody and fine grass fuels and fire in the reserve areas. All alternatives are projected to result in continued increases of exotic weeds within areas occupied by the dry forest potential vegetation group.

Alternatives 1 and 2 would likely result in the extent of dry forest mid-seral structural stages exceeding the desired range of future conditions in the long term. Long-term projections for mid-seral stages under Alternatives 1 and 2 are four to seven percent higher than the desired conditions for any other alternative. The increasing abundance of dry forest mid-seral structural stages under Alternatives 1 and 2 would be due to: (1) continued fire exclusion, thereby hindering fire-related successional processes that drive mid-seral forests toward late-seral structural stages, and (2) less emphasis on restoration activities, resulting in continued mortality of intermediate and large diameter trees from insects, disease, and stress in late-seral multi-layer forests, causing retrogression toward mid-seral structural stages.

Table 4-15. Percent of Forested Potential Vegetation Groups in Each Seral Stage, Eastside Planning Area.

PVG and Seral Stage	Current	Alternative 1		Alternative 2		Alternative 3		Alternative 4		Alternative 5		Alternative 6		Alternative 7	
		10yr	100yr	10yr	100yr	10yr	100yr	10yr	100yr	10yr	100yr	10yr	100yr	10yr	100yr
<i>percent</i>															
Dry Forest															
Early-seral	17	+	--	+	--	++	-	++	NC	++	-	++	-	+	-
Mid-seral	41	-	++	-	+	-	-	-	-	-	-	-	-	-	-
Late-seral multi-story	31	+	-	+	+	- ¹	--	-	--	-	--	-	--	-	-
Late-seral single-story	12	--	--	--	--	++	++	++	++	++	++	++	++	+	++
Moist Forest															
Early-seral	30	-	--	-	--	-	--	-	--	-	--	-	--	-	--
Mid-seral	42	+	++	+	+	+	+	+	+	+	+	+	+	+	+
Late-seral multi-story	20	++	+	++	++	+	++ ¹	+	++ ¹	+	++ ¹	+	++ ¹	+	++ ¹
Late-seral single-story	9	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cold Forest															
Early-seral	44	--	--	-	--	-	--	- ¹	--	-	--	- ¹	--	--	--
Mid-seral	33	++	++	++	++	++	++	++	++	++	++	++	++	++	++
Late-seral multi-story	19	-	NC	-	+	-	-	-	-	-	-	-	-	-	++
Late-seral single-story	4	NC	--	NC	--	NC	--	NC	--	NC	--	NC	--	NC	--

This table displays the current percentages of each seral stage for the forested PVG on Forest Service- and BLM-administered lands in the Eastside planning area. Under the seven alternatives are 10- and 100-year projections of relative degree and direction of change from current conditions for each community type.

- (++) = greater than or equal to a 20% increase
- (+) = up to a 20% increase
- (-) = up to a 20% decrease
- (--) = greater than or equal to a 20% decrease
- (NC) = no change from current

Abbreviation used in this table: PVG = potential vegetation group

¹ Projected conditions that differ by 5% or more from desired range of future conditions (see Table 4-16).

Source: ICBEMP GIS data (converted to 1 km² raster data).

Table 4-16. Desired Ranges of Future Conditions: Percent of Forested Potential Vegetation Groups in Each Seral Stage¹, ICBEMP.

PVG and Seral Stage	Alternative						
	3	4	5 ²	5 ³	6	7 ⁴	7 ⁵
Dry Forest							
Early-seral	15-25	10-20	10-25	15-25	10-20	20-35	15-25
Mid-seral	30-45	30-40	35-45	30-45	30-40	35-45	30-45
Late-seral							
multi-layer	10-20	10-20	15-25	10-20	10-20	5-15	10-20
Late-seral							
single-layer	10-30	20-30	10-20	10-30	20-30	5-20	10-30
Moist Forest							
Early-seral	20-30	20-35	20-30	20-30	20-35	25-40	20-30
Mid-seral	45-60	40-50	45-60	45-60	40-50	45-60	45-60
Late-seral							
multi-layer	10-20	15-25	10-25	10-20	15-25	5-15	10-20
Late-seral							
single-layer	5-10	5-10	2-7	5-10	5-10	2-7	5-10
Cold Forest							
Early-seral	25-35	20-30	25-35	25-35	20-30	30-40	25-35
Mid-seral	40-50	45-55	40-50	40-50	45-55	40-50	40-50
Late-seral							
multi-layer	10-20	10-20	10-20	10-20	10-20	5-15	10-20
Late-seral							
single-layer	5-15	5-15	5-15	5-15	5-15	5-10	5-15

Abbreviations used in this table:

PVG = potential vegetation group

DRFC = desired range of future conditions

¹ DRFCs for seral stages by forested PVG were not available for Alternatives 1 and 2.

² Alternative 5 within timber priority areas.

³ Alternative 5 outside timber priority areas.

⁴ Alternative 7 within reserves.

⁵ Alternative 7 outside reserves.

Source: Chapter 3, Desired Range of Future Conditions.

In the long term, Alternatives 3 through 7 would result in the extent of dry forest mid-seral structural stages being similar to the desired range of future conditions. However, Alternative 7 is projected to result in mid-seral amounts in the dry forest that are in the upper limit of the desired condition. Maintenance of mid-seral stages in the dry forest above or in the upper end of the desired condition in Alternatives 1, 2, and 7 may eventually result in greater area with high insect and disease susceptibility compared to other alternatives (see the Effects on Insects and Disease section).

Alternatives 3, 4, 6, and 7 are projected to result in amounts of late-seral multi-layer structural stages in the dry forest exceeding their desired ranges of future conditions by more than five percent in the short term (next 10 years). In the long term, Alternatives 3, 4, and 6 are projected to have amounts within the upper end of their desired condition for this seral stage, while Alternative 7 would have amounts between 6 and 11 percent above the desired condition. Alternatives 1 and 2 would also likely have more than the desired ranges of future conditions for late-seral multi-layer; these types are projected to extend greater than

the desired condition for other alternatives by 5 to 21 percent. This is likely due to less emphasis within Alternatives 1 and 2 on activities that restore late-seral single-layer from late-seral multi-layer conditions, and reduce the amount of mid-seral forests that change to late-seral multi-layer conditions over time. All alternatives would result in the amount of dry, late-seral, multi-layer forest at the upper end of or above the desired range of future condition. A likely result will be a relatively high insect and disease susceptibility (see the Effects on Insects and Disease section).

For the late-seral single-layer structural stage of the dry forest, Alternatives 4 and 6 are projected to result in amounts that are 5 percent below the desired range of future condition in 10 years, but are within the desired condition within 100 years. The increased amount of late-seral, single-layer forest would come from late-seral, multi-layer forest and mid-seral forest with the help of harvest and prescribed fire activities. Alternatives 1 and 2 are projected to continue current undesirable declines in the extent of late-seral single-layer structural stages and will likely be below the desired condition for this seral stage; their projected conditions are less than the desired range of future conditions for other alternatives by 5 to 15 percent (except for Alternative 7 within reserves). This projected decline would be due to less emphasis on restorative harvest and prescribed fire activities in Alternatives 1 and 2 than other alternatives. Alternatives 1 and 2 would result in greater transition rates from late-seral single-layer forest to late-seral multi-layer forest than Alternatives 3 through 7.

Projected conditions for all other alternatives are within, or have little difference from, their desired ranges of future conditions for early-, mid-, late-seral multi-layer, or late-seral single-layer dry forest.

Moist Forest Potential Vegetation Group

In general, Alternatives 1 and 2 are rated low in their relative ability to improve the ecological integrity of the moist forest potential vegetation group, due to the lack of landscape-level analysis and lack of focus on improving moist forest conditions. Alternative 3 is rated as moderate to high because it is likely that moist forest conditions would receive increased emphasis by individual Forest Service and BLM

administrative units. Alternative 4 is rated as high because there would be significant emphasis on moist forests at a multi-scale level. Alternative 6 would also have an active emphasis on moist forests at a multi-scale level, but is rated as moderate to high because of the slower rate of activity compared to Alternative 4, especially in the short term. Alternative 5 is rated low to moderate because of the resulting potentially mixed priorities across the project area. Alternative 7 is rated low because of a lack of active management of woody and fine grass fuels and fire in the reserve areas.

Alternatives 3 through 7 would result in amounts of late-seral multi-layer forests that are similar to or greater than the desired range of future condition within 100 years (5 to 16 percent). Alternative 7 would result in the greatest divergence from the desired conditions for this community (11 to 16 percent greater), followed by Alternative 3 (12 percent greater), Alternative 5 (5 to 10 percent greater), Alternative 6 (8 percent greater), and Alternative 4 (7 percent greater). Most of the change would come from the mid-seral forests. Alternatives 1 and 2 would maintain relatively high levels, but would not likely exceed the desired condition for amount of late-seral multi-layer forest by more than five percent in the long term. High levels of the late-seral multi-layer stage in these moist forests would likely contribute to relatively high insect and disease susceptibility (see the Effects on Insects and Disease section).

Projected forest structures for all other alternatives are within, or differ slightly from, their desired range of future conditions for early-, mid-, late-seral multi-layer, or late-seral single-layer moist forest.

Cold Forest Potential Vegetation Group

In general, Alternatives 1 and 2 are rated low in their ability to improve the ecological integrity of the cold forest potential vegetation group because of: (1) a general lack of management emphasis on this potential vegetation group, (2) inadequate design and implementation of practices that resemble historical disturbances and processes, and (3) the continued decline of whitebark pine. Alternative 3 is rated low to moderate because uncoordinated actions by local Forest Service and BLM administrative units are not likely to adequately address or emphasize conditions within cold forests.

Alternative 4 is rated high because of an emphasis on active management and multi-scale planning. Alternative 6 is rated moderate because of its slower rate of active management. Alternative 5 is rated low because its emphasis on economic efficiency would not adequately address a forest type that has relatively low economic potential. Alternative 7 is rated low because of a potential lack of landscape emphasis outside reserves and lack of active management in reserves.

For the early-seral cold forest structural stage, Alternatives 4 and 6 are projected to result in amounts that are slightly greater than the desired range of future condition in 10 years, but slightly less within 100 years.

Projected forest structures for all other alternatives are within, or differ only slightly from their desired condition for early-, mid-, late-seral multi-layer, or late-seral single-layer cold forest.

Sub-basin Departures from Historical Conditions

To provide a perspective on the likely magnitude of broad-scale terrestrial community changes, Figures 4-3 through 4-11 display the projected percentage of the 164 sub-basins above, within, and below the historical range of variability (HRV) for each forested terrestrial community for the ICBEMP at 100 years. “Above HRV” refers to the percentage of sub-basins containing more of that community type today than before European settlement. “Below HRV” refers to the percentage of sub-basins containing less of that community type today than before European settlement. In determining these effects, late-seral multi-layer and late-seral single-layer structural stages were combined into a single late-seral category. These figures indicate that for the project area as a whole, there would be large changes between current conditions and the 100-year projections of the distribution and extent of each forested terrestrial community type in terms of the percentage of sub-basins that would be within the historical range of variability. Identified causes for these changes are described in the Effects on Forested Community Successional and Disturbance Regimes section. More detailed discussion can be found in the Landscape Ecology section of the *Evaluation of Alternatives* (Quigley et al. 1997).

Few overall differences exist among alternatives, but some broad-scale, project area-wide patterns emerge:

- ◆ *Alternative 1:* The lower montane forest and the mid-seral and early-seral structural stages of the montane forest would most likely deviate from the historical range of variability. The extent of the lower montane and montane mid-seral structural stages would significantly increase within the Upper Klamath Ecological Reporting Unit (ERU). Conversely, sub-basins in the Northern Glaciated Mountains ERU would have decreased abundances of montane mid-seral forests, although some sub-basins would have increases.
- ◆ *Alternative 2, 5, and 7:* The extent of lower montane mid-seral forests would be greater than the historical range of variability in many sub-basins, especially in the Upper Klamath ERU.
- ◆ *Alternatives 3 and 4:* The extent of lower montane mid-seral and subalpine early-seral forests would be greater than the historical range of variability in many sub-basins, especially in the Upper Klamath ERU.
- ◆ *Alternative 6:* The extent of lower montane mid-seral forests would be greater than the historical range of variability in many sub-basins, especially in the Columbia Plateau, Blue Mountains, and Northern Glaciated Mountains ERUs. Alternative 6 would differ from other alternatives in the geographical distribution of increases in lower montane mid-seral forests due to complex interactions among relative management emphases (conserve/restore), management activity rates, succession rates, and landscape conditions (unroaded vs. roaded).

Landscape Patterns

Table 4-17 displays relative effects of alternatives on landscape patterns on the basis of predicted “restructuring” emphases and trends. “Restructuring” refers to actions aimed at creating terrestrial community landscape-scale patterns that are more consistent with characteristic biological and physical conditions, and disturbance regimes (such as fire, floods, insects, and disease). Although no alternative addresses restructuring directly, this

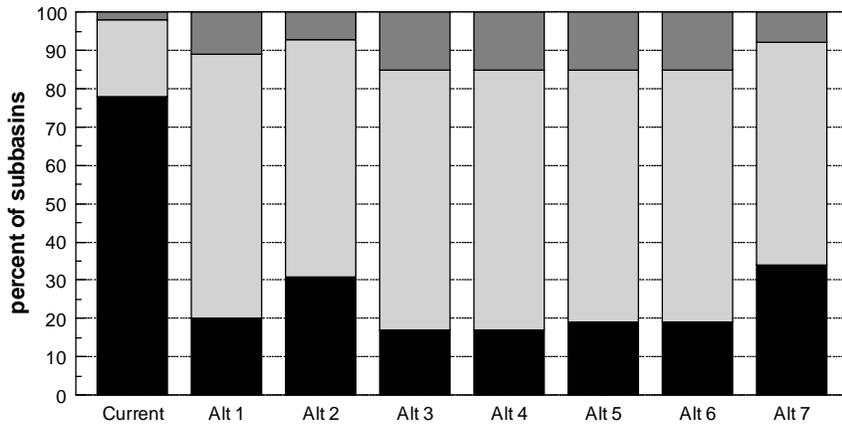


Figure 4-3. Lower Montane Early Seral Forest Departures from Historical Ranges of Variability Year 100, Project Area. (Source: Quigley et al. 1997).

Figure 4-4. Lower Montane Mid-Seral Forest Departures from Historical Ranges of Variability Year 100, Project Area. (Source: Quigley et al. 1997).

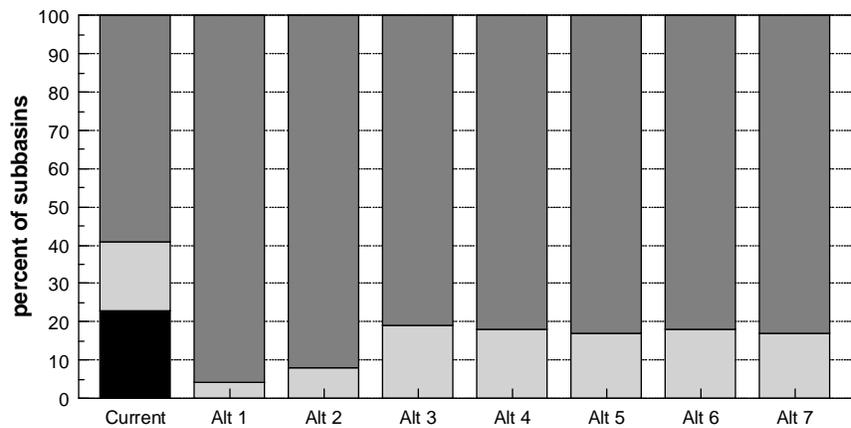
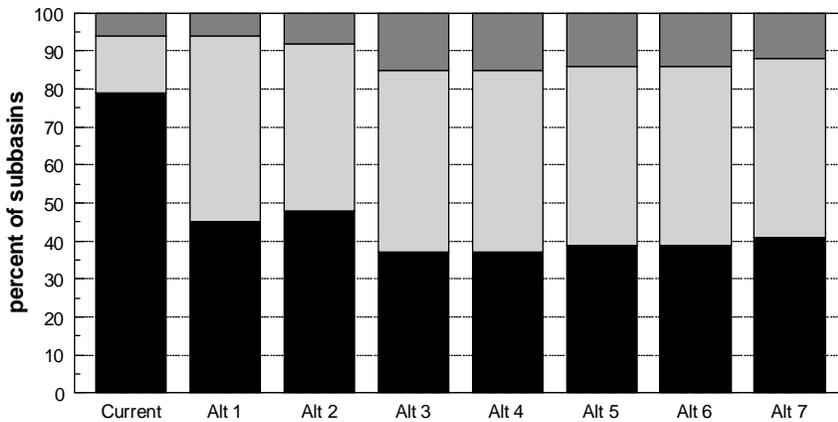


Figure 4-5. Figure 4-4. Lower Montane Late Seral Forest Departures from Historical Ranges of Variability Year 100, Project Area. (Source: Quigley et al. 1997).



		
Below HRV Percent of subbasins with less of this community type than would be expected in HRV.	Within HRV	Above HRV Percent of subbasins with more of this community type than would be expected in HRV.

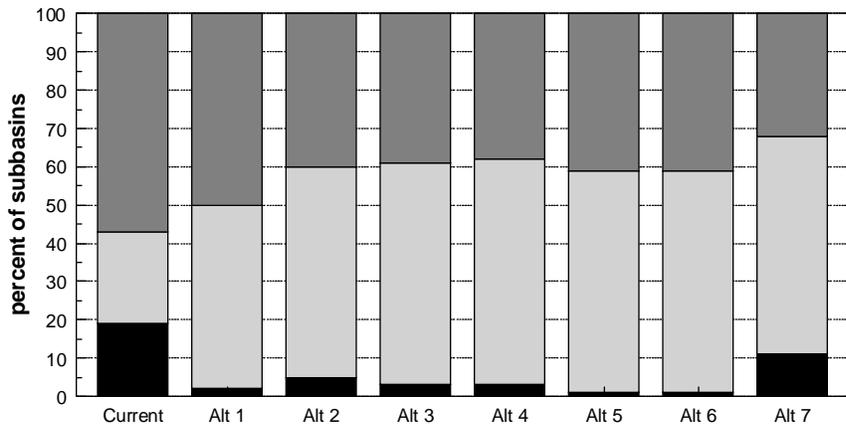


Figure 4-6. Montane Mid-Seral Forest Departures from Historical Ranges of Variability Year 100, Project Area. (Source: Quigley et al. 1997).

Figure 4-7. Montane Early Seral Forest Departures from Historical Ranges of Variability Year 100, Project Area. (Source: Quigley et al. 1997).

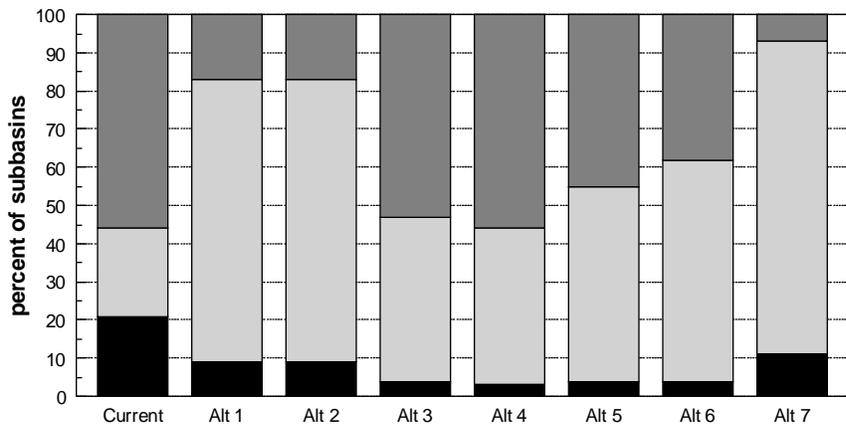
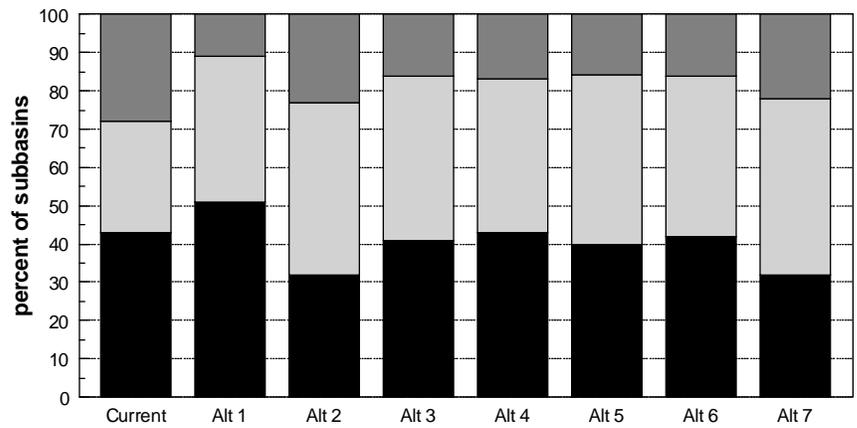


Figure 4-8. Subalpine Early Seral Forest Departures from Historical Ranges of Variability Year 100, Project Area. (Source: Quigley et al. 1997).



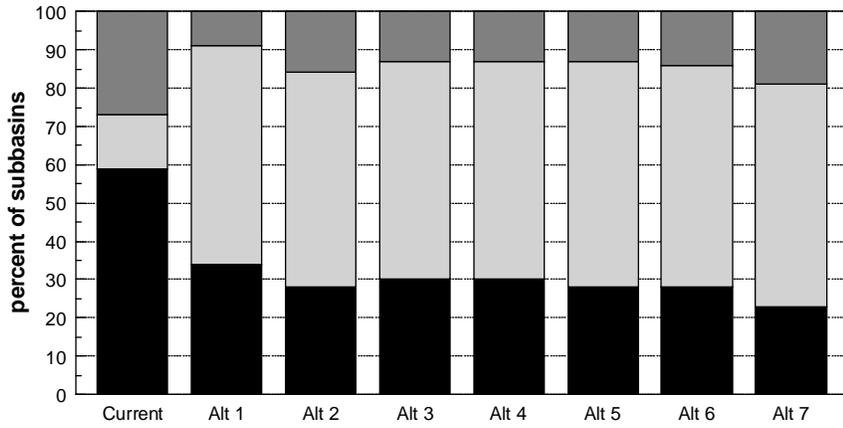


Figure 4-9. Montane Late Seral Forest Departures from Historical Ranges of Variability Year 100, Project Area. (Source: Quigley et al. 1997).

Figure 4-10. Subalpine Mid-Seral Forest Departures from Historical Ranges of Variability Year 100, Project Area. (Source: Quigley et al. 1997).

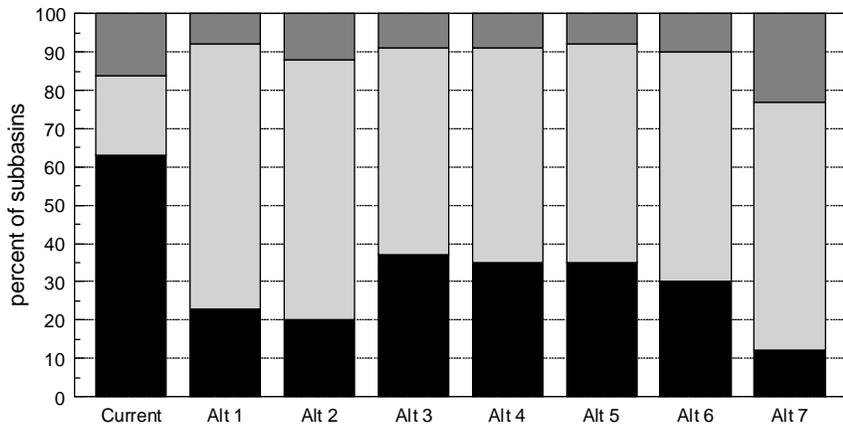
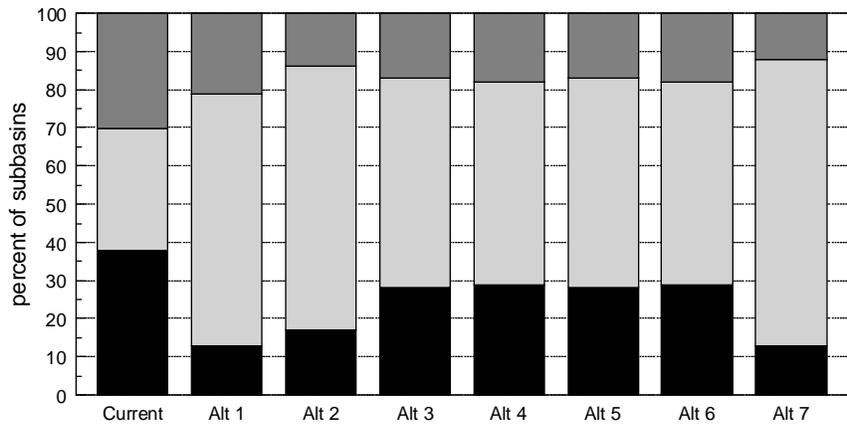


Figure 4-11. Subalpine Late Seral Forest Departures from Historical Ranges of Variability Year 100, Project Area. (Source: Quigley et al. 1997).



Table 4-17. Landscape Level Patterns¹ (Landscape Level Response and Trends), Project Area.

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Relative Response	None	None	Moderate	High	Moderate	High	Low/Moderate
Trend ²	(--)	(--)	(-)	(++)	(-)	(+)	(-)
Explanation	-Large amounts of terrestrial communities have structure and composition inconsistent with biophysical environment. -Traditional management has created high risk situations.	-Large amounts of terrestrial communities have structure and composition inconsistent with biophysical environment. -Traditional management has created high risk situations.	-Low emphasis on rapid fitting of standards to biophysical environments. -Prioritizes local issues rather than multi-scale ecosystem relationships.	-Highest probability and trend for repatterning landscapes to biophysical environments.	-Low emphasis on rapid fitting of standards to biophysical environments. -Prioritizes local issues rather than multi-scale ecosystem relationships.	-High probability and trend for repatterning landscapes to biophysical environments.	-Unpredictable within reserves. -Outside reserves, similar to Alternative 3.

¹ Landscape level response to relative repatterning emphasis refers to the ability of alternatives to create patterns more consistent with biophysical environments, based on desired ranges of future conditions (DRFCs), Alternative Themes in Chapter 3, relative types of management (traditional vs. ecosystem-based), and disturbance treatments.

² Trend ratings (current to future): (0) = stable projected trend, (+) = upward projected trend, (-) = downward project trend.

effect was evaluated by the Landscape Ecology staff of the Science Integration Team on the basis of the desired range of future conditions, alternative themes, and relative types and emphases of specified management or disturbance treatments (see Chapter 3).

There is a concern that some prescribed standards are not appropriate at the scale of the project area. These standards, such as buffer widths, tree diameters, five-year regeneration requirements, patch size, and old growth classifications that were determined at broad scales instead of the more appropriate scales such as those associated with landforms or plant associations, would likely produce negative effects on landscape patterns and ecosystem health in the long term. These standards would result in systematic recurring patterns on the landscape as they were implemented through time. Over time, as these systematic patterns became more prevalent, the effects on ecosystem processes and species would become more pervasive. In many cases the effects of such patterning would dominate landscape patterns and disrupt basic ecologic processes, resulting in the decline of other desired attributes of forest composition and structure.

Alternatives 4 and 6 have the highest potential to repattern landscapes to conditions that are more consistent with the characteristic biological and physical conditions and disturbance regimes. This is due to their emphasis on restoring terrestrial communities to the desired range of future condition, and their emphasis on multi-scale ecosystem analysis and scientific study to assess and promote landscape patterns that are conducive to restoration and maintenance of historical disturbance regimes. Although all alternatives use standards to provide direction for many fine-scale landscape attributes, Alternatives 4 and 6 emphasize the use of multi-scale analysis to determine more appropriate fine-scale management standards to replace those values.

Alternatives 1 and 2 have the lowest probability of restoring and maintaining historical disturbance regimes due to their emphasis on traditional management, which has contributed to the current high-risk conditions. For example, many late-seral multi-layer forests are located on steep slopes, which have high potential for crown fires. Historically, these

forest structures were located on moist footslope landforms where the risk of crown fire was not as high. Additionally, Alternative 1 has many standards that were developed to promote or sustain commodity development. These standards have resulted in landscape simplification. Alternative 2 has many additional standards for aquatic and riparian conservation. These standards have resulted in the development of systematic, recurring patterns that are not well suited to the characteristic biological and physical conditions and disturbance regimes. The widespread effect of Alternatives 1 and 2 would be to change relationships between the biophysical environment and landscape pattern resulting in landscapes that are at high risk to large-scale disturbance events, such as wildfire.

Alternative 3 also would not have great emphasis on rapid fitting of standards to the biophysical environments and prevailing succession/disturbance regime at mid and fine scales. It would provide some context to determine multi-scale landscape patterns. This alternative would tend to emphasize local participation in land management planning.

Alternative 5, with an economic efficiency emphasis, would not result in rapid fitting of standards to conditions and prevailing succession/disturbance regimes to biophysical environments at mid and fine scales. It would provide some context for multi-scale landscape analysis. This alternative would tend to prioritize management actions on landscapes that have higher potential for producing economic benefits.

Alternative 7 (within reserves) would have unpredictable outcomes relative to landscape dynamics and future landscape patterns due to the variety of current conditions in conjunction with passive management, and the effects of wildfire, the primary agent of change. Outside reserves, landscapes would respond similarly as they would to Alternative 3. Overall, Alternative 7 would not have great emphasis on rapid fitting of standards to biophysical environments and prevailing succession/disturbance regimes at mid and fine scales. It would provide some context for multi-scale landscape analysis.

Effects on Successional and Disturbance Regimes in Forest Communities

Effects of the alternatives on forest community successional and disturbance regimes are described in terms of: (1) primary successional transitions for terrestrial communities, (2) effects on fire regimes, (3) effects on insects and disease disturbance, and (4) relative abilities to resemble natural disturbance processes.

Successional Transitions

A net transition refers to the primary change(s) of one terrestrial community into another (for example, succession of mid-seral into late-seral multi-layer forests), “minus” the transitions of other communities into its class (early-seral into mid-seral forests, for the previous example). The primary, or most common, net transitions described can be tied directly to the geographical extent and trends in terrestrial communities and sub-basins (Figures 4-3 through 4-11) discussed earlier. The alternatives differ in the management actions and other probable disturbance processes that cause those trends and transitions among forested communities. Projected transitions for subalpine mid-seral and late-seral communities would not differ significantly among alternatives, and are not further described in this section. More detailed discussion can be found in the Landscape Ecology section of the *Evaluation of Alternatives*. Projected successional processes and net transitions among forested terrestrial communities are displayed in Tables 4-18 through 4-24.

Lower montane early-seral forests (Table 4-18): For all alternatives, most transitions into this terrestrial community would be from late-seral multi-layer forest in all alternatives. In Alternatives 1 and 2, this transition would be caused by traditional harvest practices and/or wildfire, generally resulting in early-seral structures with uniform spacing and size, relatively small patch sizes, or associated effects from salvage logging. Alternatives 3, 4, 5, 6, and 7 (outside reserves) would use harvest and prescribed fire to cause this transition, with Alternatives 4 and 6 emphasizing practices that are intended to more closely resemble ecological disturbance processes, creating stand structures, composition, and patterns closer to historical conditions. Alternative 3 would result

in forest structures and composition that are in some cases uniform, and in other cases more like Alternatives 4 and 6. Alternative 5 would be similar to Alternative 1 in timber priority areas. Alternative 7 (outside reserves) would be similar to Alternative 3. In Alternative 7 (within reserves), wildfire would be the dominant mechanism for transition of late-seral multi-layer to early-seral structural stages, and would create relatively large patch sizes in the short term.

There is little emphasis in any alternative for management of herb, shrub, and exotic plant communities found within the early structural stages of the lower montane forest (dry forest potential vegetation group). Historically, herb and shrub communities of this type were generally on steeper landforms with climatic and topographic conditions that resulted in either relatively frequent fires that maintained upland herb, shrub, and early-seral communities, or in less frequent crown fire regime that would allow sufficient time for development of mid-seral communities before reverting back to early-seral conditions. Due to past cutting practices, most early-seral communities in lower montane terrestrial communities (dry forest potential vegetation group) are now on benches or ridges, which historically were subject to relatively frequent underburning that maintained park-like or savannah structures.

Harvest patterns and prescribed fire in Alternatives 1 and 2 would continue patterns formed by past management, resulting in early- and mid-seral communities located in areas inappropriate for the fire regimes. For Alternative 2, continued fuel accumulation in areas that had underburning fire regimes would result in uncharacteristic wildfire and further serve to create lower montane early-seral forests in areas that historically supported park-like or savannah structures. Harvest and prescribed fire in Alternatives 4 and 6 would repattern landscapes to conditions more consistent with the succession/disturbance regime. Alternative 6 would proceed at slower rates of activities, requiring more research than Alternative 4. Alternative 5 would generally not emphasize repatterning of lower montane early-seral forests. Alternative 3 would proceed at a very slow rate given the emphasis on local priorities. Alternative 7 (outside reserves) would have similar effects as Alternative 3 and

Table 4-18. Primary Successional Transitions in Lower Montane Early-seral Forests.

Alternative	Action Causing Transition	Primary Net Transitions		Effects
		Initial TC	Resulting TC	
1, 2	Harvest Wildfire	Late-seral multi-layer Tolerant	Early-seral Intolerant	-Alt 1 structures similar to plantations - uniform spacing and size. -Alt 2 small patches, associated salvage logging effects. -Early-seral locations inconsistent with biophysical environments. -Increase in exotic species.
3, 5, 7 (outside reserves)	Harvest Prescribed Fire	Late-seral multi-layer Tolerant	Early-seral Intolerant	-Alt 3 some structures uniform, some more native. -Alt 5 similar to Alt 1 in timber priority areas, similar to Alt 3 elsewhere. -Alt 7 similar to 3 outside reserves. -Increase in exotic species.
7 (within reserves)	Wildfire	Late-seral multi-layer Tolerant	Early-seral Intolerant	-Alt 7 (within reserves) wildfire-created structures, some very large patches. -Increase in exotic species.
4, 6	Harvest Prescribed Fire (resembling ecosystem processes)	Late-seral multi-layer Tolerant	Early-seral Intolerant	-Alts 4 and 6 more native structures and composition. -Early-seral locations more consistent with biophysical environments. -Increase in exotic species.

These effects are for Forest Service- and BLM-administered lands only.

Abbreviation used in this table: TC = Terrestrial Community type

would be relatively unpredictable within reserves. The abundance and distribution of exotic plant species would increase in lower montane forests without implementation of monitoring and control efforts.

Lower montane mid-seral forests (Table 4-19): Alternatives 1 and 2 would result in the greatest abundance of lower montane mid-seral structural stages due to continued fire exclusion and associated effects of insect, disease, and stress mortality of large or intermediate trees in dense, multi-layer mid-seral or late-seral stands. With fire exclusion, many mid-seral communities in Alternatives 1 and 2 would persist in the mid-seral stage longer than would have happened historically. Under historical conditions, mixed severity fires thinned many of these mid-seral stands, accelerating succession toward late-seral

conditions. Prescribed fire in Alternatives 3 through 7 (outside reserves) would move mid-seral stands toward late-seral single-layer structural stages and cause fewer net transitions to mid-seral than Alternatives 1 and 2. Alternatives 4 and 6 would result in more historical structures and compositions than the other alternatives because of their emphasis on activities that resemble ecosystem processes.

Lower montane late-seral multi-layer and single-layer forests (Table 4-20): Transitions to late-seral multi-layer structural stages would primarily occur from mid-seral, or late-seral single-layer structural stages (Alternatives 1 and 2), or late-seral multi-layer structural stages (Alternatives 1 through 7 [outside reserves]). Alternatives 1 and 2 would continue selective harvest of large trees and fire exclusion to cause transitions to late-seral

Table 4-19. Primary Successional Transitions in Lower Montane Mid-seral Forests.

Alternative	Action Causing Transition	Primary Net Transitions		Effects
		Initial TC	Resulting TC	
1, 2	Fire Exclusion	Mid-seral Mid-seral	Mid-seral Late-seral multi-layer	-Mortality of large, intermediate trees due to stress, insect, and disease mortality.
		Late-seral	Mid-seral	-Associated effects of salvage logging.
3, 4, 5, 6 (outside reserves)	Prescribed Fire	Mid-seral	Late-seral single-layer	-Less net transitions to mid-seral than Alternatives 1 and 2.
4, 6	Harvest Prescribed Fire (resembling ecosystem processes)	Early-seral Mid-seral	Mid-seral Late-seral	-More native structures and compositions (live and dead standing, down trees).
				-Less crown fire potential than Alternative 7 (within reserves).

These effects are for Forest Service- and BLM-administered lands only.

Abbreviation used in this table: TC = Terrestrial Community type

multi-layer, resulting in greater amounts of late-seral multi-layer forests with structures and compositions unlike historical conditions. These structures would be similar to mid-seral communities due to the selective harvest of large overstory trees, and would have high risk of mortality due to fire, insects, disease, and stress). Alternatives 3 through 7 (outside reserves) would use harvest, prescribed fire, and/or thinning practices to promote transition of late-seral multi-layer forest to late-seral single-layer structures and to sustain that structure. Alternatives 4 and 6 would result in more native-like structures and compositions than the other alternatives because of their emphasis on activities that resemble ecosystem processes.

Montane early-seral forests (Table 4-21):

Transitions to montane early-seral forests would primarily result from harvest, wildfire, or prescribed fire in mid-seral and late-seral multi-layer communities. Alternatives 2 through 7 would use genetically improved western white pine stock to regenerate some harvested areas to provide some recovery of this species where it has been lost to white pine blister rust. Overall, the causes and effects of

transitions would be similar to those described for lower montane early-seral communities.

Montane mid-seral forests (Table 4-22):

Continued fire suppression under Alternatives 1 and 2 would cause many mid-seral communities to remain in this condition longer than would be typical for the fire regimes and biophysical conditions which would thin mid-seral communities and accelerate development of late-seral structures). Continued fire exclusion, however, would also allow some mid-seral structures to develop into late-seral multi-layer communities in areas that would otherwise cycle back to early-seral structural stages. For Alternatives 3, 5, and 7 (outside reserves) transitions to early-seral structural stages would result from prescribed fires. Alternatives 4 and 6 would emphasize use of harvest and prescribed fire to resemble ecological processes and promote the transition of early-seral communities to mid-seral structural stages, and mid-seral structural stages to late-seral single- and multi-layer structural stages, in areas and with patterns that are more consistent with characteristic biological and physical conditions and disturbance regimes. Effects of these

Table 4-20. Primary Successional Transitions in Lower Montane Late-seral Multi-layer and Late-seral Single-layer Forests.

Alternative	Action Causing Transition	Primary Net Transitions		Effects
		Initial TC	Resulting TC	
1, 2	Selective Harvest Large Trees	Late-seral multi-layer	Late-seral multi-layer	-Increased amounts of late-seral multi-layer structures similar to native, and more like mid-seral;
	Fire Exclusion	loss (dense) of large trees.		
		Mid-seral	Late-seral multi-layer	-Mortality risk (insects, disease, stress) high -Fire risk high. -Net productivity declines
		Late-seral single-layer	Late-seral multi-layer	-Associated effects of salvage logging. -Locations not consistent with biophysical environment.
3, 5, 7 (outside reserves)	Harvest Thinning Prescribed Fire	Late-seral multi-layer	Late-seral single-layer	-Fewer net transitions to late-seral multi-layer. -More transitions to late-seral single-layer.
4, 6	Harvest Prescribed Fire (resembling ecosystem processes)	Late-seral multi-layer	Late-seral single-layer	-More native compositions and structures (live, dead standing, down trees). -Repatter locations to be consistent with biophysical environments.

These effects are for Forest Service- and BLM-administered lands only.

Abbreviation used in this table: TC = Terrestrial Community type

transitions would be similar to those described for the lower montane mid-seral community. Overall, activity levels prescribed within all the alternatives would not be sufficient to reverse current trends of stable or increasing amounts of mid-seral communities, although Alternatives 4 and 6 would reduce the rates of increase more than other alternatives. Additionally, all alternatives would maintain a high likelihood of large crown fires due to the high density of trees in multi-layer mid-seral and late-seral forests.

Montane late-seral multi-layer and single-layer forests (Table 4-23): The primary transitions from late-seral multi-layer structural stages would be to early-seral (Alternatives 1, 2, and 7 [within reserves]) and late-seral single-layer structural stages (Alternatives 3 through 7 [outside reserves]). Transitions to late-seral multi-layer structural stages would occur from late-seral single-layer or mid-seral structural stages (Alternatives 1

and 2). For Alternatives 1 and 2, timber harvest, wildfire, and fire exclusion would be the primary causes for the predicted transitions in these communities. Alternatives 3 through 7 (outside reserves) would use harvest, thinning, and prescribed fire to reduce amounts of late-seral multi-layer structural stages and increase amounts of lower montane late-seral single-layer structural stages. Alternatives 4 and 6 would use these methods to resemble ecological processes. Wildfire would be the primary cause of predicted transitions from late-seral multi-layer to early-seral structural stages in Alternative 7 (inside reserves); consequently responses within reserves would be relatively unpredictable in the short term. Causes and effects of these transitions would be similar to those discussed for lower montane late-seral communities.

Most of the montane late-seral single-layer forest is found in moister parts of dry forest or

Table 4-21. Primary Successional Transitions in Montane Early-seral Forests.

Alternative	Action Causing Transition	Primary Net Transitions		Effects
		Initial TC	Resulting TC	
1	Harvest Wildfire	Mid-seral Late-seral multi-layer	Early-seral	-Uniform spacing and size (similar to plantations). -Landscape location inconsistent with biophysical environment.
2	Wildfire Some Harvest	Late-seral multi-layer Mid-seral	Early-seral	-Small harvest units. -Associated effects of salvage logging. -Landscape locations inconsistent with biophysical environment.
2 through 7	Artificial Regeneration	Early-seral	Early-seral (with western white pine)	-Recovery of some western white pine lost due to white pine blister rust.
3, 5, 7 (outside reserves)	Harvest Prescribed Fire	Mid-seral	Early-seral	-Alternatives 3 and 7 structures between Alternatives 1 and 2 and 4 and 6. -Alternative 5 structures similar to Alternative 1 in timber priority areas, similar to Alternative 3 elsewhere.
4, 6 processes)	Harvest Prescribed Fire (resembling ecosystem	Mid-seral	Early-seral	-More native compositions and structures (live/dead standing and down trees). -Landscape locations consistent with biophysical environments.
7 (within reserves)	Wildfire	Late-seral multi-layer	Early-seral	-Wildfire created structures.
All		Mid-seral		-Not enough emphasis to restore role of large western white pine lost to white pine blister rust.

These effects are for Forest Service- and BLM-administered lands only.

Abbreviation used in this table: TC = Terrestrial Community type

drier parts of moist forest potential vegetation groups. The present abundance of this terrestrial community is greater than that historically. Most of the land that currently supports montane late-seral single-layer forest structures historically supported lower montane late-seral single-layer forest (dominated by ponderosa pine, western white pine, or western larch in moist environments, or lodgepole pine in cooler environments). The current structures in these forests, affected by selective harvest of large ponderosa pine, western larch, and western white pine, as well as fire exclusion, would quickly shift into mid-seral structures due to mortality of the remaining overstory trees from stress, insects,

or disease, or into multi-layer structures through regeneration of shade-tolerant species in the understory. No alternative prescribes sufficient management activities necessary to stabilize or reverse the ongoing long-term decline of montane late-seral single-layer structures, especially for forests previously dominated by western white pine.

Subalpine early-seral forests (Table 4-24):

Primary transitions would be from late-seral to early-seral forests in all alternatives. Alternatives 2 through 7 would use genetic improvement of whitebark pine planting stock to support recovery of whitebark pine that was lost to white pine blister rust. Transitions in

Table 4-22. Primary Successional Transitions in Montane Mid-seral Forests.

Alternative	Action Causing Transition	Primary Net Transitions		Effects
		Initial TC	Resulting TC	
1, 2	Fire Exclusion	Mid-seral	Mid-seral	-Mortality of large, intermediate size trees due to stress, insect, disease mortality. -Associated effects of salvage logging.
		Mid-seral	Late-seral multi-layer	
3, 5, 7 (outside reserves)	Prescribed Fire	Mid-seral	Early-seral	-Less net transitions to mid-seral than Alternatives 1 and 2.
7 (within reserves)	Wildfire	Mid-seral	Early-seral	-Lower amounts of mid-seral than Alternatives 3 through 6.
4, 6	Harvest Prescribed Fire (resembling ecosystem processes)	Early-seral	Mid-seral	-More native structures and compositions (live and dead, standing, down trees). -Less crown fire potential than Alternative 7 (within reserves).
		Mid-seral	Late-seral	
All		Overall		-Activity levels not sufficient to reverse trends maintaining or increasing amounts of mid-seral, although Alternatives 4 and 6 reduce rates of increase more than other alternatives. -Maintain current high levels of mid-seral, although Alternatives 3 through 7 maintain less than 1 and 2. -Maintain high likelihood of large crown fire events due to contagion of areas of dense, multi-layer mid-seral and late-seral multi-layer.

These effects are for Forest Service- and BLM-administered lands only.

Abbreviation used in this table: TC = Terrestrial Community type

Alternatives 1 and 2 would be caused by harvest and fire exclusion, and often would result in: (1) uniform structures and compositions, (2) locations of early-seral communities inconsistent with biophysical environments and native disturbance regimes, and (3) little regeneration of shade-intolerant species. Alternatives 3 through 7 (outside reserves) would use prescribed fire and harvest to change late-seral structural stages to early-seral, with similar results as those described for lower montane early-seral forests. Alternatives 4 and 6 would emphasize management to resemble ecosystem processes, and could be more effective in restoring whitebark pine by providing suitable post-fire ash environments and planting blister rust resistant stock.

Within reserves in Alternative 7, wildfire would be the major cause of predicted transitions between late-seral and early-seral communities, although outcomes within reserves would be relatively unpredictable in the short term. No alternative would provide sufficient emphasis on restoration of whitebark pine to facilitate recovery of native diversity in the subalpine early-seral community.

Effects on Fire Regimes

Probabilities of wildfire vary with cover types and structural stages, and change according to the management prescriptions that affect forest composition and structure. To evaluate the effects of the alternatives on the occurrence and

Table 4-23. Primary Successional Transitions in Montane Late-seral Multi-Layer Forests.

Alternative	Action Causing Transition	Primary Net Transitions		Effects
		Initial TC	Resulting TC	
1,2	Harvest Wildfire	Late-seral multi-layer	Early-seral	-Structures not consistent with biophysical environment.
	Fire Exclusion	Mid-seral Late-seral single-layer	Late-seral multi-layer Mid-seral	-High mortality risk (insects, disease, snags). -Loss of large trees. -Locations inconsistent with biophysical environments.
3, 5, 7 (outside reserves)	Harvest Thinning Prescribed Fire	Late-seral multi-layer	Late-seral single-layer	-Increased net transitions to late seral single-layer, consistent with biophysical environments.
4, 6	Harvest Thinning Prescribed Fire (resembling ecosystem processes)	Late-seral multi-layer	Late-seral single-layer	-Increase net transition to late-seral single-layer, consistent with biophysical environments. -Native composition and structures.
7 (within reserves)	Wildfire	Late-seral multi-layer	Early-seral	-Response unpredictable. -High contiguous wildfire probabilities.
All				-Activity levels not sufficient to substantially reverse trends maintaining high amounts of multi-layer conditions, but Alternatives 3 through 6 have lower net transitions to this TC and are more proactive than Alternatives 1 and 2.

These effects are for Forest Service- and BLM-administered lands only.

Abbreviation used in this table: TC = Terrestrial Community type

type of wildfire in forestlands, CRBSUM simulations of historical, current, and potential future conditions were used to provide a relative framework for comparison (Table 4-25). The Columbia River Basin Successional Model estimates of historical wildfire conditions were derived from a 400-year simulation of pre-European settlement conditions, starting with historical vegetation conditions and using historical fire probabilities. Estimates for wildfire probability associated with implementation of each alternative were reported on the basis of the average acres per decade of disturbance, based on a 100-year simulation of prescribed alternative activities and succession patterns. Current wildfire levels were based on year 10 of the simulation

for Alternative 1 and are intended to provide an index of the present fire risk.

The CRBSUM outputs were adjusted to account for the effects of finer-scale patterns of live and dead vegetation, fuels compositions and structures, and overestimates in the modeled amount of management-ignited prescribed fire (Hann et al. 1996). Adjustment factors also incorporated the typical amounts of unburned area contained within wildfire perimeters that resulted from irregular vegetation and fuel patterns.

Estimates of acreage burned by crown fires (as opposed to surface fires) were developed by applying a classification based on species group

Table 4-24. Primary Successional Transitions in Subalpine Early-seral Forests.

Alternative	Action Causing Transition	Primary Net Transitions		Effects
		Initial TC	Resulting TC	
1	Harvest Wildfire Fire Exclusion	Late-seral	Early-seral	-Uniform spacing and size. -Locations inconsistent with biophysical environments. -Lack of regeneration of shade intolerant species.
2 through 7	Artificial Regeneration	Early-seral	Early-seral with whitebark pine	-Some recovery of whitebark pine lost to blister rust.
2	Wildfire Some Harvest Fire Exclusion	Late-seral	Early-seral	-Small harvest units. -Associated salvage logging effects. -Locations inconsistent with biophysical environments. -Lack of regeneration of shade-intolerant species.
3, 5, 7 (outside reserves)	Harvest Prescribed Fire	Late-seral	Early-seral	-Alternative 3 structures between Alternative 1 and Alternatives 4 through 6. -Alternative 5 structures similar to Alternative 1 in timber emphasis.
4, 6	Harvest Prescribed Fire (resembling ecosystem processes)	Late-seral	Early-seral	-More native composition and structures (live, dead standing and down trees). -Landscape locations consistent with biophysical environments.
7 (within reserves)	Wildfire	All	Early-seral	-Response unpredictable.
All				-Insufficient emphasis on restoration of whitebark pine lost due to blister rust.

These effects are for Forest Service- and BLM-administered lands only.

Abbreviation used in this table: TC = Terrestrial Community type

and crown closure to the vegetation burned in year 100 of the simulations of historical and potential future conditions. This classification was best-suited for estimating the percentage of wildfires that would become crown fires within the dry forest potential vegetation group. The percent of wildfires estimated to be surface fires was calculated by subtracting the crown fire percentage from 100 percent (Table 4-26).

To better illustrate the relative extent of the planning area to be affected by crown and surface fires in dry forests, the ratio of crown fires and surface fires to total wildfire was multiplied by the estimated percentage of the planning area that burns each decade, then

divided by the historical wildfire percentages. This provided a ratio of estimated acres burned by surface and crown fires (for current conditions and for each alternative) to historical acres burned by these types of fires historically (Table 4-27).

These simulation results (Tables 4-25 through 4-27) are the basis for the following discussions of likely consequences of the alternatives on wildfire. However, there are important modeling limitations. For example, CRBSUM is limited by the user's ability to account for substitution or overlap of prescribed fire, thinning, and harvest activities – the primary drivers of wildfire effects. Treatments proposed in the alternatives

Table 4-25. Net Acres Burned by Wildfire (Projected: Historical), Eastside Planning Area.

PVG	Historical Acres ¹	Current	Alternative						
			1	2	3	4	5	6	7
			<i>percent</i>						
Cold Forest	148,740	113	107	107	61	53	66	60	100
Dry Forest	1,972,647	38	39	38	20	17	20	18	40
Moist Forest	423,021	56	60	61	38	33	39	36	75

This table displays the ratio of estimated net acres burned by wildfire each decade to estimated historical acres (after 100 years). These data are for Forest Service and BLM-administered forestlands in the Eastside planning area.

¹ Acres per decade.

Abbreviation used in this table: PVG = potential vegetation group

Source: Adapted from ICBEMP GIS data and associated databases (1 km² raster data) and Quigley et al. (1997).

Table 4-26. Percentage of Dry Forest Burned by Surface and Crown Fires, Eastside Planning Area.

	Historical Acres ¹	Current	Alternative						
			1	2	3	4	5	6	7
			<i>percent</i>						
Surface Fires	72	46	27	25	50	51	45	53	36
Crown Fires	28	54	73	75	50	49	55	47	64

This table displays the estimated net percentage of acres burned by wildfires (after 100 years) that are surface or crown fires in the dry forest potential vegetation group for the Eastside planning area on Forest Service- and BLM-administered lands.

Source: Adapted from ICBEMP GIS data and associated databases (1 km² raster data) and Quigley et al. (1997).

Table 4-27. Ratio of Dry Forest Burned by Surface and Crown Fires, Eastside Planning Area.

	Historical Acres ¹	Current	Alternative						
			1	2	3	4	5	6	7
			<i>percent</i>						
Surface Fires	1,422,143	24	14	13	14	12	13	13	20
Crown Fires	550,507	72	101	103	35	30	39	30	92

This table displays the ratio of net acres of dry forest burned by surface fires and crown fires to historical acres on Forest Service- and BLM-administered lands in the Eastside planning area.

¹ Acres per decade.

Source: Adapted from ICBEMP GIS data and associated databases (1 km² raster data) and Quigley et al. (1997).

could be conducted on the same sites; for example, an area could be burned several years after it was thinned, or a sequence of prescribed fires could be conducted over a short time on the same area to incrementally reduce fire hazard without harming dominant overstory trees. For the DEIS, simulation of the alternatives did not provide sufficient detail to solve such modeling limitations. Prior to publishing the Final EIS, there may be model refinements to account for these more complex treatment scenarios, which could adjust interpretations of differences among alternatives and their comparison to historical patterns of wildfire. Nevertheless, the present simulations offer a relative basis for alternative comparison.

Effect on Wildfire Acres

In the cold forest potential vegetation group in the Eastside planning area, projections for Alternatives 3 through 6 yield fewer burned acres than current levels, with the lowest amount in Alternative 4 (Table 4-25). The amount of wildfire estimated for Alternatives 1, 2, and 7 in cold forests would be much greater than the other alternatives, with Alternative 7 resulting in burned acreage totals similar to estimates of historical conditions, and Alternatives 1 and 2 having more net acres burned than during the historical period.

All alternatives would have fewer acres burned in dry and moist forests than historically, with

the greatest reduction being in the dry forest potential vegetation group. Wildfires would burn only 17 to 20 percent of the acreage that was affected by wildfires historically under Alternatives 3, 4, 5, and 6. These levels of wildfire are in part due to the emphases on restoring late-seral single-layer structures, which would increase the potential effectiveness of fire suppression. There would be little difference among Alternatives 1, 2, and 7 for dry forest, although these alternatives would have approximately twice as much wildfire as Alternatives 3 through 6.

Alternatives 3 through 6 would have the lowest amounts of projected wildfire for the moist forest potential vegetation group, ranging from 33 to 39 percent of historical amounts of wildfire. Alternative 5 could have somewhat higher fire incidence than Alternatives 4 and 6 because timber priority areas in Alternative 5 would have more area with mid-seral stand structures, which have a higher level of fire risk. Alternative 3 could have higher wildfire risks than Alternatives 4 and 6 because Alternative 3 would have less prescribed fire treatment that could reduce flammability. For the moist forest potential vegetation group, Alternatives 1 and 2 would likely continue current conditions of relatively high fire risk (approximately 60 percent of the historical incidence of wildfire). Alternative 7 would increase the fire risk from current conditions to approximately 75 percent of the historical incidence of wildfire.

Effect on Crown Fire Occurrence

Under all alternatives, the amount of area burned by wildfires would be less than it was historically for the dry and moist forest potential vegetation groups. However, a clear idea of the wildfire trend and its ecologic effects cannot be gained without also considering the incidence of crown fires, which are, in general, more intense than surface fires and can result in substantial tree mortality. The CRBSUM simulation was not highly sensitive to mid- and fine-scale changes of forested landscape patterns which cause increased crown fire potential. However, a coefficient was developed that was used to reflect differences among alternatives for these conditions. The dry forest had the highest relative differences in crown fire potential and, therefore, was used as an indicator of differences among alternatives.

Considering only the dry forest potential vegetation group, simulated crown fire conditions indicated that all alternatives would have large decreases in the area burned by surface fires compared to the area burned with crown fires (Table 4-26). The CRBSUM simulations indicate that historically in the Eastside planning area, 72 percent of wildfire acres in the dry forest were burned by surface fires (Table 4-26). This is a similar conclusion to estimates made by comparing historical and current fire regimes (Morgan et al. 1996), where the nonlethal and mixed severity fire regime was present in 89 percent of the dry forest historically, and only 11 percent of the area would have burned with lethal, stand-replacing fires. Surface fires in dry forest were usually nonlethal to the dominant overstory, maintaining the open, park-like stands characteristic of ponderosa pine forests on benches and ridges, and generally controlled forest density on most dry forest sites.

The CRBSUM simulations further indicated that for all alternatives a substantially larger proportion of wildfire acres would be burned with crown fires than were historically in the dry forest potential vegetation group (Table 4-26). Alternatives 3, 4, and 6 would mostly closely achieve the historical proportion of crown fires (28 percent) of the seven alternatives, but would be only slightly lower than the current estimated proportion of 54 percent crown fires. The historical to current trend of increased proportions of crown fires in dry forest would not be reversed by Alternatives

1, 2, and 7, which show acres burned in dry forest would be 73, 75, and 64 percent crown fires, respectively, compared to surface fires.

Because the total burned acreage would be less than that historically for all alternatives in the dry forest potential vegetation group, a comparison was made of the relative amounts of wildfire burned by surface fires and crown fires within the planning area by alternative to historical amounts (Table 4-27). All alternatives would result in substantial reductions in the amount of surface fire compared to the amount of area historically burned. Alternatives range from 12 to 20 percent of the estimated historical surface fire acreage. However, the estimated area of the dry forest that would burn with crown fire varies considerably among alternatives. Alternatives 3 through 6 would have 30 to 40 percent of the acres of crown fire that occurred historically. Alternatives 1, 2, and 7 would have about the same net percent of the planning area burning with crown fire in dry forest as occurred historically. Consequently, most of the wildfire that does occur in dry forest under Alternatives 1, 2, and 7 is likely to result in high tree mortality. The relatively high amounts of crown fire in Alternatives 1, 2, and 7 probably would be due to the greater amounts of mid-seral and particularly late-seral multi-layer forest resulting from these alternatives, and to stand conditions that contribute to crown fire potential.

Fire suppression could result in fewer total acres burned than did historically. However, the resulting forest structures increased the relative proportion of crown fire. None of the alternatives prescribe sufficient activities to restore the historical proportions of crown fire relative to surface fire. This would result in continued wildland/urban interface fire problems, particularly in the dry forest potential vegetation group, unless forest restoration treatments, including fuel management, become a priority in wildland/urban interface areas. Management-ignited prescribed fire would replace a portion of the surface fire in dry forest in Alternatives 3 through 7 (Figure 4-12), although there could be higher tree mortality than typically associated with surface fires when stands are initially entered with prescribed fire after decades of fire exclusion.

A high proportion of wildfire acres in dry forest in Alternatives 1, 2, and 7 would be crown fires in areas that would likely burn with much less of a mosaic pattern than occurred historically. Crown fires can be accompanied by high amounts of consumption of surface fuel (including all size classes from twigs to coarse woody debris), litter, and duff layers. Much more extensive soil heating, to higher temperatures at greater depths in the soil, could result. It is not known what effects these significant changes in fire regime would cause over the long term.

Discussion and Conclusions

All alternatives would result in less wildfire than occurred historically because wildfires were not suppressed historically. Of the action alternatives, Alternative 7 would result in the greatest burned acreage because of the presence of reserves. (CRBSUM simulations assumed that fire suppression would occur only where fires threatened reserve boundaries, and essentially no actions would be taken within reserves to reduce flammable forest structures and fuels.) Alternatives 3 through 6 would have less wildfires than Alternatives 1, 2, and 7, because of the greater emphasis in Alternatives 3 through 6 on forest restoration and management actions that reduce the area of stand conditions susceptible to wildfire. However, no alternative prescribes sufficient restoration activities to prevent severe effects from wildfire. Wildfire, insects, disease, and stress would continue to have major effects on forest vegetation even in Alternatives 4 and 6,

which would have the highest level of restoration activities. Alternatives 3 through 7 would have much more prescribed fire than Alternatives 1 and 2, and Alternative 7 would have much less proposed harvest and thinning than Alternatives 3 through 6. Additionally, Alternatives 3 through 6 would have much more emphasis on restoration of vegetation patch size and pattern. Alternatives 4 and 6 would be most likely to repattern landscapes to their characteristic biological and physical conditions.

Harvest, thinning, and management-ignited prescribed fire actions often target late-seral multi-layer, and mid-seral lower montane and montane forest communities, often with the intent of reducing stand density and re-establishing dominance by a single forest canopy layer. Actions would tend to favor fire-tolerant, shade-intolerant species. Activity fuels generated by forest management activities would generally receive treatment to reduce flammability. Prescribed fire, both from management and natural ignitions, would restore natural processes to some extent. Appropriate post-fire rehabilitation actions would reduce the flammability of early-seral stands, and allow them to begin development toward a low density, single-layer forest, which is much less flammable than mid-seral or multi-layer forests.

However, no alternative would have a high enough level of active restoration to reverse wildfire trends. Wildfire, insects, disease, and stress would continue to have a major effect on

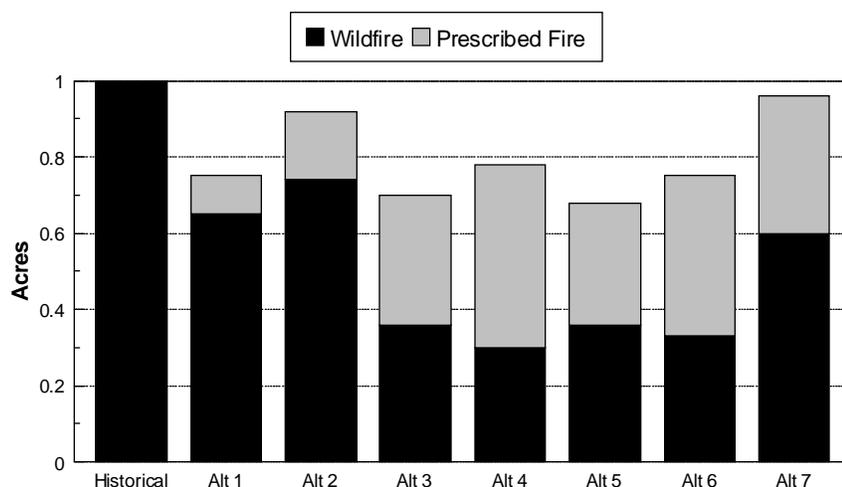


Figure 4-12. Relative Disturbance from Wildfire and Prescribed Fire, Dry Forest, Eastside Planning Area.

forest vegetation, even in Alternatives 4 and 6, which would have the highest level of restoration activities.

Effects on Insects and Disease

The alternatives would affect insect and disease susceptibility by altering forest structure and composition and landscape pattern. Forested communities with the highest composite insect and disease susceptibility are generally those with mid-seral closed canopy or understory reinitiation structures, or those with late-seral multi-layer structures. The net change index displayed in Table 4-28 summarizes anticipated effects relative to historical and current conditions by integrating predicted changes in broad-scale forest composition and structure, mid-scale landscape patterns, and fine-scale live and dead vegetation composition and structure. In general, effects on insect and disease susceptibility are likely to be underestimated because simulations did not account for increased susceptibility of a location due to its adjacency to an existing infected location.

Currently, there is 186 percent more area with high insect and disease susceptibility in the dry forest potential vegetation group (lower montane and some parts of the montane terrestrial communities) than historically. Alternatives 3 through 7 would reverse historical to current trends in high insect and disease susceptible forest communities; however, in the long term, areas with high susceptibility would remain 84 to 111 percent greater than historical levels. Predicted decreases in susceptibility from current conditions are due to restoration activities (harvest, thinning, prescribed fire) reducing the amounts of mid-seral and late-seral multi-layer communities. Trends for Alternatives 1 and 2 would continue to increase in area with high insect and disease susceptibility due to less emphasis on prescribed fire, and increases in mid-seral (especially in the Upper Klamath ERU) and late-seral multi-layer structures.

Currently, there is 66 percent more area with high insect and disease susceptibility in the moist forest potential vegetation group (lower montane and some parts of the montane and subalpine terrestrial communities) than historically. Increases in forestlands that have high insect and disease susceptibility for this

group were projected to continue for Alternatives 1 and 2 due to increasing trends in dense, multi-layer mid-seral structure (especially in the Northern Glaciated Mountains ERU). Alternatives 3 through 6 would reverse historical to current trends of increasing insect and disease susceptibility, but future conditions would remain at 31 to 49 percent above historical levels.

Currently, there is 50 percent more area with high insect and disease susceptibility in the cold forest potential vegetation group (subalpine and some parts of the montane terrestrial community) than historically. Under Alternatives 1 and 2, cold forests would continue their increasing trends of high insect and disease susceptibility due to less emphasis on prescribed fire treatments and greater increases in dense multi-layer mid-seral structures than Alternatives 3 through 6. Alternatives 3 through 7 would likely reverse this current trend of increasing high susceptibility. However, Alternative 7 is projected to have less decrease in area with high susceptibility than Alternatives 3 through 6, due to passive management within reserves. Outside reserves, Alternative 7 would likely have a similar response as Alternative 3.

Ability to Resemble Natural Forest Disturbance

All alternatives will affect forest disturbance processes through practices such as prescribed fire, thinning, fire suppression, and harvest, and the effects of these practices on natural processes such as wildfire and insects and diseases. Alternatives 1 and 3 through 6 are likely to directly disturb the same percentage of the project area per decade as was disturbed historically (approximately 30 percent), while Alternative 2 would disturb less area (approximately 20 percent) per decade in the short and long term (Table 4-29). However, when evaluating the relative ability of each alternative to resemble natural forestland disturbance processes, as shown in Table 4-30, greater differences among alternatives emerge. Alternatives 4 and 6 would result in the greatest emphasis on practices that resemble or closely resemble natural forest disturbance processes. Alternatives 3, 5, and 7 (outside reserves) would diverge more from natural disturbance processes due to local emphasis and regional priorities. Alternatives 1, 2, and 7 would result in practices or conditions that do

Table 4-28. Long-Term Change Index of Areas in High Insect and Disease Susceptibility Condition, Eastside Planning Area.

PVG	Terrestrial Forest Community	Reference Point	Current	Alt 1 100yr	Alt 2 100yr	Alt 3 100yr	Alt 4 100yr	Alt 5 100yr	Alt 6 100yr	Alt 7 100yr
Dry Forest	Lower Montane and Montane	Change from historical	186	257	293	111	84	111	90	182
		Change from current	-	25	37	-26	-36	-26	-34	-2
Moist Forest	Montane and Subalpine	Change from historical	66	77	76	49	31	46	37	67
		Change from current	-	6	6	-11	-21	-12	-18	0
Cold Forest	Subalpine	Change from historical	50	75	69	31	14	34	22	48
		Change from current	-	16	12	-13	-24	-11	-19	-2

This table displays the net change index of areas with high susceptibility to insects and disease. The change is from historical to current to projected (100 years) conditions on Forest Service- and BLM-administered land in the Eastside planning area.

Abbreviation used in this table: PVG = potential vegetation group

Source: Adapted from ICBEMP GIS data and associated databases (1 km² raster data) and Quigley et al. (1997).

not resemble natural forest disturbance processes due to: (1) less use of prescribed fire than Alternatives 3 through 6; (2) implementation of traditional fire and fuel treatment that focus on fuels reduction rather than resembling natural disturbance processes; or (3) potentially large, high-severity wildfires (Alternative 7 within reserves) that do not resemble natural fire regimes in the short term.

Cumulative Effects

Table 4-31 summarizes and integrates major conditions and trends as they relate to forested community structure and composition.

In the project area, there may be as much as a 20 percent increase in commodity production on non-federal lands with implementation of Alternative 7 because of the establishment of reserves and the consequent reductions in commodity production on approximately 50 percent of Forest Service- and BLM-administered lands.

Table 4-29. Percent of Area Affected by Direct Forest Disturbance, Eastside Planning Area.

Projection	Historical	Alternative						
		1	2	3	4	5	6	7
<i>percent</i>								
10 year	21	18	13	24	23	22	22	14
100 year	21	18	14	24	24	23	22	15

This table displays the percent of Forest Service- and BLM-administered lands in the Eastside planning area that are affected by direct forest disturbance (prescribed fire, wildfire, thinning, harvest) at the broad scale.

Source: ICBEMP GIS data (1 km² raster data).

Table 4-30. Ability of Disturbances to Resemble Natural Processes in Forestlands, Eastside Planning Area.

	Alt 1	Alt2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7 within reserves	Alt 7 outside reserves
Relative Rating	0	0	-	+	-	++	0	-
Explanation	-Less prescribed fire than Alts 3-7. -Thinning and prescribed fire treatments traditional (fuel reduction).	-Less prescribed fire than Alts 3-7 -Prescribed fire treatments traditional (fuel reduction).	-Prescribed fire aims to resemble ecological fire processes. -Thinning and harvest achieve some prescribed fire objectives. -Local priorities drive activities. -"Minimal fix" of existing plans.	-Prescribed fire aims to resemble ecological fire processes. -Thinning and harvest achieve some prescribed fire objectives.	-Prescribed fire aims to resemble ecological fire processes. -Thinning and harvest achieve some prescribed fire objectives. -Emphasizes economic efficiency.	-Prescribed fire aims to resemble ecological fire processes. -Thinning and harvest achieve some prescribed fire objectives. -Technology development supports ecological treatments.	-Amount of wildfire highest. -Large, high severity fires do not resemble ecological regimes.	-Less prescribed fire than Alts 3-6, more than 1 and 2. -Prescribed fires aims to resemble ecological fire processes. -Thinning and harvest achieve some prescribed fire objectives.

This table shows the relative ability of broad-scale actions in each alternative to resemble natural ecological processes in forestlands administered by the Forest Service or BLM in the Eastside planning area.

- (0) = does not resemble natural ecological disturbance
- (-) = diverges from natural ecological disturbance
- (+) = resembles natural ecological disturbance
- (++) = closely resembles natural ecological disturbance

Table 4-31. Major Trends in Forestland Conditions, Eastside Planning Area.

Conditions and Trends	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Interior ponderosa pine decreases across its range, with significant decrease in the amount of old single-story structures. Primary transitions were to Douglas-fir and grand fir/white fir.	Continued decline due to traditional harvest and fire exclusion although it is essentially non-existent within another 50 years.		Amount of this type (late-seral ponderosa pine single-layer forest Terrestrial Community) increases on BLM/FS land to approximately 60% of the historical level over a 100-year period with thinning and prescribed fire. Difficult to achieve in wilderness and semi-primitive areas unless a fairly active prescribed fire program is used.				Within reserves-- similar to Alt 2. Outside reserves-- similar to Alt 3 except resulting in only half the amount projected for Alt 3.
	Transition to late-seral multi-story or mid-seral would continue with high mortality of large and intermediate trees from stress, insects, disease, wildland fires along with associated effects of salvage logging.		Relatively high levels of net transitions to late-seral single-story. Pattern similar to regime associated with biophysical template of this type.				Within reserves-- similar to Alt 2. Outside reserves-- similar to Alt 3.
	Tend to produce late-seral multi-story or mid-seral communities in place of late-seral single-story communities.		Somewhat between traditional structures of Alts 1&2 and ecological structures of Alts 4&6 depending on local priority and degree of ecological emphasis.	Emphasis on resembling ecosystem processes with harvest, thinning, and prescribed fire would produce late-seral single-story structures closest to native composition and structure for live and dead standing, down trees.	High production areas would be similar to Alt 1 and other areas would be similar to Alt 3. Limitations related to economic priorities create a moderate ability to emphasize repatterning of this type.	Same as Alt 4 except would proceed at slower rate with more energy put into technology development.	Within reserves-- this type would be cycled with prescribed natural fire. Outside reserves--similar to Alt 3.
	No management emphasis for this type.		Focus for thinning, harvest, and fuel treatments is in ERUs 1-6.	Prescribed natural fire would play primary role with some associated harvest, thinning, and prescribed fire treatments in ERUs 1&6. Thinning, harvest, and fuel treatments to reduce risk of wildfire would be prioritized in ERUs 5-7. Moderate emphasis on thinning, harvest, and fuel treatments in ERUs 1-6. Low emphasis in ERUs 1-7.	Some focus on this type, but it would be prioritized in ERUs 1-7.	Same as Alt 4.	Within reserves-- no management emphasis.

Table 4-31. Major Trends in Forestland Conditions, Eastside Planning Area (continued).

Conditions and Trends	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Western larch decreased across its range. Primary transitions were to interior Douglas-fir, lodgepole pine, or grand fir/white fir.	Steep decline in late-seral single-story montane forest from current to well below historical by year 100.	Same as Alt 1 for late-seral single-story.	Generally restoration alternatives reduce the decline of this type, but emphasis is not sufficient to stabilize the decline. Possible to maintain historical level but average decade of activities to manage need to increase by about 50% and need substantial emphasis placed on managing western white pine in the more moist environments. To achieve this type in wilderness and semi-primitive areas, its assumed that a fairly active prescribed natural fire program is used.				Within reserves--late-seral single-story continues to shift to late-seral multi-story but wildland fires would shift many to early-seral communities. Late-seral multi-story has a steep decline similar to Alt 1 and is affected primarily by prescribed natural fire. Outside reserves--late-seral single-story is similar to Alt 3. Late-seral multi-story has similar curve as Alt 3 and is affected primarily by harvest, thinning, and prescribed fire.
Western white pine has decreased 95 percent across its range. Primary transitions were to grand fir/white fir, western larch, and shrub/herb/tree regeneration.	Strongest decline in late-seral multi-story over 100 years in response to harvest and some wildland fires.	Much less of a reduction in late-seral multi-story.	Generally a decline through the first 50 years and then changing to an increasing trend between years 50-100. This shift is a result of much of the current mid-seral stages in roadless areas and early-seral stages in roaded areas changing into late-seral stages.				
	Transition to late-seral single-story from mid-seral and from late-seral single-story ponderosa pine caused decrease primarily in mid-seral stages. This pattern of change is associated with high mortality of large and intermediate size trees from stress, insects, disease, wildland fire, and associated effects of salvage logging.	Same as Alt 1. For late-seral single-story.	The late-seral single-story decline slightly and are associated with transitions to the mid-seral stages. Slight decrease in current trend but between year 50 and 100 basically become overwhelmed by the large component of early-seral and mid-seral shifting into late-seral because not enough area is treated to substantially change the trend. Substantial increases in the transitions to the late-seral single-story community. Pattern is similar to the regime associated with the biophysical environment of this type.				Within reserves--less decline of late-seral single-story. Response of late-seral multi-story is highly unpredictable because the probabilities for large contiguous wildland fires in this community were substantially underestimated. Outside reserves--late-seral single-and multi-story response is similar to Alt 3.

Reduces transition to late-seral multi-story the most after achieving historical levels, but continues to create structures not in sync with the basic disturbance regime.

Slight decrease in rate of transition to late-seral multi-story.

For all alternatives, the overall pattern in the future on the dry end of the moist forest and the moist end of the dry forest is one that will be associated with high mortality of large and intermediate size trees from stress, insects, disease, wildland fire, and associated effects of salvage logging.

Increase the transition to mid-seral and late-seral multi-story, which are not in short supply.

Tend to produce late-seral multi-story communities which are very dense with high mortality in response to fire exclusion or communities without large old trees due to effects of harvest.

Late-seral single- and multi-story structures are somewhat between traditional structures of Alts 1&2 and ecological structures of Alts 4&6 depending on local priority and degree of ecological emphasis.

Emphasis on resembling ecosystem processes with harvest, thinning, and prescribed fire would produce late-seral single- and multi-story structures closest to native composition and structure for live and dead standing/down trees. Late-seral single-story communities would also emphasize regenerating shade- intolerant species such as western white pine, western larch, and lodgepole pine.

High production areas would be similar to Alt 1 and other areas would be similar to Alt 3 for late-seral single- and multi-story communities. Limitations related to economic priorities create a moderate ability to emphasize repatterning of this type.

Same as Alt 4 but at a slower rate with more energy put into technology development.

Within reserves-- the late-seral single-story structures would eventually develop fairly similar to the native structures. Late-seral multi-story structures would be created by wildland fire. Outside reserves-- similar to Alt 3 for both late-seral single- and multi-story structures.

Table 4-31. Major Trends in Forestland Conditions, Eastside Planning Area (continued).

Conditions and Trends	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
<p>Western larch decreased across its range. Primary transitions were to interior Douglas-fir, lodgepole pine, or grand fir/white fir.</p> <p>Western white pine has decreased 95% across its range. Primary transitions were to grand fir/white fir, western larch, and shrub/herb/tree regeneration.</p>	<p>No management emphasis for late-seral single-story. Restoration is less proactive than Alts 3-7. Disturbances and treatments for late-seral multi-story are scattered throughout all ERUs.</p>	<p>Emphasis for thinning, harvest, and fuel treatments in the late-seral single- and multi-story communities would be in ERUs 1-6.</p>	<p>Prescribed natural fire program would play primary role in late-seral single- and multi-story communities with some associated harvest, thinning, and prescribed fire treatments in ERUs 1 and 6. Thinning, harvest, and fuel treatments to reduce risk of wildland fire would be prioritized in ERUs 5-7. Moderate emphasis on thinning, harvest, and fuel treatments in ERUs 1-6. Low emphasis in ERUs 1 and 2 and 4-7.</p>	<p>Some focus but prioritized in ERUs 1-7.</p>	<p>Same as Alt 4.</p>	<p>Within reserves--no management emphasis for these types. Outside reserves--similar to Alt 3.</p>	
<p>Whitebark pine/alpine larch potential vegetation type has decreased 95% across its range, primarily through a decrease in the alpine larch component. Overall, pure whitebark pine stands have decreased, with</p>	<p>The late-seral single-story communities decline well below historical levels at about the same rate for all alternatives. Most of this type is wilderness and semi-primitive areas.</p>					<p>Alt 6 has higher potential than other alternatives for technology development and progress to higher levels of prescribed natural fire in late-seral single-story communities.</p>	

compensating increases in Engelmann spruce/subalpine fir.

All alternatives show an increase in late-seral multi-story communities to historical levels within 50 years.

Alternatives 1 and 2 show steady increase above historical levels.

Alternatives 3-6 increase to historical levels by year 50 and level out through year 100.

Within reserves level by year 100. late-seral multi-story is fairly unpredictable given dynamic nature of fire. Outside reserves-- similar to Alt 3.

Traditional harvest and fire exclusion would increase levels of the late-seral single- and multi-story structures that is out of sync with its basic disturbance regime. This is particularly true in the 50- to 100-year period for late-seral multi-story communities.

Substantial action is not taken for late-seral single-story communities relative to prescribed natural fires during the weather conditions that could be used to provide for this disturbance regime. Late-seral multi-story communities would be between traditional structures of Alt 1 and ecological structures of Alts 4&6 depending on local priority and ecological emphasis.

Substantial action is not taken for late-seral single-story communities relative to prescribed natural fires during the weather conditions that could be used to provide for this disturbance regime. Emphasis on mimicking ecosystem processes with harvest, thinning, and prescribed fire would produce late-seral multi-story structures closest to native composition and structure for live and dead standing/down trees.

Substantial action is not taken for late-seral single-story communities relative to prescribed natural fires during the weather conditions that could be used to provide for this disturbance regime. Little emphasis on mimicking ecosystem processes with harvest, thinning, and prescribed fire to produce late-seral multi-story structures closest to native composition and structure for live and dead standing/down trees.

Same as Alt 4.

Within reserves-- response of late-seral single- and multi-story structures over the long term would be similar to historical structures however dynamic nature of wildland fire may preclude development of mid-seral structures. The patterns for late-seral multi-story are not expected to stabilize within the 100 year period. Outside reserves-- late-seral single- and multi-story are similar to Alt 3.

Table 4-31. Major Trends in Forestland Conditions, Eastside Planning Area (continued).

Conditions and Trends	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Whitebark pine/ alpine larch potential vegetation type has decreased 95% across its range, primarily through a decrease in the alpine larch component. Overall, pure whitebark pine stands have decreased, with compensating increases in Engelmann spruce/ subalpine fir.	Disturbance and treatments for late-seral single- and multi-story would generally be scattered throughout all ERUs.		Emphasis areas based on local priorities.	Prescribed natural fire program would play primary role in late single and multi-story communities with some associated harvest, thinning, and prescribed fire treatments in ERUs 1 and 6. There would not be substantial emphasis in other ERUs due to the low composition of the cold forest and higher priorities through all alternatives on improving conditions in the dry and moist PVGs.	Some focus on this type.	Same as Alt 4.	Within reserves-No management emphasis for these types. Outside reserves-- similar to Alt 3.
Mid-seral forest structures have increased in dry and moist forest PVGs with a loss of large scattered residual shade-intolerant tree components and an increase in density of smaller diameter shade-tolerant trees.	Mid-seral ponderosa pine community shows a strong increase primarily on BLM/FS lands but also somewhat comparable to management on other lands. Mid-seral montane shows a general decline to year 50 then levels out at somewhat greater than historical levels at year 100.		Mid-seral ponderosa pine community generally is maintained at current levels with harvest, thinning, and prescribed fire along with the associated effects of wildfire. Mid-seral montane shows a general increase to year 50 then a decline to somewhat greater than current levels by year 100 but results in lower amounts of this type than Alts 1&2.				Within reserves-- mid-seral ponderosa pine is similar to Alt 2. Mid-seral montane would be converted by prescribed natural fire to early-seral communities and there would be less mid-seral than Alts 3-6. Outside reserves-- mid-seral ponderosa pine is similar to Alt 3. Mid-seral montane is similar to Alt 3.

Mid-seral ponderosa pine community continues transition of upland herb, early-seral, and late-seral to mid-seral and maintains much of mid-seral (generally transitions to itself or late-seral multi-story).

Mid-seral montane generally transitions to itself or to late-seral multi-story. High mortality of large and intermediate size trees from stress, insects, disease, and wildland fire, and associated effects of salvage logging are associated with the transitions of both mid-seral montane and ponderosa pine communities.

Produces mid-seral communities similar to tree farms with uniform spacing and size for both mid-seral ponderosa pine and montane communities. Traditional harvest and fire exclusion continues to create structures not in sync with the basic disturbance regime.

Produces stands of high density and small dead standing and down trees with patches similar to Alt 1. Traditional harvest and fire exclusion continue to create structures not in sync with the basic disturbance regime.

Mid-seral ponderosa pine community has much lower levels of net transitions to mid-seral and are generally to late single. Pattern is similar to regime associated with BPT of this type. Maintains amount on BLM/FS lands similar to current and substantially above historical levels.

Mid-seral montane community has much lower levels of net transitions to mid-seral and late-seral stages with an increased transition to early-seral. Lower amounts of this type exist by year 100 than Alts 1&2.

Somewhat between traditional structures of Alts 1&2 and ecological structures of Alts 4&6 depending on local priority and degree of ecological emphasis. Proceeds at varying rates based on local emphasis.

Emphasis on resembling ecosystem processes with harvest, thinning, and prescribed fire would produce mid-seral ponderosa pine and montane structures closest to native composition and structure for live and dead standing/down trees.

High production areas would be similar to Alt 1 and other areas would be similar to Alt 3. Limitations related to economic priorities create a moderate ability to emphasize repatterning of this type.

Same as Alt 4 except would proceed at slower rate with more energy put into technology development.

Within reserves--mid-seral ponderosa pine community is similar to Alt 2. Mid-seral montane community has wildland fire converting some of the type to early-seral. There would be less of this type than Alts 3-6. Outside reserves--mid-seral ponderosa and montane are similar to Alt 3.

Within reserves--mid-seral ponderosa pine has structures created by prescribed natural fire. Mid-seral montane is highly dynamic and variable in response to wildland fires. Outside reserves--similar to Alt 3 for both mid-seral ponderosa pine and montane communities.

Table 4-31. Major Trends in Forestland Conditions, Eastside Planning Area (continued).

Conditions and Trends	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Mid-seral forest structures have increased in dry and moist forest PVGs with a loss of large scattered residual shade-intolerant tree components and an increase in density of smaller diameter shade-tolerant trees.	Disturbance and treatments for mid-seral ponderosa and montane communities would generally be scattered throughout all ERUs.		Emphasis for thinning, harvest, and fuel treatments in the late-seral single- and multi-story communities would be in ERUs 1-6.	Prescribed natural fire program would play primary role in late single and multi-story communities with some associated harvest, thinning, and prescribed fire treatments in ERUs 1, and 6. Thinning, harvest, and fuel treatments to reduce risk of loss from wildfire would be prioritized in ERUs 5-7. Moderate emphasis on thinning, harvest, and fuel treatments in ERUs 1-6. Low emphasis in ERUs 1, 2, 4-7.	Some focus but prioritized in ERUs 1-7.	Same as Alt 4.	Within reserves-- disturbances would generally be scattered throughout all clusters. Outside reserves-- would be similar to Alt 3.
Loss of the large tree component (live and dead) within roaded and harvested areas. This decrease affects terrestrial wildlife species closely associated with these old forest structures.	Traditional harvest and fire exclusion continue to create structures not in sync with the basic disturbance regime.		Somewhat between traditional structures of Alts 1&2 and ecological structures of Alts 4&6 depending on local priority and degree of ecological emphasis. Proceeds at varying rates based on local emphasis.	Emphasis on resembling ecosystem processes with harvest, thinning, and prescribed fire would produce late-seral single- and multi-story structures closest to native composition and structure for live and dead standing/down	High production areas would be similar to Alt 1 and other areas would be similar to Alt 3. Limitations related to economic priorities create a moderate ability to emphasize repatterning of this component.	Similar to Alt 4.	Within reserves-- the large tree component would be cycled with wildland fires. Outside reserves-- similar to Alt 3.

This table applies to the Eastside planning area only.

Abbreviations used in this table:

BPT = biophysical template

PVG = potential vegetation group

Rangelands

Assumptions

The following major assumptions were made by the Science Integration Team during their evaluation of alternatives:

Rangeland Vegetation

- ◆ Technology is presently available that can produce desirable grazing systems and range restoration results in forest, range-riparian, cool shrub, and woodland potential vegetation groups.
- ◆ The modeled 100-year projection of the geographic extent of exotic vegetation

Summary of Key Effects and Conclusions

- ◆ Alternatives 4 and 3 are predicted to be the most effective in reducing the spread of noxious weeds and cheatgrass on rangelands in the project area. Alternatives 6 and 7 would be the next most effective, followed by Alternative 5, with Alternatives 2 and 1 being the least effective. No alternative was predicted to reduce the acres of infestations on dry grassland. Alternatives 3 and 4 were predicted to decrease the acres of noxious weed infestations, in general, on the dry and cool shrublands. Differences among alternatives would be due to differing management activity levels and the differing emphases of control efforts, related to the number of acres treated, location of treatment, and type of noxious weed species treated. Alternative 4 proposes the most acres of noxious weed control and the greatest emphasis of implementation of the integrated weed management strategy; therefore, it is projected to be the most effective alternative with regard to reducing the spread of noxious weeds and cheatgrass.
- ◆ Alternatives 4, 3, 6, and 7 are predicted to be the most effective in reducing the encroachment or density of woody species on rangelands in the project area. Alternative 5 would be the next most effective, and Alternatives 2 and 1 would be the least effective. It is predicted that Alternative 4 and possibly Alternative 3 would meet the desired range of future condition (DRFC) with regard to reducing woody species encroachment or density problems. Differences among alternatives would be due to differing management activity levels and differing emphases of control efforts, related to the number of acres treated and the location of treatment. Alternative 4 proposes the highest levels of prescribed burning and harvesting of woody species; therefore it is predicted to be the most effective with regard to reducing woody species encroachment or density.
- ◆ Alternatives 4, 3, and 6, respectively, are predicted to be the most effective in restoring rangeland vegetation in the project area. Alternative 7 would be the next most effective, followed by Alternative 5. Alternatives 2 and 1 would be the least effective. These alternatives would not have an effect on restoration of rangeland vegetation types on non-federal lands. The ranking of alternatives was based on their relative predicted ability to restore rangeland vegetation types that have been taken over by noxious weeds or by woody species, such as juniper, on BLM- or Forest Service-administered lands. Differences among alternatives are due to similar factors as those for noxious weeds and woody species control.
- ◆ Alternatives 4 and 6 would be the most effective in reducing fragmentation and loss of connectivity on rangelands in the project area. Alternative 7 would be the next most effective, followed by Alternative 3. Alternatives 5, 2, and 1 would be the least effective. Most restoration activities would be undertaken under Alternatives 3 through 7 after consideration of fragmentation and connectivity issues. Standards and guidelines in Alternatives 4 and 6 would be the most effective in reducing fragmentation and loss of connectivity due to the implementation of management actions that reduce existing problems and do not cause further problems.
- ◆ Alternatives 4, 6, and 7 are predicted to be the most effective in restoring slow-to-recover rangelands (not infested with exotics) in the project area. Alternative 3 would be the next most effective, followed by Alternative 5. Alternatives 2 and 1 would be the least effective. Restoration activities such as range vegetative improvements and livestock management improvements, would be the highest in Alternatives 3 and 4 (range improvements) and Alternatives 4 and 6 (livestock management improvements).
- ◆ Alternatives 7, 4, and 6 would be the most effective in reducing wildlife displacement and vulnerability to mortality on rangelands in the project area. Alternative 3 would be the next most effective, followed by Alternative 5. Alternatives 2 and 1 would be the least effective. Differences among alternatives are due to relative effects of road closure, road use, and human activity. Alternative 7 would reduce wildlife displacement and vulnerability to mortality through existence of the reserves.
- ◆ The amount of wildfire would be much less than historical levels on rangelands because of fire exclusion, with the exception of the dry shrub potential vegetation group in Alternatives 1, 2, and 7. For all range potential vegetation groups Alternatives 3, 4, 5, and 6 would have lower levels of wildfire than the other alternatives.

probably is overestimated for Alternative 2. The SIT believes the objectives for Alternative 2 are quite similar to those for Alternative 1 ~ at least those that pertain to the dispersal and control of exotic plants. Consequently, values of exotic weeds, upland shrubland, and upland herbland communities were adjusted to be similar to those of Alternative 1.

Discussion ~ The EIS Team made the assumption that all results regarding rangeland vegetation were the same for Alternatives 1 and 2 because the interim direction that applies in Alternative 2 (but not Alternative 1) does not significantly affect rangeland vegetation.

- ◆ The current amount of exotic vegetation was probably underestimated using remote sensing. Consequently, it is highly probable that exotics would increase to higher levels than projected with the Columbia River Basin Successional Model (CRBSUM) simulations.

Discussion ~ The EIS Team agreed with the hypothesis that at the fine scale the amounts of exotic weeds are much higher than was able to be mapped at the broad scale. The projected trends for exotics will depend upon the interaction of the alternative, the range cluster, and the rangeland potential vegetation group (see Effects on Noxious Weeds section later in this chapter). See the first assumption in the Noxious Weeds Assumptions section.

- ◆ The diversity and productivity of native plant communities at the fine scale has been reduced by the history of excessive livestock grazing. However, changes in range management practices over the past 20 to 40 years have improved the state of rangeland vegetation. Through time, the integrity of dry grass, cool shrub, and dry shrub groups will improve.

Discussion ~ This assumption relates to rangeland integrity at watershed or larger scales (the SIT ranked Alternatives 1 and 2 as “low” for achieving landscape rangeland integrity [see Table 4-12]). The EIS Team assumed, in addition, that rangeland integrity could be improved through the cumulative effect of management actions

taken at finer scales. The EIS Team also noted that integrity is affected by exotic vegetation; therefore, rangeland condition or integrity may not necessarily improve under all alternatives when considering exotics.

- ◆ Grazing regimes typically will be implemented to resemble the types of grazing to which the dominant decreaser (species most palatable and preferred by grazing animals, and that tend to decrease under grazing pressure) native grasses and forbs are adapted. Typically this results in short-duration, low to moderate utilization, with emphasis on higher utilization levels during the dormant seasons.

Discussion ~ There are exceptions in the case of seeded areas, especially areas seeded with crested wheatgrass, where grazing might not be implemented in a manner that fosters maintenance of decreaser native herbs. Some crested wheatgrass seedings need relatively heavy grazing pressure to reduce the presence of plants with tall dead stems and to sustain forage production. Higher utilization levels during the dormant season would be consistent with Alternatives 3 through 7 direction and promote protection of the soil resources by leaving residual matter.

- ◆ Current Forest Service and BLM land use plans (Alternatives 1 and 2) rely on systematic livestock grazing systems. In Alternatives 3 through 7, there will be more emphasis on systematic grazing during the dormant season, with monitoring of grazing more closely during the growing season in order to resemble native grazing regimes and to improve the competitive ability of native perennial grasses against exotic annuals and perennials.

In addition to the SIT assumptions, the EIS Team also assumed the following:

- ◆ The results of CRBSUM runs for rangelands (see the Rangelands Methodology section later in this chapter) were used in Chapter 4 for their value in the relative ranking (comparison) of alternatives. The relative differences among alternatives were believed to be accurate, but the actual acreage of terrestrial communities predicted for each alternative were not accurate because

current amounts of exotics were underestimated. Exotic weeds, wildfire, and prescribed burn acres that were simulated with CRBSUM for Alternatives 3 through 7 are useful for comparisons of trends among alternatives but have low accuracy in amounts by potential vegetation group.

Noxious Weeds

The following assumptions are based on the understanding that remote sensing of vegetation did not accurately portray the historical or current geographic extent of noxious weeds. Because those data were used as inputs for the Columbia River Basin Successional Model (CRBSUM), the outputs from CRBSUM were also inaccurate. Therefore, the evaluation of noxious weeds and cheatgrass did not use the CRBSUM outputs for exotics.

- ◆ The SIT's evaluation assumed that projected exotic weed extent would vary, according to (1) the alternative, (2) the range cluster, and (3) the rangeland potential vegetation group under consideration. The noxious weed portion of Chapter 3 was set up so noxious weed control would vary by the management emphasis (Conserve, Restore, or Produce) of each range cluster within each alternative; consequently, the exotic weed extent sometimes could decrease in 100 years for some clusters under some alternatives.
- ◆ Integrated Weed Management (IWM), described in Chapter 3, would be applied to all lands. The steps of Integrated Weed Management are expected to be implemented on all lands, but the assumption was made that noxious weeds would continue to encroach upon BLM- or Forest Service-administered lands from other lands, in all alternatives and all range clusters.
- ◆ Remote sensing did not accurately portray the current extent of exotic weeds in the project area, primarily because the broadleaved exotic forb species (for example, the knapweed complex) could not be detected from aerial photos and satellite imagery, and the exotic annual grasses, for example cheatgrass and medusahead, could not be detected where they were an understory component or in small patches (less than 160 acres).
- ◆ All rankings between 20 and 30 in Table 4-36 (later in this chapter) represent prevention of further infestation of rangeland potential vegetation groups (dry grass, dry shrub, or cool shrub) by noxious weeds; the higher the ranking, the higher the amount of the potential vegetation group restored. In other words, in 100 years, at least some of the potential vegetation group would be restored if the rank is greater than 20. All rankings of 20 or less represent further weed infestation; as the rank decreases toward 0, more of the potential vegetation group would be infested by weeds.
- ◆ Some of the acreage proposed for Livestock Management activities in Table 3-7 would include acreage proposed for noxious weed control within the Improve Rangelands activity. If this assumption is not met, there is a relatively higher risk of reinvasion by noxious weeds of sites that have received control, compared with sites that have received control but lack post-control livestock management. The Livestock Management activity is pertinent to Step 7 (Proper Range Management) and Step 2 (Preventing Weed Encroachment) of Integrated Weed Management.
- ◆ Some areas within the Prescribed Burning activity in Table 3-7 would include burning for weed control. For example, prescribed burning could control of medusahead, especially if it is conducted just prior to seed ripe.
- ◆ Weed species presented in the range cluster tables, predicted effects tables in the *Evaluation of Alternatives*, and Chapter 4 tables are not the only weeds that will be targeted for weed control. Species referred to in these tables were those assessed in the Scientific Assessment. Other noxious weeds undoubtedly are present in the project area and should be the target for weed control (IWM) efforts if they are found. Cheatgrass is not legally declared noxious in the project area, but the assumption is made here that the alternatives and the IWM strategy would pertain to cheatgrass as if it were a noxious weed. The acreage listed in the Improve Rangelands portion of Table 3-7 are assumed to apply to cheatgrass.

- ◆ The midpoint of the range of acres presented in the Improve Rangelands activity in Table 3-7 is the highest estimated number of acres that would be treated for weed control, because other activities are included in the Improve Rangelands category. The acreage scheduled for noxious weed control was assumed to be within the Improve Rangelands activity, and was assumed to pertain to each decade for the next 100 years.
- ◆ Integrated weed management efforts would be emphasized in high human process disturbance areas, which typically include roaded areas, waterways, campgrounds, and trails.
- ◆ In Alternative 7, noxious weeds that are already present in reserves would continue their spread, although at a slower pace than in those outside reserves. Some reserves, especially in Range Cluster 4, contain fragmented habitat, are relatively small, and are often surrounded by agricultural and other private land. Even though IWM was assumed to be implemented on other lands, it is assumed that weeds would invade and spread into reserves at greater rates in areas of fragmented ownership compared to less fragmented, more contiguous blocks of land in reserves.

Causes of the Effects of Each Alternative on Rangelands

Rangeland effects were projected for 100 years using the Columbia River Basin Successional Model (CRBSUM). The model used the interactions of several effects to come up with the analysis of the alternatives. It is the combination of causes that produced the effects of the implementation of the seven alternatives. The following is a list of the six main causes:

- ◆ grazing effects;
- ◆ rangeland vegetation improvements;
- ◆ prescribed fire;
- ◆ exotics;
- ◆ wildfire; and
- ◆ succession.

The fire regime in rangeland potential vegetation groups is different than it was historically because of changes in plant

community composition and structure related to management actions, including: wildfire suppression; loss of fine fuels, which were a primary carrier of fire; and establishment of flammable exotic plants.

The trend in the amount and type of wildfires would vary among alternatives primarily because of differences in the amount of prescribed fire. Some fire exclusion still would be apparent within alternatives, because wildfire suppression and livestock utilization of fine fuels continue to occur. No alternative would restore the natural disturbance process of fire to historical levels.

Methodology: How Effects on Rangelands were Estimated

Rangeland effects were estimated using these sources: Landscape Ecology and Noxious Weeds sections of the *Evaluation of Alternatives* (Quigley et al. 1997); the *Scientific Assessment* (Quigley et al. 1996a,b); and professional judgement by the Science Integration Team (SIT) and EIS Team.

The Landscape Ecology staff of the SIT used the objectives and standards for the alternatives (Table 3-5), and the acres of certain management activities per decade (Table 3-7), and modeled the results of implementing these activities primarily using CRBSUM. Numerous assumptions were made reflecting the model outputs and conclusions made about the results by the SIT. Grazing effects, wildfire, prescribed burning, rangeland vegetation improvements, exotic weeds, and plant succession were modeled.

Effects of noxious weeds were evaluated by considering the alternatives and their objectives and standards; management activities for noxious weed control; and rule sets established for each alternative in each range cluster. These factors were all used to determine the amount of noxious weed control by cluster for each alternative and the effect that amount would have on the spread of noxious weeds. This information then led to a ranking of the alternatives in their effectiveness of noxious weed control and whether the alternative was successful in reducing the spread.

An estimate of relative amounts of wildfire acres burned in rangelands was made from outputs from CRBSUM. Probabilities of wildfire vary with cover type and structural stages and with management prescriptions that affect vegetation composition and structure within each alternative. The model estimates historical wildfire occurrence from a 400-year simulation, starting with historical stand conditions and using historical fire probabilities. The projected future outputs for the seven alternatives represent average acres per decade of disturbance, based on a 100-year simulation. Current levels are derived from year 10 of the simulation. Model outputs were adjusted for the effects of mid-scale pattern and fine-scale live and dead vegetation and fuels composition and structure, as well as for overestimates in the modeled amount of management ignited prescribed fire (Quigley et al. 1997). Adjustment factors incorporated the concept that patterns of vegetation and fuels cause relative amounts of unburned area to be contained within wildfire perimeters. Effects analyses were based upon an estimate of historical acres burned, and trends in the relative amounts of acres burned per decade by wildfires for the next 100 years under each of the alternatives. The interpretation of the differences among alternatives and their comparison to historical disturbance may be adjusted before the Final EIS if additional refinement of the model is conducted (for example, to account for areas impacted by more than one treatment type).

Estimates of total acres that would be burned by alternative and potential vegetation group were compared to historical estimates. Ratios of acres burned under the different alternatives to the historical period were calculated for the three rangeland potential vegetation groups ~ cool shrub, dry grass, and dry shrub ~ in which almost all of the burned acreage occurred on rangelands.

Professional judgement by the Rangeland staff on the SIT and EIS Team was used to take the landscape evaluation information, noxious weed evaluation, the *Scientific Assessment*, management prescriptions, and experience in rangeland systems to determine the final outcomes of implementing the alternatives. This required coordination with other SIT members, and identifying and discussing inaccuracies of the model runs (for example,

noxious weeds and wildfire and prescribed fire were not accurately modeled and probably did not reflect the accurate implementation of the alternatives) with other EIS Team and SIT professionals.

Effects of the Alternatives on Rangelands

Introduction

The following discussion is structured similar to Chapter 2, Affected Environment, to aid the reader in tracking between the chapters. The *Evaluation of Alternatives* completed by the Landscape Ecology staff of the SIT was reported by physiognomic type and terrestrial community. However, the rangeland information in Chapter 2 of the EIS was reported by potential vegetation groups (PVGs). Table 4-32 provides a crosswalk between these physiognomic types and terrestrial communities and the three major rangeland PVGs. Terrestrial plant communities are groups of cover types with similar moisture and temperature regimes, elevational gradients, structures, and use by vertebrate wildlife species.

The evaluation by the Landscape Ecology staff of the SIT was used in the overall analysis of the effects of the alternatives. To do the analysis, they used the CRBSUM to predict outcomes of key elements in 10, 50, and 100 years. Due to the extreme sensitivity of the model to changes in modeling criteria, there were three major inconsistencies that have implications for this chapter:

- (1) Wildfire and prescribed burning were not modeled accurately by the CRBSUM. Therefore, acreage predictions for upland herbland, upland shrubland, upland woodland, and exotics may not be accurate.
- (2) As stated previously, the extent and rate of spread of noxious weeds and cheatgrass in the project area were underestimated. In addition, the model probably did not accurately estimate ecological processes relating to exotic weeds. Modeled outcomes in conjunction with the *Evaluation of Alternatives* were used to address this inconsistency.

Table 4-32. Crosswalk Between Rangeland Potential Vegetation Groups and Terrestrial Communities.

Potential Vegetation Group	Physionomic/Terrestrial Community
Dry Grassland	Exotics Upland Herbland Upland Woodland
Dry Shrubland	Exotics Upland Herbland Upland Shrubland Upland Woodland
Cool Shrubland	Exotics Upland Herbland Upland Shrubland Upland Woodland

(3) With regard to effects on the four major terrestrial communities, evaluation of Alternatives 1 and 2 should have produced similar results since the only difference between the two alternatives is PACFISH, INFISH, and Eastside screens. However, the model showed substantially different results between Alternatives 1 and 2. For rangelands, results for Alternative 1 will be used to describe the results for both Alternatives 1 and 2.

Although the terrestrial community acres reported in the tables may not be quantitatively accurate, they can be used to compare and rank the alternatives relatively with respect to restoring rangeland health.

Effects on Rangeland Distribution, Composition, and Structure

Terrestrial Communities

Table 4-33 displays the minimum and maximum historical, current, and 100-year projections by alternative for the four major rangeland terrestrial communities. Alternatives 3, 4, and 6 would reduce the geographical extent of exotic weeds below current levels within 100 years. Alternatives 5 and 7 would have no substantial effect. Alternatives 1 and 2 would result in substantial increases in exotic weeds. All alternatives would result in

increases in upland herbland from current, with no major differences among alternatives. All alternatives would move the extent of upland herbland to within historical levels. All alternatives would result in a decrease in upland shrubland from current levels. All alternatives would move the extent of the upland shrublands to within the historical range.

All alternatives would result in a decrease of upland woodland from current levels, but Alternatives 3 through 6 would result in a decrease to within the historical range, while Alternatives 1, 2, and 7 would not. Overall, in relation to meeting or moving toward the desired range of future condition, it would be expected that Alternatives 3, 4, and 6 would be within the desired range of future condition for extent of the major terrestrial communities, with the possible exception of upland shrublands, which is probably below or at the low end of the desired range of future condition for these alternatives.

IFigures 4-13, 4-14, and 4-15 display the percentage of sub-basins containing upland herbland (Figure 4-13), upland shrubland (Figure 4-14), and upland woodland (Figure 4-15) that would be above, within, or below the historical range of variability in the project area for each alternative. Generally, there are no substantial differences among the alternatives

Table 4-33. Percentage of Terrestrial Communities, Eastside Planning Area.

Terrestrial Community	Historical Minimum	Historical Maximum	Current	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Exotics	0	0	2	3	9	1	1	1	1	2
Upland Herbland	4	17	3	10	7	12	14	12	13	12
Upland Shrubland	30	43	40	31	28	32	31	32	32	32
Upland Woodland	2	3	4	3	4	3	3	3	3	4

This table displays historical, current, and future (100 years) percentage of the four major terrestrial rangeland communities on Forest Service- and BLM-administered land in the Eastside planning area.

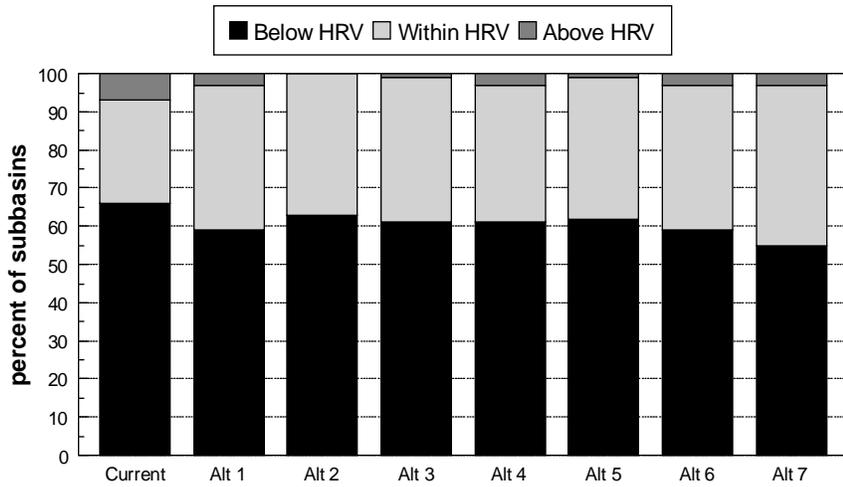
for upland herbland when compared to current conditions. For upland shrubland, all the alternatives would result in more sub-basins below the historical range of variability when compared to current, with no sub-basins above the historical range of variability. This was mostly due to prescribed burning, wildfire, and succession of upland shrubland into upland woodlands. For upland woodland, all the alternatives would result in increases of the percent of sub-basins above the historical range of variability and decreases in the percent of sub-basins below the historical range of variability when compared with current conditions. This was mostly due to the succession of upland shrublands into upland woodland and to conifer encroachment into hard-to-access areas for control treatments.

Table 4-34 displays the historical to current trends and the 10- and 100-year projections by alternative for the four major rangeland terrestrial communities. Future projections are expressed in relative percent change from current conditions. Alternatives 3 and 4 would be expected to reduce the extent of exotic weeds in 10 years, and substantially reduce the extent of exotic weeds from 10 to 100 years. Alternatives 5, 6, and 7 are expected to have no change in the extent of exotic weeds in 10 years and a slight reduction in extent of exotics from 10 to 100 years. Alternatives 1 and 2 are the only alternatives that would be expected to increase exotic weeds above current levels in 10 years and a substantial increase from 10 to 100 years.

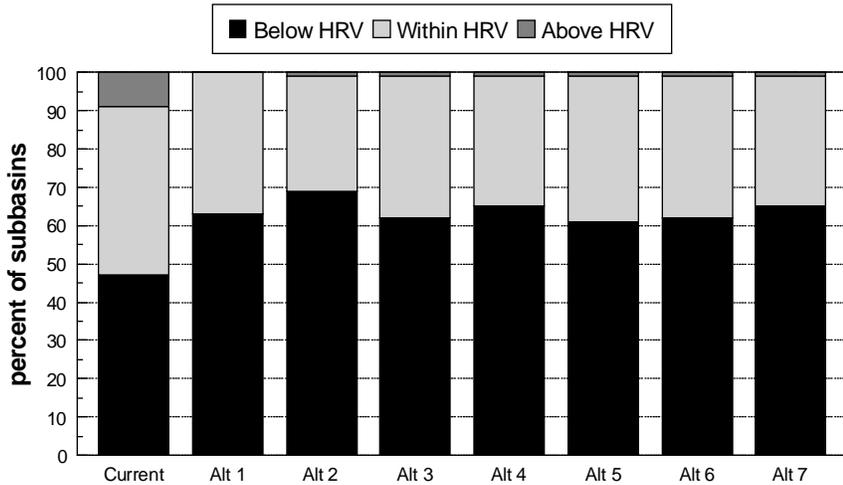
All alternatives would be expected to substantially increase upland herbland after 10 years, with the increase continuing to 100 years. Alternatives 1, 2, 3, 4, and 6 would result in the highest increase in upland herbland, but differences among alternatives would be small. The main reason for the significant increase in upland herbland would be due to the conversion of exotics, upland shrublands and/or upland woodlands to upland herbland based on the alternative and its emphasis. All alternatives would reduce upland shrubland over 10 years and the 100-year period to a similar extent. Alternatives 3 through 7 would reduce the extent of upland woodlands slightly in 10 years as well as from 10 to over 100 years. Alternatives 1 and 2 would not be effective in reducing upland woodlands over 100 years.

Dry Grassland Potential Vegetation Group

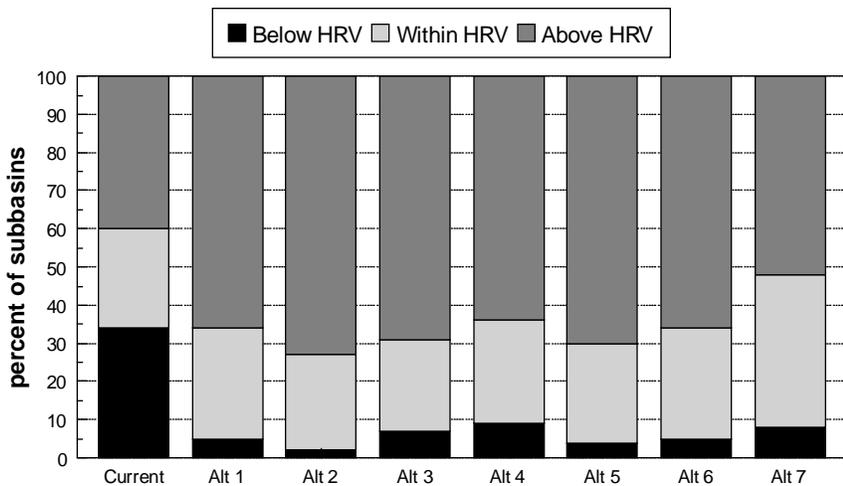
The overall extent of the dry grassland communities moving toward the desired range of future condition would decrease from current conditions in the project area under all alternatives. The causes for this effect would be the continued invasion and spread of existing infestations of noxious weeds into these communities, and the encroachment of conifers under Alternatives 1 and 2. Under Alternatives 3 through 7, noxious weed encroachment would be slower than Alternatives 1 and 2, but conversion to noxious weed communities would still occur. Conversion to noxious weed



Eastside Figure 4-13. Upland Herb, Above/Within/Below Historical Range of Variability, Project Area (Source: Quigley et al. 1997).



Eastside Figure 4-14. Upland Shrub, Above/Within/Below Historical Range of Variability, Project Area (Source: Quigley et al. 1997).



Eastside Figure 4-15. Upland Woodland, Above/Within/Below Historical Range of Variability, Project Area (Source: Quigley et al. 1997).

Table 4-34. Percent Change in Extent of Terrestrial Communities, Eastside Planning Area.

Terrestrial Community	Historical to Current	Alternative 1		Alternative 2		Alternative 3		Alternative 4		Alternative 5		Alternative 6		Alternative 7	
		10 yr	100 yr												
Exotics	N/A	+	++	+	++	-	--	-	--	NC	-	NC	-	NC	-
Upland Herbland	--	++	++	++	++	++	++	++	++	+	++	+	++	+	++
Upland Shrubland	-	NC	-	NC	-	NC	-	NC	-	NC	-	NC	-	NC	-
Upland Woodland	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-

This table shows the percent change in the extent of area of terrestrial communities from historical to current to future (1 year, 100 years). The data are for Forest Service- and BLM-administered lands in the Eastside planning area only.

++ = greater than 20 percent increase

+ = up to 20 percent increase

NC = no significant change from current

- = up to 20 percent decrease

-- = greater than 20 percent decrease

communities would be greater under Alternatives 5 and 6 than under Alternatives 3, 4, and 7.

The relative ineffectiveness of Alternative 7 relates to the lack of active weed control efforts in reserves and the presence of noxious weed species that are particularly invasive into dry grasslands (for example, yellow starthistle, spotted knapweed, and leafy spurge) and can spread even in the absence of disturbance.

Improved grazing strategies or a no-grazing strategy would continue to restore dry grasslands, increasing the dominance of large perennial bunchgrasses in most areas, but the invasion of noxious weeds and cheatgrass would occur at a higher rate than the restoration.

Conifer encroachment would generally be reduced under Alternatives 3 through 7 as a result of the emphasis of prescribed burning, prescribed natural fires, and the basic reestablishment of fire regimes where possible. The exception to this would be in steep, rough, inaccessible areas, especially in the Blue Mountains Ecological Reporting Unit (ERU 6), where conifer encroachment would be expected to continue.

Under Alternatives 4 and 6, most crested wheatgrass seedings that were once essentially monocultures would be more diverse, including various forb and shrub species. As a result of interseeding, Alternatives 3, 5, and 7 would be more diverse than under Alternatives 1 and 2 where diversity is controlled by natural succession. Dry grassland communities would be outside the desired range of future condition for all alternatives. However, Alternatives 3, 4, and possibly 7 would be the most successful in moving dry grasslands toward the desired range of future condition.

Dry Shrubland Potential Vegetation Group

The extent of the dry shrubland communities moving towards the desired range of future condition would decrease from the current conditions in the planning area for Alternatives 1, 2, 3, 5, and 7. The decrease in extent of dry shrubland moving toward the desired range of future condition is expected to be at a slower rate for Alternatives 3, 5, and 7 than under Alternatives 1 and 2, due to relative rates of continued invasion of noxious weeds and

cheatgrass into these communities. Alternative 4 and possibly 6 would reduce the spread of noxious weed infestations and therefore increase the extent of dry shrublands moving towards the desired range of future condition in the planning area. Livestock grazing pressure would improve under all these alternatives, but especially under Alternatives 3, 4, and 6.

Areas with native large bunchgrasses with sagebrush overstories would not be common across the planning area under Alternatives 3 through 7, but would be much more apparent than under Alternatives 1 and 2, especially under Alternatives 3, 4, and 6. Livestock grazing pressure would be modified through emphasis on grazing systems that allow for soil and vegetative processes to function in a more natural state and the implementation of these systems under a more spatially- and functionally-integrated landscape approach. Litter accumulation, plant vigor, and soil protection would be enhanced under Alternatives 3 through 7, increasing the rate of improvement of dry shrublands. Overall, Alternative 4 would increase the extent of dry shrublands moving towards the desired range of future condition.

Cool Shrubland Potential Vegetation Group

The extent of the cool shrubland communities moving towards the desired range of future condition would increase from current conditions in the planning area under Alternatives 3 through 7. Alternatives 3 and 4 would be the most effective in increasing the extent of cool shrublands moving towards the desired range of future condition because they have the highest emphasis on noxious weed control, livestock grazing pressure improvement, and western juniper and other conifer control. Alternatives 5, 6, and 7 would be less effective in noxious weed control, but would have a slower rate of decrease in cool shrublands than Alternatives 1 and 2.

Areas with native large bunchgrasses with sagebrush overstories would be common across the planning area under Alternatives 3 through 7, especially under Alternatives 4 and 6, due to projected improvements in livestock grazing pressure. These improvements would be due mainly to the emphasis on grazing systems that allow for soil and vegetative processes to function in a more natural state and

implementation of those systems under a more spatially- and functionally-integrated landscape approach.

Litter accumulation, plant vigor, and soil protection would be enhanced under Alternatives 3 through 7, increasing the rate of improvement of cool shrublands. Reduction of woody species encroachment would be effective under Alternatives 3 through 7, especially under Alternatives 4, 6, and 7, because of greater emphasis on prescribed burning and prescribed natural fires, along with liberal wildfire policies in the reserves under Alternative 7. Harvesting of conifers where their density is high and where fire is not practical would also increase in Alternatives 3, 4, and 6. This would increase vegetative diversity of these communities, assuming rehabilitation of those areas with a noxious weed or cheatgrass understory.

Effects on Major Factors Influencing Rangelands

Livestock Grazing

Improved livestock grazing strategies would likely reduce adverse effects of grazing on ecosystem processes and functions under all alternatives, especially in the dry shrublands and western juniper dominated areas. Grazing systems would be tailored to meet soil and vegetative processes and functional needs, especially under Alternatives 3, 4, and 6. Grazing pressure would be reduced under Alternatives 3, 4, and 6 because: (1) the timing of livestock grazing in relation to critical times for plant health and the desired amount of residual vegetation would be designed to substantially improve conditions allowing soil and vegetative processes and functions to function properly; and (2) implementation of grazing systems under a more spatially- and functionally-integrated landscape approach would increase the amount of rangelands having grazing systems that allow for healthy ecosystem functions and processes.

Areas with vegetation types that respond according to the traditional climax model with regard to vegetation succession are predicted to improve in condition at a faster rate under Alternatives 3 through 7 than under Alternatives 1 and 2. The climax model asserts that reduction or elimination of livestock

grazing pressure will permit improvement in rangeland vegetation through secondary succession (see Appendix 2-2 for more detail). The areas with vegetation types that more closely resemble the state and transition model (where succession of vegetation does not necessarily parallel changes in livestock pressure) are not predicted to improve much from improved grazing practices. These areas ~ most notably the Wyoming big sagebrush warm and salt desert shrub potential vegetation types ~ would continue to decline because of noxious weeds and cheatgrass invasions, but at a much slower rate under Alternatives 3 through 7 (especially 4 and 6) than Alternatives 1 and 2. In addition, improper grazing during and immediately after drought periods would be discontinued across the planning area under Alternatives 3 through 7, allowing those areas of relatively intact native plant communities to maintain plant vigor and competitiveness against noxious weeds and cheatgrass.

In Alternative 7, livestock grazing in the reserves would be limited to site-specific problem areas such as cheatgrass and noxious weed infestations for the purpose of furthering the intent of the reserves. There would be no annual grazing permits allowed in reserves. Hence, there would be slight to no measurable effects on slowing noxious weed and cheatgrass problems. The ability of livestock to effectively reduce noxious weeds or cheatgrass through consumption can be appreciable, but effects are site-specific and generally risky in success rate because intensive management of livestock on extensive rangeland acreage is difficult to achieve.

Most noxious weeds are not highly palatable by livestock, and the consumption of cheatgrass is not heavy enough to substantially reduce the threat of fire. In good moisture years when cheatgrass production is very high and fire risk is high, the amount of livestock needed to reduce cheatgrass would be extremely high. Even if enough livestock were brought in to effectively reduce the extent of cheatgrass, remaining large, native bunchgrasses would be adversely affected since the grazing use would be partially during the critical growing season for these species. Natural re-establishment of large, native bunchgrasses would be inhibited by excessive livestock pressure during these periods.

Changes in Fire Regimes

For the major rangeland potential vegetation groups, all alternatives would result in fewer acres burned than historically, with the exception of dry shrub under Alternatives 1 and 2 (see Table 4-35). Burned acres would be reduced the most from historical in dry grass, and the least in dry shrub.

For all three rangeland potential vegetation groups, the least acreage of wildfire is expected to occur in Alternatives 3 through 6. For the cool shrub group, these alternatives would have less wildfire than occurs currently (29 to 37 percent of historical levels). Alternatives 1, 2, and 7 would have wildfire acres that range from

49 to 71 percent of historical levels. If prescribed fire were implemented at planned levels (Figure 4-16), herbaceous-dominated communities may eventually achieve historical wildfire levels and juniper encroachment could be controlled, particularly in Alternatives 3, 4, 6, and 7. Only Alternative 5 would show less disturbance by fire (wildfire and prescribed fire) than is estimated to have occurred from historical wildfire.

For the dry grass group, Alternatives 1 through 6 would have only 11 to 22 percent of historical levels of burned acres, probably due to model assumptions of extremely effective fire suppression. While there would be little wildfire suppression within reserve areas, the

Table 4-35. Ratio of Estimated Rangeland Net Acres Burned by Wildfire Each Decade to Estimated Historical Acres, Eastside Planning Area.

Potential Vegetation Group	Historical Acres	Current	Alternative						
			1	2	3	4	5	6	7
			<i>percent</i>						
Cool Shrub	417,655	59	71	63	35	29	37	32	49
Dry Grass	422,876	22	22	17	13	11	13	12	53
Dry Shrub	953,376	99	121	185	70	61	76	66	95

This table applies to lands administered by either the Forest Service or the BLM in the Eastside planning area.

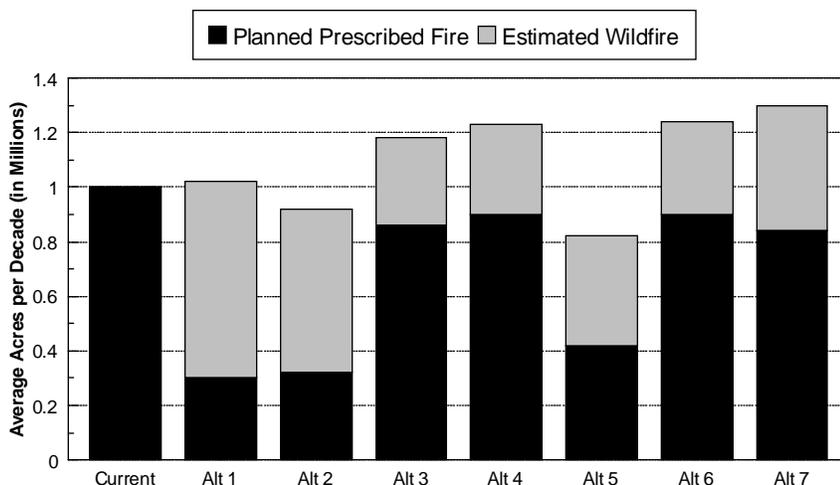


Figure 4-16. Cool Shrub Wildfire and Prescribed Fire, Eastside Planning Area.

amount of wildfire in Alternative 7 is still estimated to be only 53 percent of historical levels, likely because of effective fire suppression outside of reserve areas.

Much more fire was simulated in the dry shrub group than in cool shrub and dry grass. Levels of burning in dry shrub range would from 61 to 76 percent of historical levels in Alternatives 3 through 6. Alternative 7 is estimated to be 95 percent of historical levels. The relatively lower emphasis on restoration of cheatgrass ranges, and the lack of fire suppression within reserves, likely would cause increased probabilities of fire. Alternative 1 has an estimate of 121 percent, and Alternative 2 has an estimate of 185 percent as much fire as historical levels. This may be caused by an assumed lack of fire suppression within PACFISH buffers and Eastside screen areas, or by a lack of restoration emphasis in Alternatives 1 and 2. Also, if protected areas received no grazing, it could be assumed that the increased amount of grass fuel could also be a cause, possibly interacting with the other two factors just discussed, for the increase in fire over current and historical levels. The reduced burned acreage from historical levels predicted for Alternatives 3 through 6 could be caused by reductions in the amount of cheatgrass and overall flammability as a result of restoration efforts.

Based strictly on estimates of the relative amounts of net wildfire, and taking into account planned levels of prescribed burning (Figure 4-16), there could be enough fire to reverse trends in increasing shrub density, loss of herbaceous stages, and encroachment of conifers in the cool shrub potential vegetation group. If improved grazing management resulted in more residual herbaceous vegetation, it can be predicted that there would be much more wildfire than the model estimates, particularly in Alternatives 3, 4, and 6, for all rangeland vegetation. This could cause increased spread of exotic annual grasses in dry shrub and dry grass. However, in the cool shrub group, where exotic grasses are generally not a problem, increased wildfire would not be detrimental if appropriate post-fire grazing management was applied.

Effects on Noxious Weeds, Exotics, and Introduced Forage Grasses

Noxious Weeds

Although cheatgrass is not legally declared a noxious weed in the project area, it is included in the following discussion when noxious weeds are mentioned.

Alternatives 5 through 7 would generally be more effective in preventing the spread of noxious weeds than Alternatives 1 and 2. However, Alternatives 5 through 7 would not be as effective overall as Alternatives 3 and 4, which would be especially effective in substantially reducing the rate of spread of noxious weeds in Range Clusters 5 and 6, where the majority of rangelands exist. Rangelands near roads and agricultural and urban areas would still be priority areas for noxious weed control efforts. This is especially true in dry shrubland types in Range Clusters 5 and 6 (see Maps 2-22 and 2-48 in Chapter 2) where dominant native rangeland vegetation generally exists in the more moist areas away from roads, agriculture, urban areas, and watering areas for livestock. Altered sagebrush steppe areas, in Range Clusters 5 and 6, would be expected to be invaded by noxious weeds such as medusahead and yellow starthistle, especially in eastern Oregon and southwestern Idaho. However, control efforts under Alternatives 3 and 4 would be expected to be relatively effective in reducing the spread of noxious weeds in these clusters.

The various knapweeds and leafy spurge would be expected to be a problem in the more moist areas. Chemical control of some noxious weeds such as leafy spurge or the various knapweeds requires repeat treatment for years to be effective in controlling existing infestations. It is anticipated that treatment of the same noxious weed areas year after year would be the norm due to the difficulty in killing some weeds. However, control efforts to reduce the spread of these weeds, especially by seed, would be expected to also be effective. Currently large infestations of these species would probably remain a problem but would not be expected to increase in extent under Alternatives 3 and 4, especially in Range Clusters 5 and 6.

Reserve areas, in general, are unroaded and away from urban and agricultural areas, so they are not expected to be heavily infested with

noxious weeds. In addition, the lack of disturbance in reserves should help in limiting some noxious weeds that require disturbance to become established. However, it is expected that some noxious weeds, such as leafy spurge and the various knapweeds, would still be able to invade and spread within reserve areas because they can spread even in the absence of disturbance.

A much more effective control effort is expected under an integrated weed management strategy in Alternatives 3 through 7 than under continuation of existing programs in Alternatives 1 and 2. The Integrated Weed Management (IWM) strategy would put emphasis on all lands, not just federally administered lands, and with a more effective educational program great strides would be expected in noxious weed control. Educational programs are expected to substantially reduce the human-caused spread of noxious weeds. Continued spread of noxious weeds by wildlife, water, wind, and fire would occur, but intensive control efforts in Range Clusters 5 and 6, especially under Alternatives 3 and 4, would reduce the spread of noxious weeds through reductions in seed sources and fire prevention. In general, rangeland productivity and biodiversity would be seriously affected by the expected increase in noxious weeds under Alternatives 1, 2, and 5, and would be expected to affect livestock operations, wildlife, and soil and native vegetative health especially in Range Clusters 1, 2, 3, and 4.

Although noxious weed control efforts under Alternatives 3 and 4 would be expected to reduce the spread of noxious weeds in Range Clusters 5 and 6, the effort needed to implement these alternatives would require substantial increases in the number of acres of treatment than is occurring under current emphasis levels and normal base funding levels. In addition, an integrated weed management strategy that incorporates all entities (city, county, state, tribal, and federal) under one strategy, and implements effective educational efforts focusing on inventory and prevention of noxious weeds, would be required along with acreage treatments to realize the expected results under Alternatives 3 and 4 to occur. Acreage treatments of altered sagebrush steppe does not include fire rehabilitation, which is not part of normal base funding levels for Forest Service and BLM administrative

units. Fire rehabilitation of altered sagebrush steppe or other weed areas would be considered in addition to the expected acres treated under noxious weed programs.

Table 4-36 ranks the alternatives according to their effectiveness in noxious weed control in the three major rangeland potential vegetation groups for the planning area. The ranking is based on a relative index ranging from a value of 0 to 30, with 0 being the least effective and 30 being the most effective in preventing further infestations of noxious weeds. Overall, Alternatives 3 through 7 would be the most effective, with Alternatives 1 and 2 the least effective. Alternative 4 would be the most effective, with Alternative 3 slightly more effective than Alternative 6. Following Alternative 6, Alternative 7 would be more effective than Alternative 5, with Alternatives 1 and 2 equally the least effective. Effectiveness of noxious weed control would be heavily dependent on the emphasis of the alternative within each range cluster. The emphasis of an alternative is defined by the steps of integrated weed management that would be taken, the rangeland plant communities and noxious weeds to which the steps would be targeted, and the acreage of weed control that would be treated. For example, noxious weed control in Alternative 4 was more effective in cool shrublands in Range Clusters 2 through 4 than in dry grasslands in those same clusters. This is a result of the amount of acres treated consistent with Table 3-7 and the objectives and standards in Chapter 3, and the fact that noxious weeds are not as prevalent in the cool shrublands as they are on dry grasslands. In the planning area, the most effective noxious weed control efforts would occur in Range Clusters 5 and 6, especially under Alternatives 3 and 4.

Table 4-37 displays a relative comparison of alternatives in relation to how effective each alternative would be in moving the trend of the three major rangeland potential vegetation groups away from a noxious weed infested community and toward the desired range of future condition. The trend is displayed using a relative range of -4 to +2, with -4 being the fastest movement away from the desired range of future condition and toward a noxious weed infested community and +2 being the fastest trend away from a noxious weed infested community and toward the desired range of

Table 4-36. Relative Ranking of Alternatives in Preventing Further Noxious Weed Infestations, Eastside Planning Area.

Potential Vegetation Group	Alternative						
	1	2	3	4	5	6	7
Dry Grassland	2	2	12	13	2	10	13
Dry Shrubland	3	3	18	22	15	19	9
Cool Shrubland	13	13	22	23	19	19	20

This table applies to the Eastside planning area.

- 0 = least effective
- 30 = most effective

Source: Tables 3-6 and 3-7 in Chapter 3.

Table 4-37. Relative Trend of Rangeland Vegetation Toward or Away from Desired Conditions, Eastside Planning Area.

Potential Vegetation Group	Alternative						
	1	2	3	4	5	6	7
Dry Grassland	-4	-4	-2	-2	-4	-3	-2
Dry Shrubland	-4	-4	-1	+1	-2	-1	-3
Cool Shrubland	-2	-2	+1	+1	-1	-1	-1

This table applies to the Eastside planning area.

- 4 = fastest movement away from desired conditions and toward noxious weed infestation
- +2 = fastest trend away from noxious weed infestation and toward desired conditions

future condition. Overall, Alternative 4 then 3 would be most effective in reducing the spread of noxious weeds into the three potential vegetation groups and moving them toward the desired range of future condition. Alternatives 1 and 2 would be the least effective, with Alternatives 6, 7, and 5 (respectively) better than Alternatives 1 and 2. If the overall trend for a potential vegetation group was projected to be downward, this does not necessarily mean that trends for each range cluster were projected to be downward. For example, even though the overall trend for dry grassland across all alternatives moved away from the desired condition, the trend in Alternative 4 for dry grassland in Range Clusters 5 and 6 was projected to be very fast towards the desired condition.

Tables 4-38, 4-39, and 4-40 display the main noxious weeds that would invade dry grassland, dry shrubland, and cool shrubland under Alternatives 1 through 7 and explain the effectiveness of the alternatives. The amount of acres treated by these alternatives were based on current (Alternatives 1 and 2) to inflated (Alternatives 3 and 4) projected costs.

Altered Sagebrush Steppe

The noxious weed discussion in this chapter provides the reader a more in-depth look at the effects of the alternatives on the control of cheatgrass and medusahead. Cheatgrass and medusahead form the vast majority of the altered sagebrush steppe vegetation.

Table 4-38. Noxious Weeds Infesting Dry Grasslands, Eastside Planning Area.

Primary Exotic Species Causing Infestation	Primary Location of Infestations (Range Clusters and General)	Discussion of Cause and Effects
Yellow Starthistle	1,3,4,5,6, Southeastern Washington, Oregon	Alternatives 1, 2, and 5: No IWM or any other strategy that is coordinated among private, city, county, state, and federal entities, is being used to control weeds in Alternatives 1 and 2. Efforts are ineffective in preventing the spread of noxious weeds because of the low amount of acres treated under these alternatives. Existing and new infestations continue to spread across the dry grasslands especially near major roads, waterways, urban, agricultural, and livestock waters initially and then elsewhere as time goes on. In conclusion: the dry grassland PVG would decline over the 100-year period as a result of ineffective noxious weed control.
Dalmation Toadflax	1,4, Central Oregon	
Leafy Spurge	3,6, Northeastern Oregon	
Diffuse Knapweed	1,2,3,4,6, Central Oregon	
Rush Skeleton Weed	4,5, Eastern Oregon	
Cheatgrass and Medusahead	1,5,6, Eastern and Central Oregon	
Whitetop	1,3,4, Northern Oregon	
Spotted Knapweed	3, Northeastern Washington	
Orange and Yellow Hawkweeds	3, Northeastern Washington	
Sulfur Cinquefoil	3, Northeastern Oregon	
Tansy Ragwort	2,3,5,6, Northeastern Oregon	Alternatives 3, 4, and 6: An effective IWM strategy has unified all private, city, county, state, and Federal entities under all these action alternatives. The amount of acres treated, which differs by alternative, does not include the treatment of many acres of these noxious weeds in Range Clusters 1 through 4. These weeds would be expected to increase in the dry grassland PVG in Range Clusters 1 through 4, under all alternatives. Control efforts are focused on cheatgrass, yellow starthistle, and leafy spurge on the highly susceptible sites with the rest of the weeds of second priority under all alternatives. The amount of acres of noxious weed control in Range Clusters 5 and 6 would be expected to be adequate to reduce the current spread of noxious weeds and increase the acreage of dry grassland PVG in Range Cluster 6 under Alternatives 3, 4, and 6 and in Range Cluster 5 under Alternative 3 and 4. In conclusion: the dry grassland PVG would be expected to decline in Range Clusters 1 through 4 under all alternatives and increase in Range Clusters 5 and 6 under Alternative 3 and 4. All of these alternatives would be more effective than Alternatives 1 and 2.

This table lists noxious weeds that are infesting dry grasslands on Forest Service- and BLM-administered lands and where those weeds are the most extensive in the Eastside planning area. Causes and effects of implementing the Integrated Weed Management strategy described in Tables 3-5 and 3-7 are also discussed.

Abbreviations used in this table:

IWM = Integrated Weed Management

PVG = potential vegetation group

Table 4-39. Noxious Weeds Infesting Dry Shrublands, Eastside Planning Area.

Primary Exotic Species Causing Infestation	Primary Location of Infestations (Range Clusters and General)	Discussion of Cause and Effects
Dalmation Toadflax	1,4,6, Central and Eastern Oregon	<p>Alternatives 1 and 2: No IWM or any other strategy that is coordinated among private, city, county, state, and federal entities, is being used to control weeds in Alternatives 1 and 2. Existing and new infestations continue to spread across the dry shrublands, especially near major roads, waterways, urban, agricultural, and livestock waters initially and then elsewhere as time goes on. In conclusion: the dry shrubland PVG would decline over the 100-year period as a result of ineffective noxious weed control. In addition, noxious weeds are invading altered sagebrush steppe which provides a disturbed site for noxious weed establishment, especially medusahead. Ineffective efforts to reduce and prevent the spread of altered sagebrush steppe would allow for more dry shrubland areas to be susceptible to noxious weeds.</p> <p>Alternatives 3, 4, 5, 6, and 7: An effective IWM strategy has unified all private, city, county, state, and federal entities under all these action alternatives. The amount of acres treated, which differs by alternative, does not include the treatment of many acres of these noxious weeds in Range Clusters 3 and 4. These weeds would be expected to increase in the dry shrubland PVG in Range Clusters 3 and 4, under all alternatives. Control efforts are focused on cheatgrass and Mediterranean sage on the highly susceptible sites, with the rest of the weeds of second priority under all alternatives. The amount of acres of noxious weed control in Range Clusters 1, 2, 5, and 6 would be expected to be adequate to reduce the current spread of noxious weeds and increase the acreage of dry shrubland PVG in Range Cluster 1 under alternatives 4 and 6; in Range Cluster 2 under Alternative 4; in Range Cluster 5 under Alternatives 3 and 4; and in Range Cluster 6 under Alternatives 3, 4, 5, and 6. In conclusion: the dry shrubland PVG would be expected to decline in Range Clusters 3 and 4 under all alternatives and increase in Range Clusters 1, 2, 5, and 6 under Alternative 4, with the other alternatives having varying success within these Range Clusters. All of these alternatives would be more effective than Alternatives 1 and 2.</p>
Halogeton	5,6, Southeastern Oregon	
Diffuse Knapweed	1,2,3,4,5,6, Washington, Central and Eastern Oregon	
Rush Skeleton Weed	5,6, Central Oregon	
Cheatgrass and Medusahead	1,5,6, Central and Eastern Oregon	
Mediterranean Sage	6, South-Central Oregon	
Russian Knapweed	4, Central Washington	
Whitetop	1,3, Northern Oregon	
Yellow Starthistle	1,3, Northern Oregon	

This table lists noxious weeds that are infesting dry shrublands on BLM- and Forest Service-administered lands and where those weeds are the most extensive in the Eastside planning area. Causes and effects of implementing the Integrated Weed Management strategy described in Tables 3-5 and 3-7 are also discussed.

Abbreviations used in this table:

IWM = Integrated Weed Management

PVG = potential vegetation group

Table 4-40. Noxious Weeds Infesting Cool Shrublands, Eastside Planning Area.

Primary Exotic Species Causing Infestation	Primary Location of Infestations (Range Clusters and General)	Discussion of Cause and Effects
Yellow Starthistle	1, Central Oregon	<p>Alternatives 1 and 2: No IWM or any other strategy that is coordinated among private, city, county, state, and federal entities, is being used to control weeds in Alternatives 1 and 2. Efforts are ineffective in preventing the spread of weeds, except in Range Cluster 4, where there is a small amount of acreage of cool shrublands and there is a very minor weed problem in them currently. Existing and new infestations would be expected to continue to spread across the cool shrublands especially near major roads, waterways, urban, agricultural, and livestock waters initially and then elsewhere as time goes on. In conclusion: the cool shrubland PVG, in general, would decline over the 100-year period as a result of ineffective noxious weed control.</p>
Leafy Spurge	1,3,6, Northern Oregon	
Diffuse Knapweed	1,2,3,5,6, Central Oregon	
Whitetop	1,3, Northern Oregon	
Cheatgrass and Medusahead	1,3,5,6, Eastern Oregon	
Tansy Ragwort	3,5,6, Northeastern Oregon	
Rush Skeletonweed	5, Southeastern Oregon	

This table lists noxious weeds that are infesting dry shrublands on BLM- and Forest Service-administered lands and where those weeds are the most extensive in the Eastside planning area. Causes and effects of implementing the Integrated Weed Management strategy described in Tables 3-5 and 3-7 are also discussed.

Abbreviations used in this table:

IWM = Integrated Weed Management

PVG = potential vegetation group

Altered sagebrush steppe would continue to slowly increase from current levels in the dry shrubland areas under Alternatives 1, 2, 5, and 7. Alternatives 3, 4, and 6 would be more effective in preventing the spread of altered sagebrush steppe than Alternatives 7 and 5, with Alternatives 1 and 2 the least effective.

The more moist areas of the dry shrublands away from roads, agriculture, urban areas, and livestock waters would generally be native species-dominated communities. Alternatives 3 and 4 are projected to be most effective in prevention of further spread of cheatgrass and/or medusahead and rehabilitation of altered sagebrush steppe, due to greenstripping, restoration efforts, and fire suppression activities. The lack of a major effort to restore altered sagebrush steppe and to prevent frequent fire occurrence (which further spreads the infestations) would be expected to allow for more spread of altered sagebrush steppe in Alternatives 5 and 7, and especially Alternatives 1 and 2. Adding to the sagebrush steppe problems is the invasion and the out-competing of the cheatgrass areas by medusahead, yellow starthistle, and other noxious weeds with no forage value for wildlife or livestock. Inadequate control efforts for these species under Alternatives 1, 2, 5, and 7 would preclude controlling the spread of altered sagebrush steppe.

Improper livestock grazing pressure during droughts would be reduced under Alternatives 3 through 7, thus slowing down the spread of altered sagebrush steppe through increased competitiveness of native large bunchgrasses.

Most of the proposed reserves in Alternative 7 would not include large acreages of altered sagebrush steppe. However, Alternative 7 would not be entirely effective in preventing the spread of cheatgrass and medusahead and altered sagebrush steppe because of the lack of active weed control, the lack of fire suppression, and the proximity of altered sagebrush steppe in adjacent matrix areas. With fire rehabilitation efforts, which are not included in BLM and Forest Service budgetary expenses for weed control, altered sagebrush steppe would be expected to decline even further in Alternatives 3 and 4, and possibly in Alternative 6.

Introduced Forage Grasses

The amount of introduced forage grasses would decrease under Alternatives 3 through 7 because fire rehabilitation efforts in dry shrubland types would emphasize native species instead of crested wheatgrass or other perennial introduced forage species, and because interseeding existing plants with native species would be pursued to one degree or another (actively in Alternatives 4 and 6, with less emphasis in Alternatives 3 and 5, inconsistent emphasis in Alternatives 1 and 2, and no emphasis in Alternative 7 within reserves). Under Alternatives 3 through 6 and outside of reserves in Alternative 7, fire rehabilitation efforts would include resting and protection until recovery of key native species is complete. If natural rehabilitation would not meet objectives within a reasonable time frame, the area would be seeded with a diverse mix of perennial species with natives being heavily emphasized. It is expected that some areas, most notably in the dry shrublands, perennial introduced forage species would still need to be seeded in order to achieve some resemblance to native vegetation structure and maintain forage production on these sites. Most existing seedings would be expected to become more diverse with interseedings of shrubs, forbs, and some grasses. The exceptions would be in those dry shrublands where limited success would be expected with seeding natives. The net effect would be that most of the existing introduced forage grass seedings that were essentially monocultures would have been diversified under Alternatives 4 and 6. Alternatives 3 and 5 would still have a substantial amount of old seedings that had not been interseeded, but the new seedings as a result of rehabilitation efforts would be diverse and mostly composed of native species.

Overall, the extent of introduced forage grasses in seedings would decline under Alternative 7, but at a slower rate than Alternatives 3, 4, and 6. Natural revegetation would be emphasized in reserves under Alternative 7. As such, many of the drier seedings such as crested wheatgrass in the dry shrubland areas would not be very diverse, because the crested wheatgrass would be able to out-compete native species trying to become reestablished. Some sagebrush encroachment back into the seedings would occur throughout the dry and cool shrublands. Under Alternative 7, the bulk

of the natural reestablishment of natives in seedlings would occur in the cool shrublands and in the more moist areas of the dry shrublands. However, it is not expected that reserve areas would have much seeded range, since part of the intent of the reserves is to protect native vegetation communities. Active rehabilitation of recently or previously disturbed areas such as wildfire areas, would be limited in reserves; therefore, opportunities would be available for noxious weeds to establish and spread to the detriment of native species. The potential increased frequency of wildfire in reserve areas would not have much of an effect on most of the seedlings, because crested wheatgrass seedlings do not burn as readily as natives or exotics and provide somewhat of a fire break (since the amount of fine dry fuels for burning is lacking).

Effects on Climate and Disturbance Stresses

Livestock grazing pressure would be changed under Alternatives 3 through 7 to allow for better grazing practices in the areas with 12 inches or less precipitation. Priorities would be established in these areas, most notably in the dry shrublands, to ensure that annual livestock grazing pressure does not interfere with soil and vegetative functions and processes especially during and after drought years. As a result, the dry shrublands in Alternatives 3 through 7 would not become more susceptible to noxious weed invasion and would be less likely to convert to altered sagebrush steppe by grazing pressure disturbance. Alternatives 1 and 2 do not have provisions to protect rangelands from improper grazing pressure during and after drought years. Alternatives 7, 4, 6, and 3 (respectively) would be the most effective in reducing drought-related impacts from livestock grazing pressure. Alternative 5 would be less effective, with Alternative 1 and 2 the least effective. Improvement in grazing pressure through changes in grazing would not be a factor in the reserve areas of Alternative 7, because permitted grazing on an annual basis would not be allowed. Limited grazing would allow dry shrubland natives to become vigorous and better compete against exotic weeds in Alternative 7.

Effects on Other Factors Affecting Rangeland Health

Woody Species Encroachment and Density

Implementation of management activities, such as prescribed burning and tree bole harvest with slash dispersal on-site under Alternatives 3 through 7, is projected to be effective in woody species control and in providing for increased diversity and productivity of understory native vegetation. The exception may be the encroachment of conifers in the Blue Mountains Ecological Reporting Unit (ERU 6), where steep, rough areas of limited access would preclude most active methods of woody species control. Otherwise, most of the problem areas with woody species would be expected to be effectively controlled under Alternatives 3, 4, 6, and 7 and slightly less so under Alternative 5. The woody species encroachment problem would still occur under Alternatives 1 and 2. The improved fire program with higher levels of prescribed burning and prescribed natural fires, along with more fine fuels being available for wildfire, would effectively reduce the woody species encroachment problem under Alternatives 3 through 7.

Juniper and other conifer density problems would still exist in some areas, but the harvesting of these woody species would have increased substantially enough to take care of most of the density problems where fuels are not available in large enough amounts to allow fire control of woody species. Woody species encroachment would probably be effectively controlled under Alternative 7. The passive approach to management, with the buildup of fine fuels and the increase in wildfires and prescribed burns, would probably eliminate most of the encroachment problems. Density problems would still be more apparent in Alternative 7 than in Alternatives 3 through 6 but would be less of a problem than in Alternatives 1 and 2. The increased fuels in Alternative 7 would allow wildfire and prescribed fire to move into the perimeters of areas with dense woody species and effectively reduce the size of some of these areas. In addition, limited active approaches (such as harvesting of the more dense areas) would be allowed in this alternative. Combined with fire, this would reduce the amount of dense woody areas in comparison with Alternatives 1 and 2.

Microbiotic Crusts

Microbiotic crust cover would probably improve on all rangelands under Alternatives 3, 4, 6, and 7. Because of the improved grazing strategies and the restoration of some native communities, most rangelands would provide a favorable environment for enhancing the development of microbiotic crust cover. Alternatives 4 and 6 would be the most effective, followed by Alternatives 7, 3, and then 5. Alternatives 1 and 2 would be the least effective. In Alternative 5, the increase of noxious weeds, especially in altered sagebrush steppe, along with the increased fire occurrence in the altered sagebrush steppe would cause a continued decline in microbiotic crusts on dry shrublands. Having no livestock grazing under reserves in Alternative 7 would benefit microbiotic crusts, however, the lack of control of noxious weeds especially in altered sagebrush steppe, could cause noxious weeds to occupy a majority of the dry shrublands. Fortunately, most of the reserve areas would not be expected to have a serious noxious weed problem because of their distance from roads and urban and agricultural areas.

Livestock/Big Game Interactions

Livestock/big game conflicts would be effectively reduced from current conditions under Alternatives 3 through 7 at a greater rate of reduction than under Alternatives 1 and 2. Alternatives 4 and 6 would be expected to have the highest reduction in conflicts, followed by Alternatives 7 and 3. Alternatives 5, 1, and 2 would be expected to be the least effective. Alternative 5, within livestock production priority areas, may actually increase conflicts where emphasis toward livestock production would reduce the shrub component of deer and antelope winter range. All results would depend on the invasion of exotic weeds onto important big game ranges. If exotics were to take over important areas such as winter ranges, the livestock/big game conflicts on those and others could increase.

Grazing in Forested Settings

The SIT did not specifically evaluate livestock grazing effects in forest ecosystems for any of the alternatives. Some forested terrestrial communities have open, park-like structures, and support stands of grasses and forbs

desirable to livestock (for example, ponderosa pine forests in dry forests). Other forested terrestrial communities provide livestock forage for a limited time following timber harvest through increased production of herbaceous and woody growth. Thinning and burning may have similar effects, but are not equally effective in all forested communities (Stoddart et al. 1975).

Grazing effects of the alternatives in forest ecosystems depend on complex interactions between livestock, forest distribution, and forest management practices such as harvest, thinning, and prescribed fire. Livestock grazing can have positive and negative effects on forest communities, depending on livestock numbers, distribution, and season of use. Grazing can reduce fuel loadings and alter fire regimes, improve tree seedling germination through seed trampling and reduction of heavy litter, reduce competition of herbaceous plants with tree seedlings, facilitate the spread of white pine blister rust through the spread of alternate hosts (for example, *Ribes* spp.) by grazing animals, increase availability of soil moisture, and/or induce direct injury to tree seedlings (Doescher and Karl 1990; Stoddart et al. 1975).

Without a detailed SIT evaluation, the effects of livestock grazing in forested communities are likely to be similar to those discussed for rangeland communities. Namely, improved livestock strategies are expected to reduce adverse affects of grazing to forested ecosystem processes and functions under all alternatives. Grazing systems would be tailored to meet soil and vegetative processes and functional needs, especially under Alternatives 3, 4, and 6, where grazing pressure is expected to be reduced. For forested communities where grazing is shown to have impacts on successional transitions, vegetation condition is predicted to improve at a faster rate under Alternatives 3 through 7 than under Alternatives 1 and 2. Improper grazing during drought periods and immediately thereafter would be discontinued across the planning area under Alternatives 3 through 7, which would allow dry forest communities with relatively intact native understories to maintain plant vigor and competitiveness against noxious weed invasion.

Terrestrial Species

Assumptions

The following major assumptions were made by the Terrestrial Vertebrate Panels during their evaluation of alternatives:

- ◆ Activities planned for the first 10 years of plan implementation will result in trends toward the desired future condition. This is especially important for roads under alternatives that call for both accelerated management activity and a reduction in road density.
- ◆ Snag standards developed in this EIS, as well as those that will be developed from

Summary of Key Effects and Conclusions

- ◆ Currently there are 62 species in the Eastside planning area with unfavorable habitat outcomes (Outcome Class 4 or 5). Implementation of Alternatives 4, 6, and 7 would result in 41, 41, and 45 species with unfavorable habitat outcomes; and Alternatives 3, 5, 2, and 1 would result in 55, 56, 57, and 59 species with unfavorable outcomes.
- ◆ On average, Alternatives 4, 6, and 7 would provide the highest likelihood of species persistence and viability over the next 100 years. These alternatives emphasize restoration of habitats, which would likely reverse negative trends for most species because of improved management, riparian emphasis, and proposed activities that would have varying degrees of positive effects on some habitats and species.
- ◆ Alternative 1 would result in the highest number of species with increased risk of extirpation or loss of viability because it lacks the increased emphasis on restoration of forestland, rangeland, and riparian habitats of the other alternatives.
- ◆ Alternatives 4, 6, and 7 would result in more species with improved likelihood of persistence than with increased risks of extirpation, due to improved habitat conditions through restoration of uplands and riparian communities.
- ◆ Alternatives 1 and 5 would result in more species with increased risk of extirpation or viability loss than with improved likelihood of persistence and viability. Activity levels expected under these alternatives would result in higher levels of traditional management, which is assumed to result in some risk to species.
- ◆ Alternatives 3 and 7 would result in an approximately equal number of species with increased risks of extirpation and improved likelihood of persistence and viability, due in part to the intermediate levels of restoration in upland and riparian communities.
- ◆ Alternatives 1, 2, and 5 would result in more species with increased risk of extirpation than with improved likelihood of persistence and viability. Activity levels expected under these alternatives would result in higher levels of habitat modification, which is assumed to result in some risk to species.
- ◆ Human access and its direct and indirect effects on wildlife species are most appropriately addressed at finer scales. However, in relative terms, Alternatives 6 and 7 would result in lower levels of human activity and therefore lower impact levels. Alternatives 1 and 5 are predicted to have the highest levels of human activity and therefore the highest level of impacts to wildlife from access and related activities. Alternatives 2, 3, and 4 would result in intermediate levels of impacts associated with access.
- ◆ Grizzly bear and Columbian sharp-tailed grouse have undergone the greatest change in habitat conditions, from historical to current times. Historically both species were widely distributed; however, current habitat for both species is greatly reduced, and populations are isolated. Non-federal lands will continue to limit populations of these species.
- ◆ Implementation of any alternative except Alternative 1 would result in improved chances of persistence and viability for a few species ("increasers") (Table 4-42).
- ◆ Implementation of any alternative would result in some risk of extirpation or reduced habitat outcomes for some species ("decreasers"), because of cumulative effects on all lands (Table 4-43).
- ◆ Under Alternatives 1 and 5, if a species were trending toward extirpation based on the changes from historical to current conditions, that trend would be continued. In comparison, under Alternatives 4 and 6, predicted negative trends in habitat would tend to be stopped or slowed down.
- ◆ There would be little change in overall outcomes for the majority of species analyzed under any alternative. This result is based on current and projected future populations and habitat conditions, and on the fact that most species respond to habitat changes at finer scales than this evaluation portrays.
- ◆ None of the alternatives approach historical conditions (habitats or population) for the 119 vertebrate and 22 plant species analyzed. Loss of habitat both on and off federal land contributes to this condition.
- ◆ Threatened or endangered plants would have outcomes indicating a risk of extirpation or viability loss, primarily due to reduced habitat conditions and availability and to limited population sizes, compared to historical conditions. No alternative would change this condition because many of these plants are locally endemic with little chance to expand habitat or populations and are difficult to analyze at this scale. However, protection will be provided for these species under provisions in the Endangered Species Act and recovery and conservation plans.
- ◆ Habitats of threatened or endangered wildlife species do not demonstrate a substantial change in any alternative at the broad scale of analysis. The one exception is the bald eagle, which shows an improved likelihood of persistence and viability under Alternatives 4 and 6 due to riparian emphases.
- ◆ Major exceptions to this list of summary findings are those for woodland birds. Alternatives 4 and 6 would result in the least favorable outcomes for woodland birds, because of proposed reductions in extent of juniper woodlands, in which the reduced extent would more closely approximate the historical range of variability.

finer-scale analyses, will address snag number, diameter, height, decay class, species, distribution, and replacement through time. Standards will be patterned from historical conditions for vegetation communities, but will include consideration of species habitat requirements and current conditions (that is, landscapes that are currently deficient in snags or contain abundant snags). Standards will clearly specify how snags are to be treated under all types of prescriptions (such as harvest, thinning, salvage, prescribed fire).

- ◆ Downed wood standards will address number and size (diameter and length) of pieces, species, distribution, and replacement through time. Standards will be patterned after historical conditions by vegetation communities, but will include consideration of habitat requirements and current conditions (that is, number of landscapes that are currently deficient in logs or contain abundant logs). Standards will clearly specify how downed wood is to be treated under all types of prescriptions (such as harvest, thinning, salvage, prescribed fire).
- ◆ Consideration of animal species will be a key component of the ecosystem analysis used to implement the selected alternative. Habitat requirements of species will be used to help shape specific prescriptions and the scheduling and location of activities. Such considerations will be part of all prescriptions, including those designed to accomplish restoration objectives. Analysis of how specific habitats change through time will be a component of ecosystem analysis. Actions that could reduce scarce or poorly distributed habitats will be carefully analyzed to ensure that they will still meet species habitat requirements.
- ◆ Vegetation patterning will be a key objective of restoration activities. Historical patterns of vegetation fragmentation and juxtaposition will be used to establish stand and landscape objectives for restored vegetation. Such consideration is particularly important where historical forest conditions included a fine-scale mix of different forest seral stages and tree densities, including small openings.

- ◆ Restoration activities will be directed at all vegetation types, with priorities determined through ecosystem analysis and finer-scale planning processes. Specific restoration activities will include aspen regeneration, cottonwood and willow regeneration and planting, and regeneration of shrub species that were historically associated with upland and riparian shrub types. Juniper woodlands will persist in amounts and distributions so as not to create a problem for species associated with this vegetation community.
- ◆ Restoration activities that are well studied and well understood will be pursued as aggressively under Alternative 6 as they are under Alternative 4 in the long term.
- ◆ Plant conservation strategies that have been approved will be implemented.
- ◆ Caves, cliffs, mines, and other bat roost sites and hibernacula will be protected under all alternatives.

Limitations

The following cautions or limitations in interpreting the scientific analysis were identified by the Science and EIS Teams:

- ◆ *Broad geographic and time scale:* Habitat projections represent summarized conditions within species' ranges within each of the EIS planning areas. This means that for some species, it is likely that conditions within a smaller area will be better than the average and in another they will be worse. Also, the landscape staff of the Science Integration Team (SIT) assessed the vegetation conditions for three time periods only: 10 years, 50 years, and 100 years. It is possible that vegetation conditions at intermediate times could be better or worse.
- ◆ *Resolution of the data and planning guidance:* Habitat data reviewed for the *Scientific Assessment* were broad in scope and represent only the macrohabitats with which species are associated. Habitats that are distributed at finer scales, such as riparian habitats and within-stand microhabitat features (such as snags and

downed logs), were not well represented by the data. Consequently, it was difficult to assess outcomes for species that require more specific habitat features. In many cases the objectives and standards in Chapter 3 do not contain enough detailed information on how management actions and habitats would be distributed across the landscape.

- ◆ *Ability to infer population results from habitat analysis:* The ability to infer population consequences from habitat assessments is difficult, especially for small and/or poorly distributed populations. The lack of specific data on population size, structure, and functional and numerical response means that inferences must be made from changes in habitat abundance and gross distribution patterns. The results may differ from actual population responses. Conclusions about habitat trends, particularly when inferring potential effects on species, must be treated as tentative working hypotheses.
- ◆ *Gaps in knowledge:* Many of the species assessed are poorly understood and studied. Their distribution, habitat associations, interactions, and demographics are not well known.
- ◆ *Modification of EIS standards:* The Science Integration Team analyzed the alternatives initially in February 1996. In an effort to provide greater assurance that some or all of the alternates met the intent of the Endangered Species Act, Clean Water Act, Clean Air Act, and Federal trust responsibilities to tribes; some of the objectives and standards, particularly for riparian widths, and snag and downed wood levels, were clarified or modified. Because the alternatives were not completely rewritten, the SIT did not fully re-evaluate them, for example, the terrestrial species panels were not reconvened; however, all material was examined to consider its appropriateness with the revised alternatives. Some outcomes may be adjusted before the Final EIS is published to fully reflect these modifications.

Causes of the Effects of Each Alternative on Terrestrial Species Habitats or Populations

The Science Integration Team assessed effects on species from a variety of influences including habitat changes at the broad scale. The team reviewed 547 vertebrates and approximately 8,000 vascular plants. Of those, 119 vertebrate species and 22 vascular plants were assessed in detail for the Eastside Draft EIS. Tables 4-41, 42, and 43, which appear later in this section, provide a summary of effects on species that were determined to be of most concern. Discussions of underlying causes for outcomes projected for these species are included in the *Evaluation of Alternatives*. Causes include those associated with agency management, those resulting from natural processes, and those associated with actions that are outside the control of the Forest Service or BLM. Prior to publication of the Final EIS, additional analysis is expected to further clarify reasons for habitat declines for these species and other species associated with the same habitats. This analysis will help identify any actions that may be necessary for the protection or enhancement of habitats.

The major causes for outcome rankings for terrestrial plant and vertebrate species are based on assumptions by the Terrestrial staff of the Science Integration Team (see the Assumptions section), the desired range of future conditions (see Chapter 3), and the objectives and standards incorporated in Chapter 3. The following are the major causes that affected the species outcomes:

- ◆ Amounts of seral stages (desired range of future conditions) and transitions of structural stages through time for terrestrial communities.
- ◆ Cumulative effects off federal lands, including the conversion of native shrub/grass/forb communities to agricultural croplands in rangeland potential vegetation groups on non-federal lands.
- ◆ Road densities and levels of human disturbance.
- ◆ Changes in patches, pattern, composition,

distribution, and structure of all forested potential vegetation groups (dry, moist, cold) and rangeland potential vegetation groups (dry grassland, dry shrubland, cool shrubland) through management activity, including: thinning, prescribed fire, harvest, fire exclusion, integrated weed management, and grazing strategies.

- ◆ Invasion and expansion of exotic plant and animal species.
- ◆ Changes in quality and quantity of wetland habitats.
- ◆ Reserve design in Alternative 7.
- ◆ Interim direction of PACFISH, INFISH, and Eastside Screens applied to Alternative 2.
- ◆ Northwest Forest Plan direction.
- ◆ Adequacy of standards for some habitat elements, including: riparian buffers, snags, downed wood, remnant large tree structure, cave/mine/cliff protection for bat roost sites.

Methodology: How Terrestrial Species were Evaluated by the Science Integration Team

The SIT assessed the effects of alternatives on terrestrial species, particularly the degree to which habitat conditions on BLM- or Forest Service-administered lands within the project area contribute to the long-term persistence of plants and animals. All information presented here, including tables and figures, was derived from the terrestrial analysis in the *Evaluation of Alternatives*, unless otherwise noted.

The terrestrial analysis also examined the extent to which other lands and other influences might affect populations of species over and above the influences of habitat conditions on federally administered lands. The evaluation is not a quantitative analysis of viable populations, because it is not an explicit model of genetic or demographic risk to species persistence. Rather, the terrestrial species evaluation provided a reasoned series of judgements about projected amounts and

distributions of habitat and the likelihood that such habitat would allow populations of selected species to persist over 100 years (a different approach to that of the landscape evaluation, which dealt with broad-scale vegetation analysis at 10, 50, and 100 years). The analysis meets the evaluation criterion of an analysis of viable populations ~ to provide an estimate of the likelihood that a population will persist over the long run, generally 100 years. However, it did so through the use of structured professional judgements rather than through the use of population projection models.

Methods for Assessing Species and Habitat Outcomes for Alternatives

The process for assessing species and habitat outcomes in the project area drew on previous efforts (such as Federal Ecosystem Management Assessment Team 1993) and also drew heavily on efforts made in the *Scientific Assessment* (Quigley et al. 1996a,b) during 1994 and 1995. The *Evaluation of Alternatives* provided information about the expected condition of species under each of the alternatives. The evaluation does not provide a simple conclusion for viable populations, but rather provides information needed to assess alternatives relative to the National Forest Management Act (NFMA), Endangered Species Act (ESA), National Environmental Policy Act (NEPA), and Federal Land Policy and Management Act (FLPMA).

Evaluations were based on expert opinions from professional panels concerning the likely outcome for species and their habitats under the proposed management alternatives. The SIT addressed habitat outcomes and population outcomes. Outcomes are a result of the numeric rating system used by the panel in making judgements concerning the relative scores for population and habitat by alternative. The EIS Team made inferences about viable populations from the SIT information, based on the following and other rationale presented in Appendix 4-2:

- ◆ *Species information* ~ maps of species' ranges, map locations for vascular plant species, tables of species/habitat associations, documented population

trends, species abundance, and species demographics, where known.

- ◆ *Alternatives information* ~ projected extent of species habitat at three points in time (historical, present, and 100 years in the future); maps of management emphases and allocations, such as aquatic strategies and reserve locations; maps and tables of vegetation types projected over 100 years; other projections of vegetation completed by the Landscape Ecology staff of the SIT; and specific management standards.

Experts were asked to make judgements about the likely condition of species and their habitats. Judgements were made for the planning area for each of the alternatives and for each of the three timeframes (historical, current, and 100 years in the future). Two distinct judgements were made: (1) the likely potential distribution of species based only on habitat conditions on BLM- and Forest Service-administered land (habitat outcomes); and (2) cumulative effects of the likely conditions across all land ownerships and considering all other influences (such as pollution) on actual species populations outcomes. To determine habitat and population outcomes, a structured process was used to provide likelihood ratings using an outcome scale. The outcome scale depicted five distinct possible outcomes for a species and/or its habitat. The analysis focused on the pattern of habitats supporting an actively breeding population that produces an excess number of juveniles that may disperse to other areas.

Overview and Factors Considered in Outcome Judgements

Individual outcomes represent points along a gradient ranging from a broadly distributed condition with a strong potential of species persistence (Outcome 1) to a poorly distributed condition with a high likelihood of extirpation (Outcome 5).

There was a level of uncertainty recognized by the expert panels in each of the species outcome rankings. Sources of uncertainty associated with the judgements differed for the three time frames considered. In the historical judgement, there was uncertainty in both the historical habitat projections and the

relationship of species to that habitat. In the judgement of current condition, there was uncertainty surrounding the habitat maps and the current distribution and condition of species' populations. In the future judgements, there was uncertainty in the habitat projection, the relationship of species habitat to unforeseen future events that might influence land management, and the response of habitat to that management. For each judgement, each expert independently spread 100 likelihood votes across five outcomes. All 100 votes had to be used. Placing 100 votes on a single outcome indicated much certainty, spreading votes indicated less certainty in any one outcome. Consensus was not an objective of votes among different experts.

Habitat Outcomes

Following are the distinct outcomes used to describe the likely species status that could be supported by habitat conditions on BLM- or Forest Service-administered lands. The term "habitat" in the outcome description is defined as primary habitat, capable of supporting a self-replacing population.

Outcome 1 ~ Habitat is broadly distributed across the planning area with opportunity for continuous or nearly continuous occupation by the species and little or no limitation on population interactions.

Outcome 2 ~ Habitat is broadly distributed across the planning area, but gaps exist within this distribution. Disjunct patches of habitat are typically large enough and close enough to other patches to permit species dispersal among patches and to allow species to interact as a metapopulation (local populations linked by migrants, allowing for recolonization of unoccupied habitat patches after local extinction events).

Outcome 3 ~ Habitat exists primarily as patches, some of which are small or isolated to the degree that species interactions are limited. Local subpopulations in most of the species' range interact as a metapopulation, but some patches are so disjunct that subpopulations in those patches are essentially isolated from other populations.

Outcome 4 ~ Habitat is typically distributed as isolated patches, with strong limitation in interactions of populations among patches and limited opportunity for dispersal among patches. Some local populations may be extirpated, and rate of recolonization will likely be slow.

Outcome 5 ~ Habitat is very scarce throughout the area with little or no possibility of interactions among local populations, strong potential for extirpations, and little likelihood of recolonization.

Population Outcomes

The outcome scale for cumulative effects across all ownerships was similar, but emphasized actual conditions for populations as follows:

Outcome 1 ~ Populations are broadly distributed across the planning area, with little or no limitation on population interactions.

Outcome 2 ~ Populations are broadly distributed across the planning area but gaps exist within this distribution. Disjunct populations are typically large enough and close enough to other populations to permit dispersal among populations to allow species to interact as a metapopulation.

Outcome 3 ~ The species is distributed primarily as disjunct populations, some of which are small or isolated to the degree that species interactions are limited. Local subpopulations in most of the species' range interact as a metapopulation, but some populations are so disjunct that they are essentially isolated from other populations.

Outcome 4 ~ Populations are typically distributed as isolated subpopulations, with strong limitation in interactions of subpopulations and limited opportunity for dispersal among patches. Some local populations may be extirpated and rate of recolonization of vacant habitat will likely be slow.

Outcome 5 ~ Populations are highly isolated throughout the area with little or no possibility of interactions among local

populations, strong potential for extirpations, and little likelihood of recolonization of vacant habitat.

Panelists were instructed to apply these outcomes in an absolute way in making their judgements. For example, if habitat for a species on BLM- or Forest Service-administered land existed as two large patches separated by non-federal land, its condition would be described as Outcome 2. Similarly, if a species and its habitat existed in a naturally patchy condition, its historical condition would be described as Outcome 3 or 4. Some outcomes may not be applicable to all taxa. For example, some amphibians and plants occur naturally in a localized or patchy distribution, and thus never would occur in the conditions described in Outcome 1, 2, or 3. This means that the best possible outcome for any species is not always Outcome 1.

Factors Considered in Judgements of Species' Response

Federal habitat judgements were based on potential species' response to the following factors:

- ◆ Amount and distribution of habitat on BLM- and Forest Service-administered lands;
- ◆ Habitat reduction causing bottlenecks and severe population decline; and
- ◆ Random environmental events, natural catastrophes, and natural variation caused by climate and other natural events.

Cumulative effects judgements were based on potential response to the following factors:

- ◆ Amount and distribution of habitat on BLM- and Forest Service-administered lands;
- ◆ Amount and distribution of habitat on non-federal lands;
- ◆ Habitat reduction causing bottlenecks and severe population decline; and
- ◆ Random environmental events and natural catastrophes, and natural variation caused by climate and other natural events; and
- ◆ Non-habitat factors, such as hunting, illegal taking of animals, and pesticides.

Methods for Analyzing Outcome Rankings

For a discussion of how the SIT analyzed the data derived from the expert panels, see the *Evaluation of Alternatives*.

Results for groups of species were shown in a simplified display of the number of species that fell into each of five classes of weighted mean outcomes. The five classes are used on many of the figures that accompany the text, figures and tables in this chapter. These classes are:

Outcome Class 1 ~ includes weighted means from 1.0 to <1.5 (strong potential for persistence)

Outcome Class 2 ~ includes weighted means from 1.5 to <2.5

Outcome Class 3 ~ includes weighted means from 2.5 to <3.5

Outcome Class 4 ~ includes weighted means from 3.5 to <4.5

Outcome Class 5 ~ includes weighted means from 4.5 to 5.0 (strong potential for extirpation)

A change of at least 0.5 (weighted mean score) downward or upward from current condition was considered significant. Mean likelihood scores were also used.

The Science Integration Team's results were reviewed by the EIS Team to ensure that they reflected an adequate understanding of the alternatives and of the landscape being analyzed. Most of the judgements reported here are identical to the results of the expert panels. If the judgements appeared to be inconsistent with projected habitat trends or with the array of standards across the alternatives, the Terrestrial staff of the SIT provided final results that differed from the expert panel. These differences are footnoted in the results. The change from historical to current and current

to future under each alternative was determined by comparing outcomes between time periods for each alternative.

Species were analyzed separately and also placed in groups for ease of discussion and comparison based on ecological and functional groupings. These groups are:

- ◆ plants,
- ◆ amphibians/reptiles,
- ◆ raptors/game birds,
- ◆ waterbirds/shorebirds,
- ◆ woodpeckers/nuthatches/ swifts,
- ◆ cuckoos/hummingbirds/passerines,
- ◆ bats and small mammals,
- ◆ carnivores, and
- ◆ ungulates.

Interpretation of Analysis

The intent of the analysis was to describe likely future conditions for habitats and species and provide for comparison of those conditions to current and historical conditions.

Interpretation of the results emphasized comparison of projected future conditions under the alternatives to historical and current conditions. The analysis did not provide a simple conclusion regarding conditions that constitute a viable population, because there were no simple thresholds for viability available for a broad array of taxa. Projected future conditions that result in improvements from current conditions (lower mean outcome scores) should generally be considered as positive outcomes. Projected declines from current conditions (higher mean outcomes scores) may be viewed as negative, particularly if they indicate a significant increase in the likelihood that populations would be isolated.

How Species Were Selected for Analysis

An analysis was not conducted for nonvascular plants or allies (bryophytes, fungi, or lichens). It is recommended that taxa in these groups be considered for further analysis at finer geographic scales.

A change in weighted mean Outcome Class from 3 to 4 is especially significant, as mean Outcome Class 4 indicates conditions under which populations would be isolated. A change to a weighted mean Outcome Class of 5 was viewed as a serious concern; this projected change in weighted mean would result in a strong likelihood of a species' extirpation from a large portion of its range. Changes in outcomes on federal lands were the primary criteria for judging alternatives, because alternatives only addressed management of those lands.

The Science Integration Team evaluated 164 plant taxa with conservation concern across their range with respect to their vegetation cover type associations, natural and human-caused threats to populations, and ecological characteristics. The majority of these taxa have either local distribution patterns or highly specialized habitats. Outcomes for these taxa could not be appropriately analyzed at the broad scale, and are best addressed at finer scales. See Appendix 4-2 for a list of these species needing finer-scale analysis. The remaining 28 taxa of range-wide conservation concern that could appropriately be analyzed at the broad scale were selected for outcome analysis; 22 of these occur in the Eastside planning area and are included in the Draft EIS (see Appendix 2-1).

No analysis was done for invertebrate species. The broad-scale direction of the alternatives would make it inappropriate to judge fine-scale effects on invertebrates. Taxa in this group should be considered for further analysis at finer geographic scales.

A Species Environment Relationships (SER) database which lists 547 vertebrate species that occur within the project area during some part of their life history was developed by the Terrestrial staff of the SIT. A step-wise process was used to determine which vertebrate species should be considered for further analysis during the evaluation of alternatives. The selection process used information gathered in the SER database and the results of a preliminary assessment done in October and November 1995. This first analysis evaluated changes in habitat and population for all species historically and under the preliminary alternatives. For the current evaluation, species from the database were placed in the following four categories: species for which a finer-scale analysis is needed, species for which no further analysis is necessary because their outcomes appear secure, species for which analysis would be conducted, and species which did not fall in any of the other three categories.

Locally endemic species within the project area are most appropriately analyzed at finer scales. Species for which no further analysis was considered necessary were those determined to be widely distributed that are common or abundant, have no recorded population or

habitat declines during the historical period, and are not expected to experience habitat declines under the alternatives. Analysis was considered mandatory for species that are federally listed or candidate species, or species that have been subject to lawsuits. However, the peregrine falcon was not evaluated because there is no significant concern of losing habitat (mostly cliffs) on BLM- or Forest Service-administered land and because the species is recovering. The northern spotted owl and marbled murrelet were not assessed because these species were thoroughly analyzed under the Northwest Forest Plan, which will be followed where it applies to the Eastside planning area. Species listed as sensitive by the Forest Service or BLM were also selected for further analysis, unless it was determined that they were suited for finer-scale analysis or considered to be little affected by federal habitat management.

Species that did not fall in any of the above categories were examined individually to determine if there were sufficient concerns about their viability on BLM- or Forest Service-administered lands to warrant detailed analysis. Species were generally considered for further analysis if they experienced significant habitat or population declines in the past or were associated with expected habitat declines under one or more alternatives. Past declines may be attributed to 1) management activities on BLM- and Forest Service-administered lands; or 2) actions such as agricultural practices or urban development on private lands. Selections were made on an ecological basis.

Issues of harvestability of terrestrial species (Appendix 1-2) are outside of the scope of the evaluation criteria for the *Evaluation of Alternatives* and would require a different evaluation process. In many cases, such species are widespread and relatively common or abundant, and there is little concern for their persistence within the planning area.

Information used in the selection of species for evaluation included literature, the SER database, initial evaluation of alternatives conducted in 1995, and any data analysis available on population trends. From the SER database, 173 vertebrate species were selected by the SIT for analysis in the project area. Of these, 119 vertebrate species and 22 vascular plant are included in this EIS. Thirty-nine

vertebrates were identified for further fine-scale analysis. See Appendix 4-2 for the respective lists of species.

EIS Team Application of Science Integration Team Information

The EIS Team made inferences about viable populations from the SIT information, based on the following and other rationale presented in Appendix 4-2.

- ◆ The Habitat Outcomes method was used to address the viability requirements of National Forest Management Act planning regulations (36 CFR 219.19). This method is reasonable for addressing NFMA requirements for broad-scale programmatic planning.
- ◆ Cumulative effects analysis, under NEPA requirements, was used to make inferences about populations and population persistence. This method is referred to as Population Outcomes.

Effects of the Alternatives on Terrestrial Species

General Trends: Terrestrial Species and Habitats At Risk

The Science Integration Team reviewed 547 vertebrate and 8,000 vascular plants. They chose 173 species for analysis; of those, 119 vertebrate species and 22 vascular plants are included in the Eastside Draft EIS.

Three major trends can be determined from the evaluation of alternatives:

- ◆ There would be little change in overall habitat outcomes and viability for the majority of the species analyzed, including threatened or endangered species. This statement is true for all the alternatives (see

Figures 4-17, 4-47, and 4-48). The percentages of species analyzed that do not demonstrate a substantial change from current outcomes, range from a high of 96 percent in Alternative 2 to a low of 83 percent in Alternative 1.

- ◆ Alternatives 1 and 5 are projected to result in the highest number of species with an increased risk of extirpation or viability loss compared to other alternatives (see Table 4-41 and Figures 4-17 and 4-18).
- ◆ Alternatives 4, 6, and 7 would result in a higher number of species with improved likelihood of persistence and viability for the next 100 years compared to other alternatives (see Table 4-42 and Figures 4-17 and 4-18).

Tables 4-41, 4-42, and 4-43 portray species habitats considered at risk, either currently or through the implementation of one or more alternatives. These tables have some species in common, reflecting risks and impacts of alternatives, primarily riparian- and snag-associated species. Some species listed in Table 4-41 show little differentiation among alternatives. In many cases these species are at risk or in decline for reasons other than federal land management activities.

Table 4-41 shows species predicted to be at risk of extirpation. Several of these species are at risk in all alternatives; actions on federal lands have little impact on these outcomes. These species or groups of species will be discussed later.

Table 4-42 lists species whose habitats are expected to improve in quality, through implementation of one or more alternatives. In general, “increaser” species (whose habitat conditions are improved from the current condition) are not seen in Alternatives 1 and 2, and are most prevalent in Alternatives 4, 6, and 7, because of standards that improve particular habitat components such as snag levels or

Outcomes vs. Status - Outcomes are a result of the panel process and are reported by a “Weighted Mean Score” of 1 to 5 (see Methodology). Status is measured in 3 ways: (1) No change, (2) Increase, and (3) Decrease. Increase/Decrease are defined as a 0.5 change in the Weighted Mean Score. The results are reported by both measures in the text of this discussion. For example, figure 4-21 displays changes in status by alternative for plants, and figure 4-22 displays outcomes for plants by alternative.

Table 4-41. Comparison of Habitat Outcome Class on Forest Service- and BLM-administered Lands, Eastside Planning Area.

Category	Historical	Current	Alternatives							
			1	2	3	4	5	6	7	
Plants										
<i>Botrychium crenulatum</i>	A4	A4	B4				B4	B4	B4	
<i>Howellia aquatilis</i>	B4	B4	B4	B4	B4	B4	B4	B4	B4	B4
<i>Lomatium suskdorfii</i>	C5	C5	C5	C5	C5	C5	C5	C5	C5	C5
<i>Polemonium pectinatum</i>	B4	C5	C5	C5	B5	B5	B5	B5	B5	C5
<i>Silene spaldingii</i>	C5	C5	C5	C5	B4	B4	B4	B4	B4	C5
<i>Stephanomeria malheurensis</i>	D5	D5	D5	D5	D5	D5	D5	D5	D5	D5
Amphibians/Reptiles										
Columbian spotted frog	A3	A4	B4							
Northern leopard frog	A3	C5	C5	C5	C5	C4	C5	C4	C4	C4
Oregon spotted frog	A3	A4	B4				B4			
Tailed frog	A3	A3	B4				B4			
Woodhouse's toad	A3	A4	C4	B4	B4		B4			
Longnose leopard lizard	A3	A4	B4				B4			
Sharptail snake	A4	C5	C5	C5	C5	B4	C5	B4	B4	B4
Waterbirds/Shorebirds										
Goldeneyes	A4	A4	B4							
Harlequin duck	A3	C5	C5	B4	B4		C5			B4
Upland sandpiper	A2	D5	D5	C5						
Raptors/Gamebirds										
Columbian sharp-tailed grouse	A1	C5	C5	C5	B4	B4	B4	B4	B4	B4
Mountain quail	A3	A4	B4	B4						
Boreal owl	B4	B4	B4	B4	B4	B4	B4	B4	B4	B4
Flammulated owl	A2	B4	B4							
Great gray owl	A3	B4	B4	B4						
Woodpeckers, Nuthatches, & Swifts										
Black-backed woodpecker	A2	A3	B4							
Lewis' woodpecker	A2	A4	C5							
Red-naped sapsucker	A2	A3	B4							
Three-toed woodpecker	A3	A3	B4							
Vaux's swift	B4	A4	C5		B4		B4			
White-headed woodpecker	A2	A4	B4		B4					
Williamson's sapsucker	A2	A3	B4							
Cuckoos, Passerines, & Hummingbirds										
Black rosy finch	A4	A4	B4	B4			B4			
Bobolink	A4	B4	C5	B4	B4	B4	C5			B4
Grasshopper sparrow	A4	C5	C5	C5	C5	C5	C5	C5	C5	C5
Yellow-billed cuckoo	A3	C5	C5	C5	C5	B4	C5	B4	B4	C5
Bats & Small Mammals										
Fringed myotis	A3	A4	B4		B4		B4			
Hoary bat	A2	A3					B4			
Long-legged myotis	A2	A4	B4							
Pale western big-eared bat	A3	A4	B4		B4		B4			
Silver-haired bat	A3	A3	B4							
Spotted bat	A4	B4	B4	B4	B4	B4	C5	B4	B4	B4
Western small-footed myotis	A2	A3	B4		B4	B4	B4			
Northern flying squirrel	A2	A3	B4							

Table 4-41. Comparison of Habitat Outcome Class on Forest Service- and BLM-administered Lands (continued).

Category	Historical	Current	Alternatives						
			1	2	3	4	5	6	7
Carnivores & Ungulates									
American marten	A3	B4	C4	B4	B4		C4		
Fisher	B4	C5	C5	B5	B4	B4	C5	B4	C4
Grizzly bear	A2	B4	B4	B4	B4	B4	B4	B4	B4
Lynx	A3	B4	C5	C5	B4	C5	C5	B4	B4
Wolverine	A3	B4	B4	B4	B4	B4	B4	B4	B4
California bighorn sheep	A4	C5	C5	C5	C5	C5	C5	C5	C5
Woodland caribou	C5	D5	D5	D5	D5	D5	D5	D5	C5
Total of "A"	38	23							
Total of "B"	5	10	26	13	18	14	18	13	10
Total of "C"	3	11	17	11	9	6	13	5	10
Total of "D"	1	3	3	2	1	2	2	2	1
Grand Total	47	47	46	26	28	22	33	20	21

This table applies to Forest Service- and BLM-administered lands in the Eastside planning area. Includes all species with at least 20 points in outcome 5 for any alternative. Weighted mean scores are included for reference.

Where no score is shown, there are fewer than 20 points in Outcome 5.

A = 0-19 points in Outcome 5

B = 20-49 points in Outcome 5

C = 50-99 points in Outcome 5

D = 100 points in Outcome 5

3 or less = Favorable Outcome Class

4/5 = Less Favorable Outcome Class

riparian widths. For the most part, the improved habitat components fall into four types: riparian, large reserves, snag/downed wood, and rangeland.

Table 4-43 displays species habitats predicted to decrease in quantity or quality, changing from outcomes that are currently favorable to outcomes that are significantly poorer. This table reveals that Alternatives 1 and 5 would have the highest number of species that are adversely affected, while Alternatives 4, 6, and 7 would affect the lowest number of species. Similar to Table 4-42, the elements most important to the outcomes are riparian habitat, snag/downed wood levels, and rangelands. Species associated with large reserves do not show up in this table, primarily because many of those species are currently at risk and would not significantly decline in any alternative.

The risk of extirpation or viability loss for a given species was examined in two ways: (1) by a weighted mean score of Outcome Class 4 or 5, and (2) by the total number of possible points in Outcome 5 (see Methodology section). The SIT chose 20 or more points in Outcome 5 as describing some risk of extirpation.

Most of the species groups on Table 4-41 whose outcomes would differ among alternatives (amphibians/reptiles, waterbirds, raptors/gamebirds, woodpeckers, and bats) can be categorized by two habitat associations: riparian habitat, or snags and downed wood. These species groups would be negatively affected by management activities in Alternatives 1 and 5, and positively affected by Alternatives 4, 6, and 7. One plant, *Botrychium crenulatum*, occurs primarily on federal land and would be negatively affected by

Table 4-42. Increasesers ~ Species Habitats That Would Improve, Eastside Planning Area.

Species	Current	Alternative						
		1 ¹	2	3	4	5	6	7
Rubber boa	3.5*							2.9**
Sharptail snake	4.5*							3.9
Oregon spotted frog	3.6*							3.1**
Woodhouse's toad	3.9*						3.5	3.4**
Columbian sharp-tailed grouse	4.8*			4.2	4.0	4.2	4.1	
Sage grouse	3.2				2.3	2.6	2.2	2.6
Bald eagle	3.6*		3.1**	3.0**	2.9**	3.0**	2.9**	3.0**
Boreal owl	4.2*							3.7
Cooper's hawk	2.4				1.9		1.9	
Ferruginous hawk	3.0				2.5		2.5	
Flammulated owl	3.8*			3.1**	2.9**	3.1**	3.0**	3.3**
Harlequin duck	4.5*				3.5		3.5	
Lewis' woodpecker	3.5*				2.5**		2.5**	2.5**
Pileated woodpecker	3.4				2.5		2.6	2.6
Red-naped sapsucker	3.3				2.7		2.7	
Vaux's swift	3.7*							2.9**
White-headed woodpecker	3.8*				2.7**	3.3**	2.7**	3.1**
Chestnut-backed chickadee	3.3		2.8	2.8				2.6
Hammond's flycatcher	3.4				2.9**		2.8**	2.9**
Western bluebird	3.0				2.4		2.3	
Long-legged myotis	3.7*				3.2**		3.0**	
Northern flying squirrel	3.5*						2.9**	3.0**
American marten	4.0*				3.4**		3.4**	3.0**
Fisher	4.8*				4.2		4.2	
Woodland caribou	5.0*							4.5
Total Number of Species:	25	0	2	4	16	5	18	17

This table applies to the Eastside planning area. Increasesers are species whose habitat would improve (by 0.5 or more) under an alternative. That is, the outcome under an alternative would decrease by at least 0.5.

¹ Where no score is shown, improvement is less than 0.5

* = species with less favorable outcomes (3.5+)

** = favorable outcomes (less than 3.5) projected to result from alternative implementation - represents a significant improvement in habitat conditions

Table 4-43. Species Habitats With a Favorable Outcome Changing to a “Less Favorable” Outcome, Eastside Planning Area.

Species	Current	Alternative						
		1	2	3	4	5	6	7
<i>Astragalus mufordiae</i>	3	4	4	4	4	4	4	4
<i>Calochortus longebarbatus</i>	3	4				4		
Tailed frog	3	4				4		
Black-backed woodpecker	3	4				4		
Piliated woodpecker	3	4	4	4				
Pygmy rabbit	3	4						
Red-naped sapsucker	3	4				4		
Three-toed woodpecker	3	4						
White-breasted nuthatch	3	4				4		
Williamson's sapsucker	3	4				4		
Chestnut-backed chickadee	3	4				4		
Olive-sided flycatcher	3	4		4		4		
Western bluebird	3	4						
Winter wren	3	4	4	4		4		
Veery	3					4		
Willow flycatcher	3	4	4	4		4		
Yellow warbler	3	4				4		
Bushtit	3					4		
Hoary bat	3	4	4	4		4		
Silver-haired bat	3	4				4		
Western small-footed myotis	3	4		4	4			
Total Number of Species	21	19	5	7	2	16	1	1
Percent of Total (141) Species Analyzed		13	4	5	1	11	1	<1

This table applies to the Eastside planning area. Where no score is shown, outcome is unchanged or improved.

Favorable outcome = a weighted mean score of (less than 3.5)

Less favorable outcome = a weighted mean score of (3.5 +)

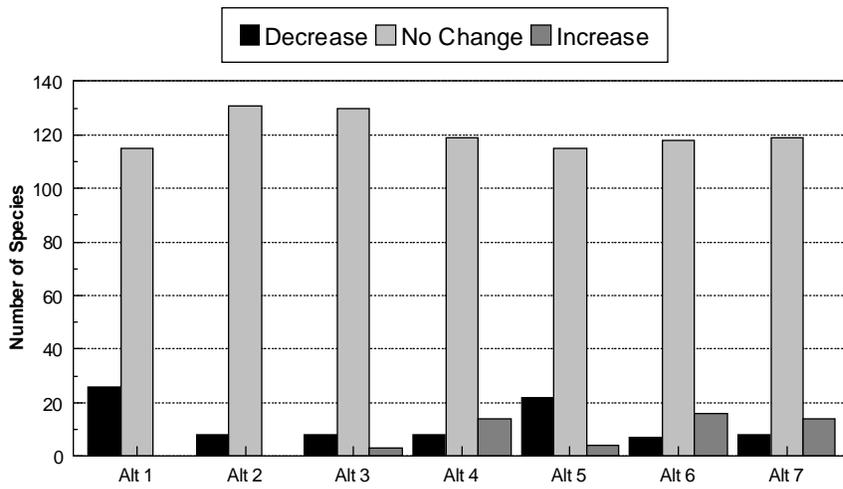


Figure 4-17. Plants and Vertebrates, Change in Habitat from Current Conditions, 141 Species, Eastside Planning Area.

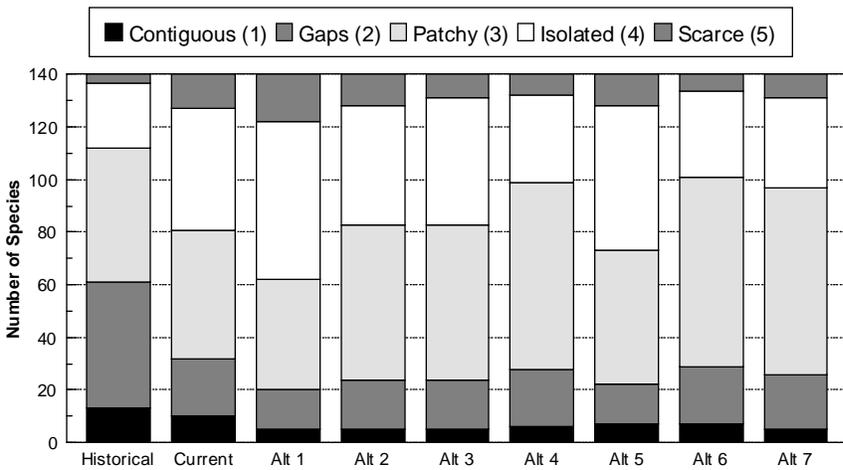


Figure 4-18. Plants and Vertebrates, Weighted Mean Outcome Scores (1-5), 141 Species, Eastside Planning Area.

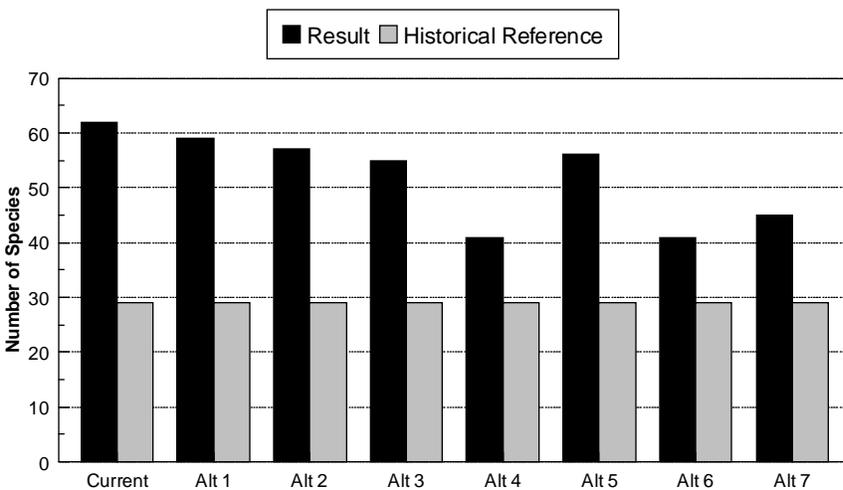


Figure 4-19. Sixty-two Species Projected to Retain a Weighted Mean Outcome Score of 4 or 5, Eastside Planning Area.

management activities including timber harvest, road building, and trampling, primarily in Alternatives 1, 4, 5, and 6.

Species at Risk Which Show Little Change in Outcome Class by Alternative

Several species shown in Table 4-41 would have poor outcomes under all alternatives. This scenario usually means that species have been and will continue to be affected by factors other than management activities on federal lands. This group includes several plant species, the northern leopard frog, sharptail snake, Columbian sharp-tailed grouse, yellow-billed cuckoo, spotted bat, fisher, grizzly bear, lynx, wolverine, California bighorn sheep, woodland caribou, upland sandpiper, boreal owl, and grasshopper sparrow.

- ◆ Of the plant species in Table 4-41 that are not likely to show changed outcomes due to the alternatives, one (*Howellia aquatilis*) occurs in specialized habitats and one (*Stephanomeria malheurensis*) occurs at a single location. Several other species (*Lomatium suksdorfii*, *Polemonium pectinatum*, *Silene spaldingii*) occur primarily on non-federal land, where the alternatives are unlikely to affect the outcomes.
- ◆ The northern leopard frog and the sharptail snake have declined for many reasons, most not associated with federal land management practices. However, Table 4-41 indicates that their outcomes would be slightly improved with implementation of Alternatives 4, 6, or 7, which should improve connectivity.
- ◆ Habitat declines on both federal and non-federal lands have affected Columbian sharp-tailed grouse and yellow-billed cuckoo. Conversion of habitat to cropland has left isolated populations of sharp-tailed grouse. Fragmentation of riparian habitat on federal and non-federal land has isolated populations of yellow-billed cuckoo. As indicated in Table 4-41, none of these species are likely to reach favorable outcomes under any of the alternatives. However, the remaining habitat is extremely important to the persistence of these species.

- ◆ Spotted bats roost primarily in cliff faces with surrounding forest, and are thought to have had patchy distribution historically. Because of continued recreation and timber harvest near cliff roost sites, there will be more habitat disturbance in Alternatives 1 and 2 than in Alternatives 3, 4, 5, 6, and 7, which provide more protection in the standards.
- ◆ As a group, carnivores currently occur in patches of isolated habitat. Table 4-41 reveals that alternatives that promote larger blocks of habitat and improved connectivity (Alternatives 4, 6, and 7) may improve these outcomes. Where habitats remain isolated by areas of private land, the alternatives would not change outcomes.
- ◆ California bighorn sheep are limited throughout their range by distribution of available habitat. Reduction in density of juniper and sagebrush would improve the connectivity of bighorn sheep habitat. Alternative 4, with the most aggressive rate of habitat restoration, would have the highest likelihood of improving this habitat. However, other factors such as diseases transmitted by domestic livestock, will continue to affect the outcome of this species.
- ◆ Woodland caribou are at the highest risk level because of small and isolated populations (with little genetic interchange) and limited range within the project area. The small populations are likely to be affected by habitat changes (through wildfire or insects and disease) or through mountain lion predation. Unless herds are augmented, this species is likely to remain at risk.

Table 4-42 displays species that are projected to have substantially improved habitat conditions from the current situation (increaser species). With the exception of Alternative 1, all of the alternatives would result in significant improvements in conditions and viability for at least some species. Alternatives 6, 7, and 4, respectively, would result in the greatest number of increaser species. Alternative 6 would result in the highest number of species projected to change from a risk of extirpation to a high likelihood of persistence and viability.

All of the alternatives also would result in declining conditions for at least some species; these species are referred to as “decreasers.” Table 4-43 displays those species that are projected to change from having a high likelihood of persistence to having some risk of extirpation for a given alternative.

As indicated in Table 4-43, Alternatives 1 and 5 would result in the highest number of species (19 and 15 species respectively, out of 141 total species analyzed) which change from a high likelihood of persistence and viability (Outcome Classes 1, 2, and 3) to having a risk of extirpation/viability loss (Outcome Classes 4 and 5). Alternatives 1 and 5 would have a negative effect on 13 percent and 11 percent of the species in the Eastside planning area, respectively. Alternatives 4, 6, and 7 would have a negative effect on 1 percent, 1 percent, and less than 1 percent. Alternatives 2 and 3 are relatively intermediate, with 4 and 5 percent of species that change from a likelihood of persisting to a risk of extirpation/viability loss.

Historically, there were 29 species with weighted mean scores of Outcome Class 4 or 5, while currently there are 62 species in the planning area with a weighted mean score of Outcome Class 4 or 5 (Figure 4-19). This group of species could be defined as having outcomes that suggest some level of concern for their long-term viability. By tracking the weighted mean scores for this group of species by alternative and by continually referencing historical conditions, it is possible to get a relative sense of the effect the alternatives would have on improving the long-term viability

of terrestrial species. In Figure 4-19, departure from historical conditions is judged by the height of the results bar above the historical background reference. Improvement in conditions, compared to the current situation, is displayed by relative reductions in the size of the bar.

Alternatives 4, 6, and 7 would result in the greatest relative improvement in habitat outcomes for this group of species. Alternatives 1, 2, 3, and 5 would result in a reduced number of species; however, the total reduction would be minimal (Figure 4-19).

The grizzly bear and Columbian sharp-tailed grouse would have the greatest change in habitat outcomes when comparing historical conditions with current conditions (Figure 4-20). Projections for grizzly bear in all alternatives show very little change from the current situation. For Columbian sharp-tailed grouse, there would be small but significant improvements projected for Alternatives 3 through 6.

Changes in habitat progression for grizzly bears have resulted from the construction of major interstate freeway systems, increasing human habitation of rural areas, and increased access on public lands. Habitat quality and availability for the Columbian sharp-tailed grouse has been diminished by conversion of native shrub-steppe to agricultural croplands, invasion of exotic plant species, and human habitation. In the context of this analysis, these are the only two species that would show such a big change in habitat conditions.

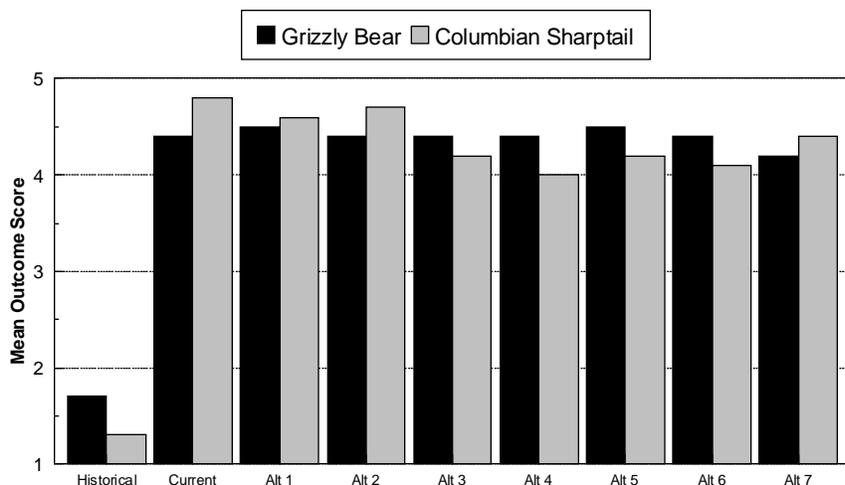


Figure 4-20. Two Species with the Greatest Magnitude of Change in Habitat Quality, Historical to Current, Eastside Planning Area.

Results from Analysis of Species Groups

Vascular Plants

The majority of the vascular plant species for which long-term viability is a concern are either very restricted in their geographic distributions, or have broader distributions but are associated with highly specialized habitats. Species with limited geographic ranges are classified as endemics; they are often represented by low population numbers, and may be more susceptible to localized extirpations. These geographically restricted or ecologically specialized species are not evaluated here, as they require analysis at finer planning scales. Exceptions include water howellia, Malheur wire lettuce, and MacFarlane's four-o'clock, which were analyzed because they are federally listed. The 19 other plant species assessed include only those that, by virtue of their broader distributions or more general habitat associations, could be addressed under the alternatives.

Most of the 22 vascular plant species analyzed are predicted to have little change in status compared to current conditions (Figure 4-21), with the exception of *Botrychium crenulatum*, which is predicted to have decreased habitat quality, especially under Alternatives 1 and 5, due to timber harvest. This species is known to be associated with mature and late-seral structures in moist forests. Weighted mean outcomes for these vascular plants would also have limited variability across alternatives, with little difference in predicted outcomes for most plant species (Figure 4-22). Modest improvements are displayed for Alternatives 3, 4, 5, and 6 when compared with current conditions, and are most evident under Alternatives 4 and 6. Fewer species would be rated as Outcome Class 5 (scarce) in these cases. Implementation of the restoration prescriptions emphasized in Alternatives 4 and 6, and the aquatic conservation strategies and Eastside screens in Alternative 2, are expected to provide the most suitable conditions for rare plants over the long term. Specifically, management activities that include maintenance or creation of canopy openings via silvicultural treatments or prescribed burning were rated as more likely to produce favorable habitat and population conditions for rare plants associated with early- and mid-seral

vegetation stages. Alternative 7 was generally rated as being slightly less favorable because it was predicted that the relationship of certain plants to fairly dynamic (early- and mid-seral structures) habitat conditions on a landscape scale would be less enhanced under this alternative.

Cumulative effects of loss of habitat and populations on non-federal lands have been greatest in the Palouse prairie (ERU 6) and low-elevation upland shrub communities, specifically the sagebrush steppe region of the upper Snake and Columbia river plains (ERUs 11 and 5). In the case of the Palouse prairie this loss has primarily been due to agricultural conversion. In the upland shrub communities, the loss has resulted from habitat conversion to non-native grass seedings, and changes in vegetation stages and composition caused by alteration of natural fire regimes, grazing, and the spread of exotic plant species. The species of greatest concern with respect to cumulative habitat loss are *Calochortus nitidus*, *Polemonium pectinatum*, and *Silene spaldingii* in the Palouse grasslands, and *Astragalus mulfordiae* in the upland shrub habitats. In these cases, the critical role that federal lands play as strongholds for the remaining habitats and populations was recognized in the analysis.

Amphibians and Riparian-associated Reptiles

The Columbian spotted frog, northern leopard frog, Oregon spotted frog, tailed frog, western toad, and Woodhouse's toad were the only six amphibians evaluated (see Figures 4-23 and 4-24). Riparian-associated reptiles include the garter snake, painted turtle, and western pond turtle. In general, the important habitat components for amphibians and riparian-associated reptiles are those which provide cool, moist environments, cool water, coarse woody debris, and protection of headwater streams. Riparian buffers around intermittent streams and wetlands, the level of harvest in currently undisturbed forestland, grazing intensity, and restoration activity were used to evaluate the effects of alternatives on these species. Habitat conditions for most riparian-associated species have declined from historical to current times on all land ownerships. Habitat decline for amphibians is tied to increased human disturbance, fragmentation of habitat, and reduced riparian acreage and quality of habitat. Habitat that was historically broadly distributed

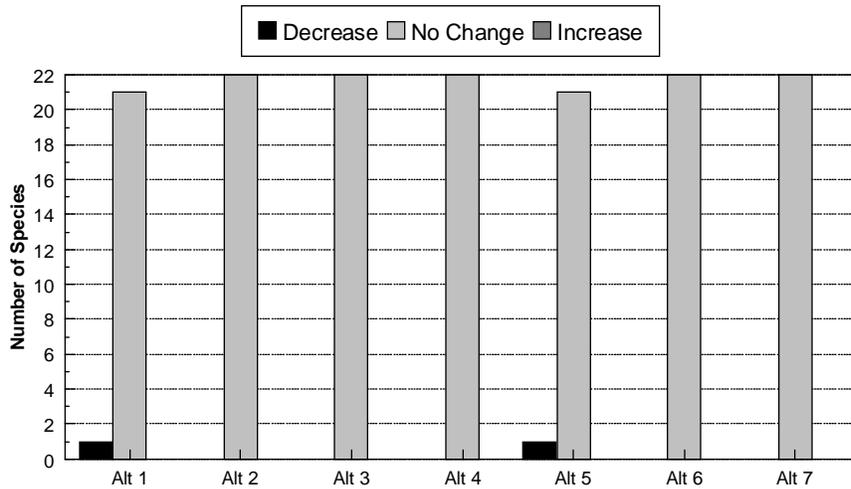


Figure 4-21. Vascular Plants, Change in Habitat from Current Conditions, 22 Species, Eastside Planning Area.

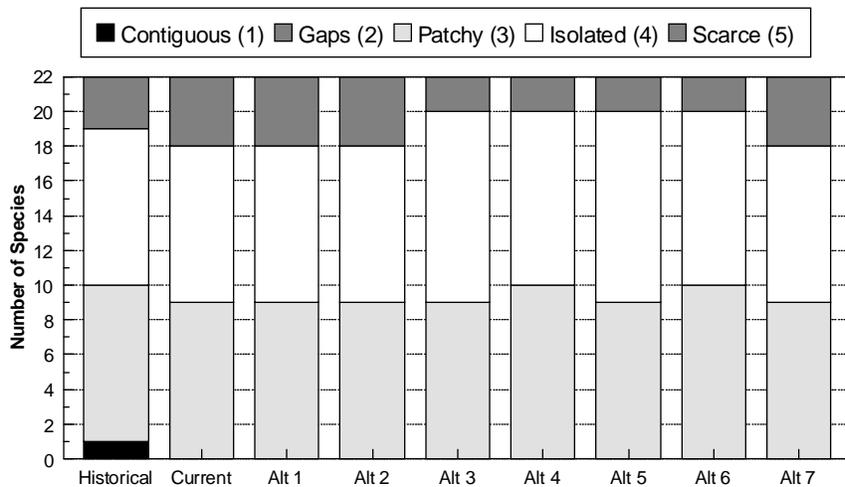


Figure 4-22. Vascular Plants, Weighted Mean Outcome Scores (1-5), 22 Species, Eastside Planning Area.

or patchy has been reduced to habitat that is isolated, resulting in strong limitations on interactions between populations.

Alternatives 2, 3, 4, 6, and 7 would generally result in no change or a slight improvement in status for amphibians and riparian-associated reptiles because they provide habitat quality, quantity, and distribution that is similar to the current habitat conditions. Alternatives 6 and 7 would result in slightly more favorable outcomes for amphibians and riparian-associated reptiles. Further habitat decline for the riparian-associated species is generally projected under Alternatives 1 and 5. Alternative 3 would be less favorable for the Woodhouse’s toad and northern leopard frog because of predicted increases in habitat isolation.

Cumulative effects are of concern for amphibians and riparian-associated reptiles. Land management activity on non-federal lands would affect nearly all amphibians and riparian-associated reptiles. The general trend is toward more isolation of populations and in some cases toward higher risks of extirpation. This trend is especially true for Alternatives 1, 2, 3, and 5 for the painted turtle and western pond turtle. Cumulative effects on populations generally reflect the viewpoint that effects of past management and disturbance cannot be fully mitigated within 100 years. Populations are declining partly as a result of factors not greatly influenced by the alternatives including pesticide accumulation, private land modification, and predation.

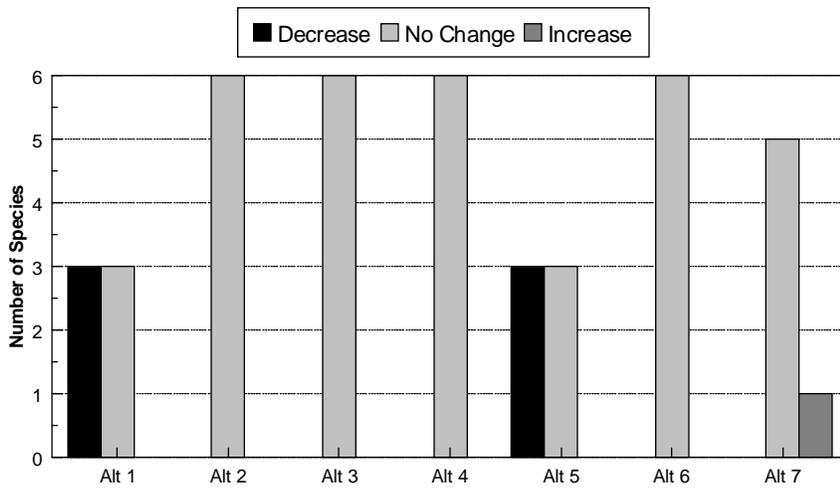


Figure 4-23. Amphibians, Change in Habitat from Current Condition, 6 Species, Eastside Planning Area.

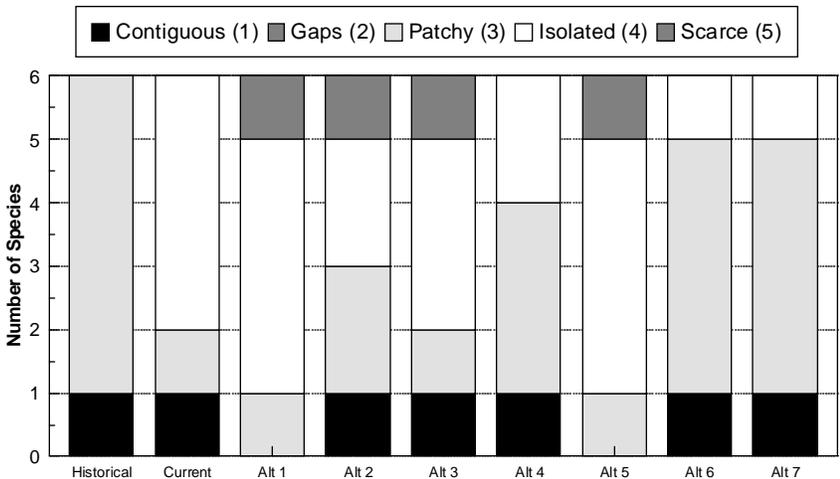


Figure 4-24. Amphibians, Weighted Mean Outcome Scores (1-5), 6 Species, Eastside Planning Area.

Reptiles

Predicted outcomes for 11 reptiles are shown in Figures 4-25 and 4-26. Current conditions have declined only slightly from historical conditions. Effects on habitat do not vary significantly (less than 0.5 weighted mean outcome score) across the alternatives, except for the sharp-tail snake. Generally, Alternatives 2, 3, 4, 6, and 7 would be more favorable for reptiles because they would result in habitat quality, quantity, and distribution that are similar to or slightly improved from the current habitat conditions (Figure 4-25).

Alternatives 4, 6, and 7 are projected to provide the best habitat components for reptile species (Figure 4-26). Further habitat decline for reptiles is generally projected under Alternatives 1 and 5, resulting from an expected

increase in isolation of habitat. Further decline on Forest Service- or BLM-administered lands is projected due to invasion of exotic weeds under Alternatives 1 and 5. Effects suggest a greater decline from historical habitat conditions for some of the rangeland-associated species (Mojave black-collared lizard, longnose leopard lizard, rubber boa, and sharptail snake). Population declines are generally related to historical conversion of rangeland to agricultural use, exotic plant introductions (such as cheatgrass which becomes established as a monoculture), fragmentation of suitable habitat, reservoir development, and riparian vegetation loss.

Cumulative effects generally trend toward somewhat more isolated populations compared to effects on Forest Service- and BLM-administered lands. Long-term global climate

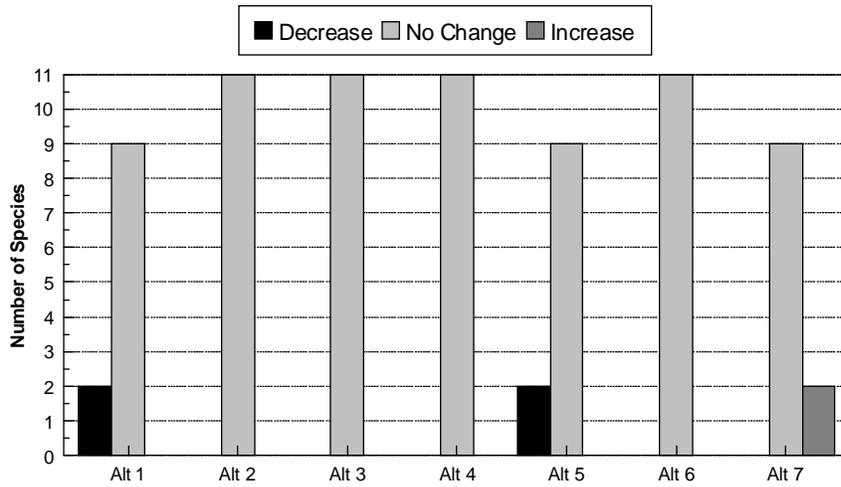


Figure 4-25. Reptiles, Change in Habitat from Current Condition, 11 Species, Eastside Planning Area.

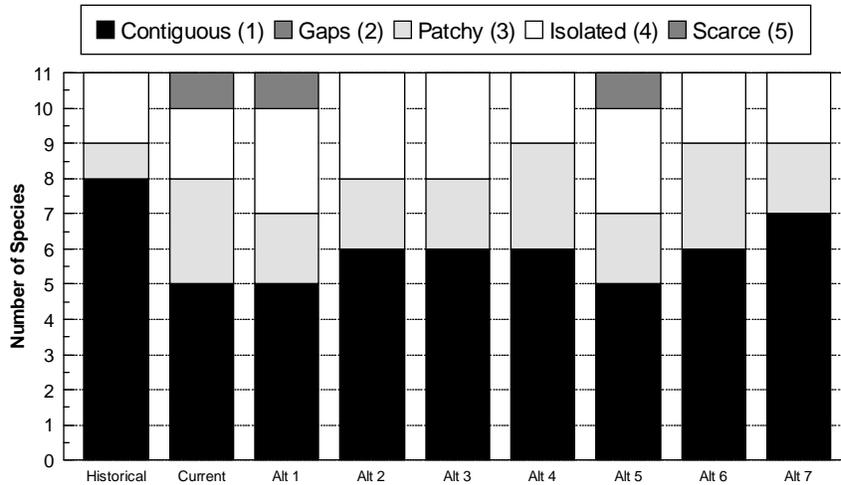


Figure 4-26. Reptiles, Weighted Mean Outcome Scores (1-5), 11 Species, Eastside Planning Area.

change seems to be causing the sharptail snake, in particular, to be undergoing continuous decline.

Bird Groups

Four separate expert panels assessed 133 bird species, and the results are reported by the following species groups:

- ◆ Waterbirds and shorebirds
- ◆ Raptors and gamebirds
- ◆ Woodpeckers/nuthatches/swifts
- ◆ Cuckoos/hummingbirds/passerines
 - ◆ Forest birds
 - ◆ Grass/shrub birds
 - ◆ Woodland birds
 - ◆ Riparian birds

Waterbirds and Shorebirds

Figures 4-27 and 4-28 display predicted outcomes for 65 species of waterbirds and shorebirds, which were divided into 15 groups for evaluation. A complete list of waterbirds and shorebirds can be found in Appendix 2-1. No groups were judged to have been widely distributed historically, and none currently are widely distributed. In general, the important habitat components for waterbirds and shorebirds are those that provide high quality riparian stream habitat and wetland habitat with natural fluctuations in water levels. The resulting conditions provide important food items early in the spring which persist well into the drier season, as well as providing open water with protection from predation, clear flowing cool water, and nesting habitat within the wetlands and in adjacent woody vegetation.

Projected outcomes for waterbirds and shorebirds as a whole changed very little from current conditions because management alternatives had little planned manipulation of wetland habitat (Figure 4-27).

Alternatives 4 and 6 are predicted to have the most favorable outcomes, improving habitat from current conditions to nearly approach historical conditions for wood ducks, mergansers, and harlequin ducks. The upland sandpiper is the only species rated in Outcome Class 5, due to loss of grassland habitats and over-hunting. Alternatives 4 and 6 would increase water quality in streams, maintain riparian herbaceous and woody vegetation through management of natural and human disturbance, increase snags in riparian and adjacent uplands for cavity nesters, and

manage grazing of upland grasslands to reduce negative impacts to breeding birds or create beneficial effects. Alternative 7, with more management restrictions inside reserves, is not expected to be more favorable than alternatives that allow for active restoration. Wetlands were not expected to change in geographic extent on BLM- or Forest Service-administered lands under the alternatives, except for natural fluctuation due to the hydrologic cycle.

Substantial improvement in harlequin duck habitat was predicted under Alternatives 4 and 6 as a result of watershed restoration that improved water quality, reduced streamside disturbance, and improved riparian vegetation.

Cumulative effects for waterbirds and shorebirds take into consideration the great

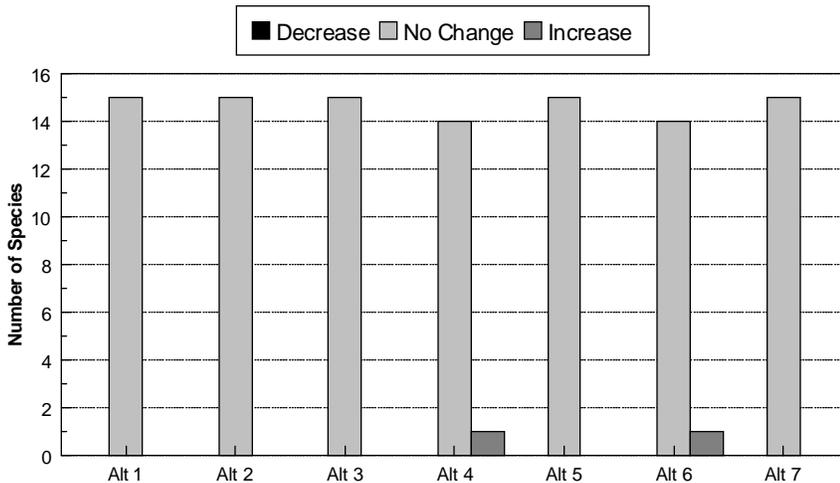


Figure 4-27. Waterbirds and Shorebirds, Change in Habitat from Current Condition, 15 Species Groups, Eastside Planning Area.

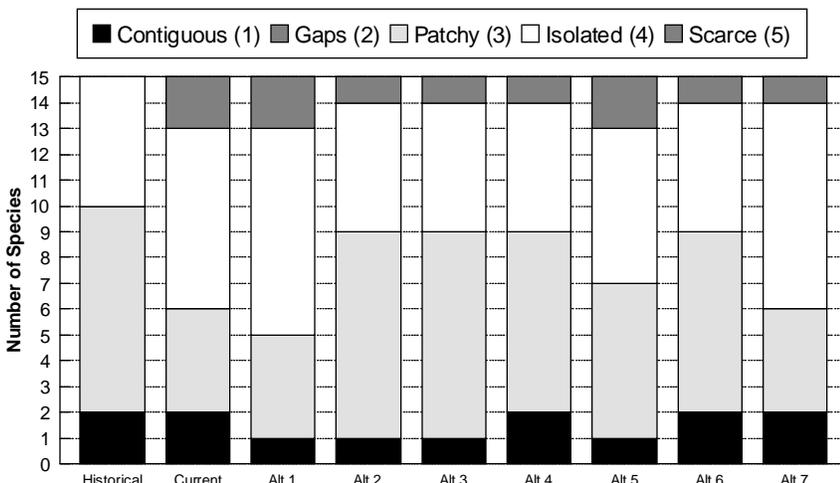


Figure 4-28. Waterbirds and Shorebirds, Weighted Mean Outcome Scores (1-5), 15 Species Groups, Eastside Planning Area.

extent of wetlands on other federal and private lands. Positive effects of habitat improvement on BLM- and Forest Service-administered lands, in many cases, were offset by negative factors such as the accumulation of pesticides and other toxic substances in wetlands, degradation of wetlands on private lands, degradation of wintering grounds, population declines south of the U.S. border, urban and industrial development, pollution, and human activities in marine wintering areas.

Raptors and Gamebirds

Four gamebirds, four hawks, nine owls, the band-tailed pigeon, the bald eagle, and the merlin (20 total species) were considered for analysis in the raptors and gamebirds group. Predicted outcomes for raptors and gamebirds are shown in Figures 4-29 and 4-30. This

group is associated with a broad range of habitat types. Eight of the 20 species are primarily forest-associated, 5 are shrubland and grassland associates, 3 are riparian associates, and 4 are woodland associates. Historical habitat for these species was more broadly distributed than at present (Figure 4-30). All of the species are associated with habitats that have declined from historical conditions or are expected to decline under one or more of the alternatives.

Average outcome scores would be most favorable under Alternatives 4 and 6, when compared to other alternatives. Alternatives 3, 5, and 7 would have intermediate results. Least favorable outcomes are projected for Alternatives 1 and 2 (Figure 4-30). Boreal owl habitat was known to be disjunct and supported isolated populations historically.

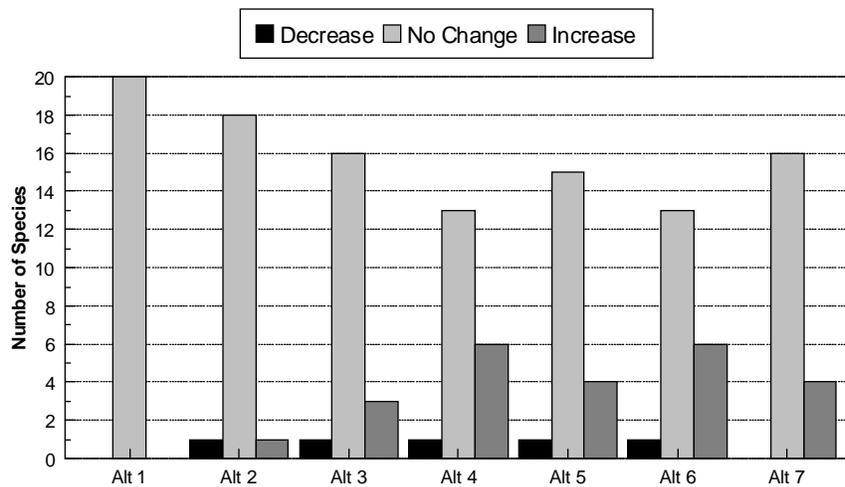


Figure 4-29. Raptors and Gamebirds, Change in Habitat from Current Conditions, 20 Species, Eastside Planning Area.

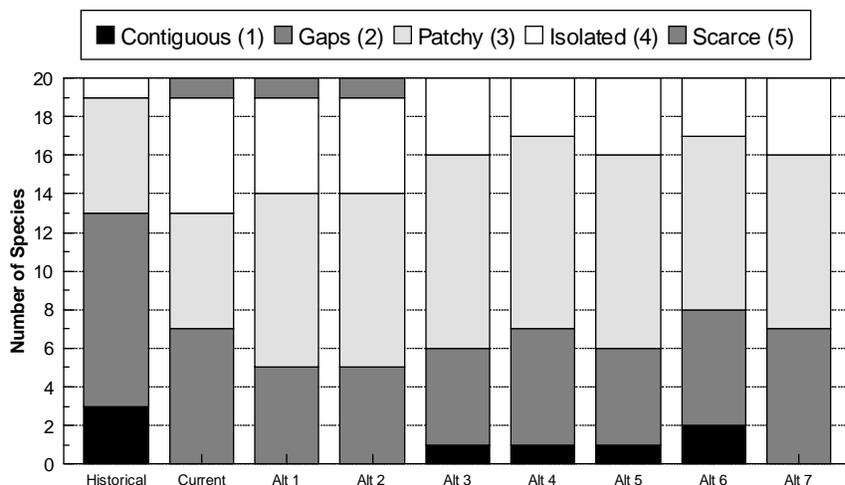


Figure 4-30. Raptors and Gamebirds, Weighted Mean Outcome Scores (1-5), 20 Species, Eastside Planning Area.

This condition is not expected to change. Columbian sharp-tailed grouse are rated as Outcome Class 5 in all alternatives.

Species with historical habitat conditions rated as Outcome Class 1 include the burrowing owl, northern pygmy owl, and northern saw-whet owl (Figure 4-30). For those species that are more closely associated with shrub steppe, native grassland, and shrubby riparian environments (such as Columbian sharp-tailed grouse, mountain quail, sage grouse, ferruginous hawk, Swainson's hawk, merlin, long-eared owl, northern pygmy owls, and northern saw-whet owl), current habitat has declined from historical levels. The decline can be attributed to the conversion of native grasslands and shrublands to introduced cheatgrass and crested wheatgrass, agriculture, reduction in riparian shrub cover, and changes in riparian shrub species from over-grazing, which has resulted in a pattern of increased patchiness and increased habitat isolation.

The blue grouse, band-tailed pigeon, Cooper's hawk, northern goshawk, flammulated owl, great gray owl, northern pygmy owl, northern saw-whet owl, and boreal owl use a mixture of forest types and seral stages. Current management practices, such as traditional timber harvest and fire suppression, which change fire regimes, result in a decline in the mix of seral stages used by these species.

Restoration through forest management practices would benefit these species under Alternatives 4 and 6, which promote a mix of forest structures including small openings created by frequent, small-scale disturbances, clumps of trees of differing densities, a combination of multi-story and single-story stands, and promotion of aspen regeneration.

Regarding the restoration of native shrubland and grassland communities, because of a more active approach to restoration, habitat outcomes are expected to be somewhat better under Alternatives 4 and 6 than under Alternatives 3 and 5. The overall difference, however, would not be large because of uncertainties surrounding the ability to actively restore native shrubland and herbland communities. For Columbian sharp-tailed grouse, which exist only as remnant populations, habitat conditions are projected to remain significantly below historical conditions, with habitat capable of supporting only

scattered populations. Under Alternatives 1 and 2, there is a high likelihood (greater than 50 percent) of local extirpations of Columbian sharp-tailed grouse.

Woodpeckers, Nuthatches, and Swifts

The SIT assessed and predicted habitat outcomes for nine species of woodpecker (black-backed woodpecker, downy woodpecker, hairy woodpecker, Lewis's woodpecker, pileated woodpecker, red-naped sapsucker, three-toed woodpecker, white-headed woodpecker, and Williamson's woodpecker), two species of nuthatch (pygmy nuthatch and white-breasted nuthatch), and one species of swift (Vaux's swift). The SIT recommended that assessments of yellow-bellied sapsucker and red-breasted sapsucker be conducted at a finer scale because of their local distributions within the project area. Species were selected for the evaluation based on the projected decline of their habitats under at least one of the alternatives. All of the selected species are cavity-nesters that require snags for nesting and/or foraging. Optimal habitat for most cavity nesters consists of mature/old forests where the occurrence of large snags is the greatest compared to other seral or structural stages.

The predicted outcomes for woodpeckers, nuthatches, and swifts are shown in Figures 4-31 and 4-32. Habitat conditions for the Vaux's swift had the least favorable outcomes. Alternative 1 is projected to result in a decrease in status for most of the species in this group (Figure 4-31). Alternatives 2 and 3 represent little change from current conditions. Alternatives 4, 6, and 7 would improve the status of 33 percent of the species in this group. Alternative 5 would likely decrease habitat condition for 33 percent of these species. Alternative 7 is the only alternative projected to have fully favorable outcomes (Figure 4-32).

The **cumulative effects** analysis predicted greater risk to this species group due to loss of adequate nesting habitat. Additionally, Vaux's swift, which is a migrant species (unlike most other cavity nesting species that are permanent residents), is subject to loss of habitat of its wintering ground. Lewis's woodpecker would likely experience increased loss of suitable nesting habitat along streams on non-federal land.

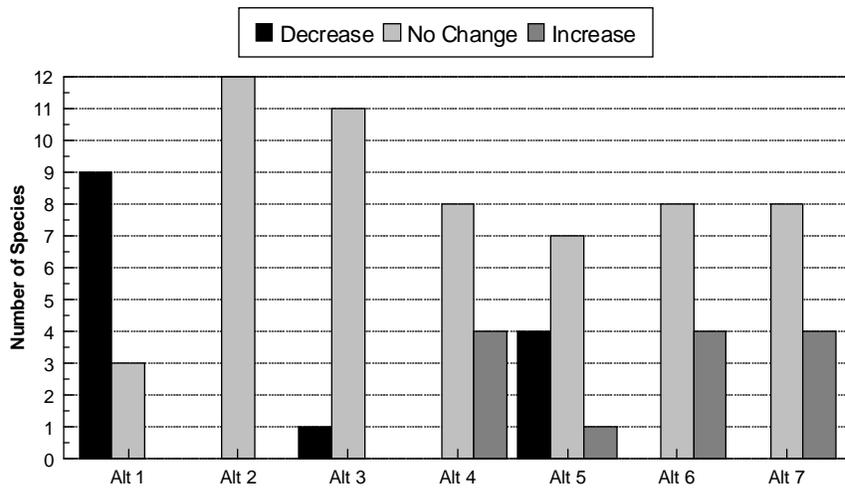


Figure 4-31. Woodpeckers, Nuthatches, and Swifts, Change in Habitat from Current Conditions, 12 Species, Eastside Planning Area.

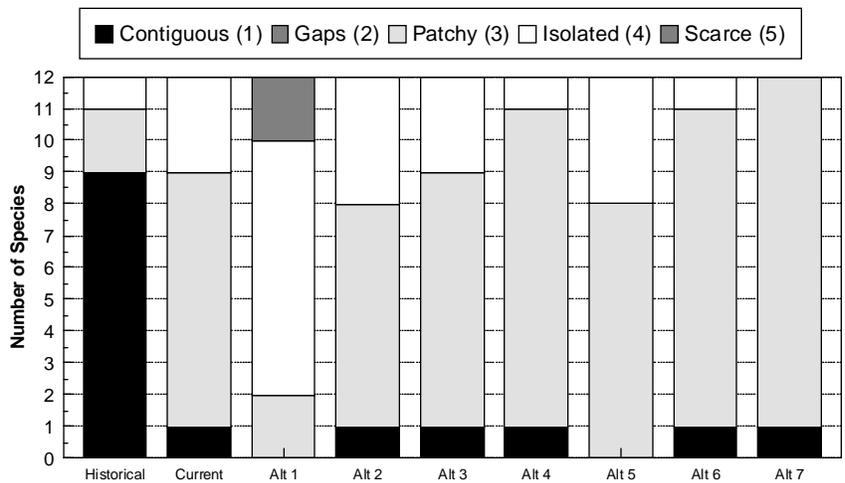


Figure 4-32. Woodpeckers, Nuthatches, and Swifts, Weighted Mean Outcome Scores (1-5), 12 Species, Eastside Planning Area.

Cuckoos, Hummingbirds, and Passerines

Thirty-five species in the Eastside planning area were selected for detailed analysis by the SIT. It was recommended that five species (black-chinned sparrow, clay-colored sparrow, hermit warbler, least flycatcher, and tri-colored blackbird) be considered for finer-scale analysis because of their local distributions within the planning area. Because of the large number of species involved in this group it was further divided into four categories by habitat association: 12 species associated with coniferous forest habitat, 12 species associated with grass/shrub habitats, 4 species associated with woodland habitats, and 7 species associated with riparian habitat.

Forest-associated Birds. Predicted effects on the 12 species of forest birds are shown in Figures 4-33 and 4-34. Alternatives 1 and 5 would result in a decrease in status for some

species. Conversely, Alternatives 4, 6, and 7 would result in an increase in status for two of the 12 species analyzed. Alternatives 2 and 3 would result in no change from current conditions for all 12 species (Figures 4-33 and 4-34).

Under all alternatives, the western tanager was judged to have broadly distributed habitat. Management practices, including fire suppression (resulting in fire regime change), have reduced the availability of mature/old forest, resulting in a decline in habitat from historical to current conditions. Overall, birds associated with coniferous forest habitats were generally projected to maintain relatively well-distributed habitat (Figures 4-33 and 4-34). However, a few species (Hammond’s flycatcher, winter wren, olive-sided flycatcher, and Wilson’s warbler) would have less favorable outcomes than the majority of the birds in this group. Hammond’s flycatcher and winter wren are

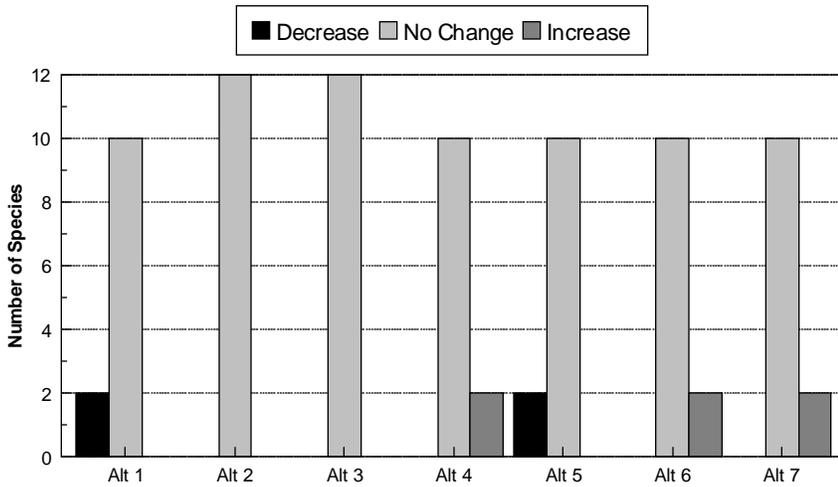


Figure 4-33. Forest Birds, Change in Habitat from Current Conditions, 12 Species, Eastside Planning Area.

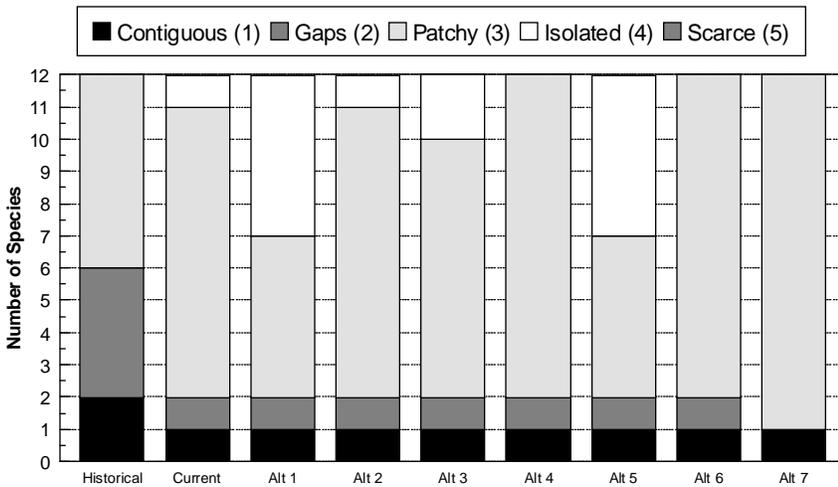


Figure 4-34. Forest Birds, Weighted Mean Outcome Scores (1-5), 12 Species, Eastside Planning Area.

more closely associated with late-seral forest, particularly ponderosa pine. Wilson’s warblers exist in mid-seral forest as well as riparian shrub communities, and their habitat outcomes were judged to be patchy and disjunct both historically and currently. This condition is not expected to change.

Under Alternatives 4 and 6, restoration of these habitats through forest management practices that promote a mix of forest structures (including small openings created by frequent, small-scale disturbances, clumps of trees of differing densities, and a combination of multi-age and single-age stands), would produce more favorable viability outcomes than other alternatives. Alternative 7, with retention of late-seral forest, was also projected to create a more contiguous distribution of habitat.

Wilson’s warbler occurs in mid-seral forest as well as riparian shrub communities, and their habitat outcomes were judged to be patchy and disjunct historically and currently, and are expected to remain that way under all the alternatives.

Grass/Shrub-associated Birds. Historical to current habitat declines for this group of 12 species have resulted from conversion of native grasslands and shrublands to agriculture cropland, introduced stands of crested wheatgrass and other exotic plant species expansions, and from reduction in riparian shrub cover. Consequently, the pattern of native grasslands and shrublands has changed. The number of species expected to maintain current status equals the number of species projected to decrease in status under

Alternatives 1, 2, 3, 5, and 7 (Figure 4-35). Under Alternatives 4 and 6, the number of species projected to maintain current status would be higher than those projected to decrease in status (Figure 4-35). All alternatives are projected to have outcomes that are less than favorable for some species (Figure 4-36).

Three bird species associated with grass/shrub habitat (bobolink, grasshopper sparrow, and black rosy finch) had current and projected future habitat outcomes that were least favorable. Bobolink are associated with moist grasslands, and their populations have undergone marked declines possibly resulting from habitat loss in wintering grounds. Habitat for the bobolink was judged to be disjunct and patchy both currently and under all

alternatives. The grasshopper sparrow, associated with Palouse prairie and other native bunchgrass ranges, has declined from historical levels due to conversion to agriculture. Their habitat was judged to be patchy and disjunct under all alternatives (Figure 4-36). The black rosy finch, associated with alpine and barren habitats at higher elevations, has a naturally patchy and disjunct distribution of habitat; no change in this condition is expected.

Alternatives 4 and 6 would result in a broader and more contiguous distribution of favorable habitat than under Alternatives 1, 2, 3, 5, and 7. Because of greater emphasis on restoration of native grassland and shrubland communities, outcomes are expected to be somewhat better under Alternatives 4 and 6

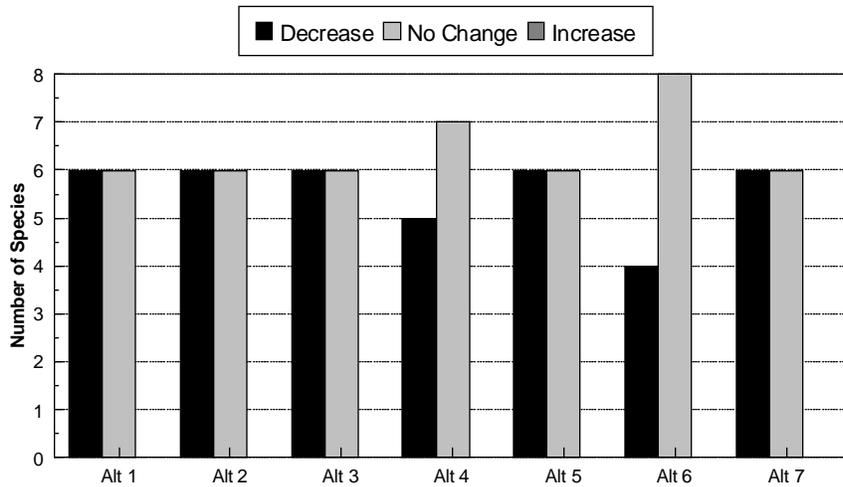


Figure 4-35. Grass/Shrub Birds, Change in Habitat from Current Conditions, 12 Species, Eastside Planning Area.

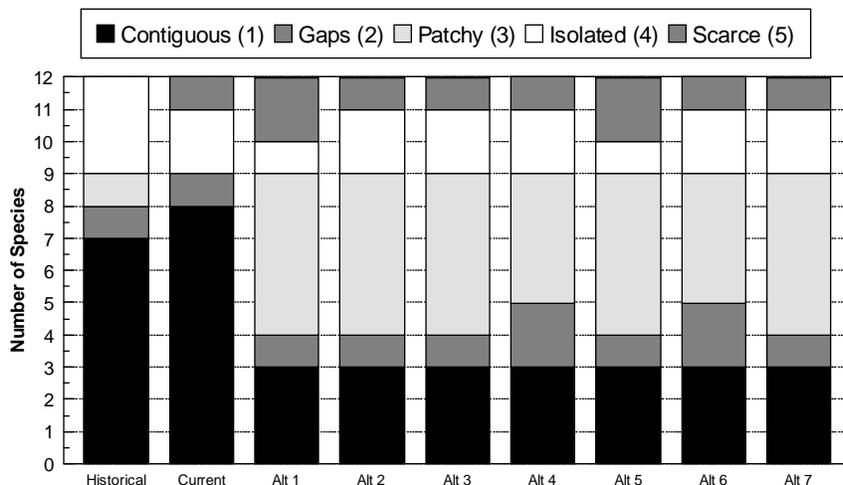


Figure 4-36. Grass/Shrub Birds, Weighted Mean Outcome Scores (1-5), 12 Species, Eastside Planning Area.

than other alternatives. The overall difference, however, is not large because of the uncertainty surrounding our ability to actively restore these types of communities.

Average outcomes were predicted to be less favorable under a **cumulative effects** analysis than under an analysis for BLM- or Forest Service-administered lands. Many of the species in this group are neotropical migratory birds that migrate at least as far as Central America and are subject to increased risk in their wintering grounds. Many of these birds eat insects and are subject to natural fluctuations of insect populations which may be depressed due to pesticide spraying, particularly on non-federal lands (Saab and Rich in press). Species associated with grassland environments will continue to be subject to habitat declines due to cheatgrass and other exotic weed expansion, especially on non-federal lands. On shrubland habitats, cheatgrass and exotic weeds will be reduced in Alternatives 3 and 4. On some sites in the planning area, shrub/steppe habitats have had an increase in area and stand density, and a shift towards older, more decadent sagebrush stands. However, widespread conversion of sagebrush to agriculture on non-federal lands has significantly reduced the overall amount of suitable sagebrush habitat. Species associated with sagebrush have generally been subject to an overall substantial decline in habitat.

Woodland-associated Birds. Results for woodland birds are shown in Figures 4-37 and 4-38. This group of four species has projected outcomes that are inconsistent with the outcomes for all other groups of species considered in the evaluation (Figure 4-38). Alternatives 4 and 6 are projected to result in a reduction in status for a number of species compared with current conditions. No change in status is predicted for these species in Alternatives 1 and 2 (Figure 4-37). No alternative is predicted to improve conditions for woodland birds (Figure 4-37).

The bushtit, ash-throated flycatcher, and sage thrasher are closely associated with juniper habitat. Of these three, the bushtit is the only species that is predicted to change from a favorable outcome to a less favorable outcome under Alternatives 4 and 6 (Figure 4-38). Restoration of native shrub-steppe would reduce the availability of juniper woodland habitat in these alternatives.

Riparian-associated Birds. Current and projected future conditions for this group of seven species were judged to have declined from historical conditions. Species associated with riparian habitats had lower mean outcome scores than other species groups, reflecting the more patchy, and disjunct distribution of riparian habitat compared with upland habitats. Habitat decline is primarily the result of increased human access and disturbance, fragmentation of habitat, reduced riparian acreage, and reduced quality of riparian habitats. With the exception of Alternative 5, all alternatives are projected to result in no change in status from current conditions for this group of species (Figure 4-39).

Alternatives that would provide wider riparian buffers (Alternatives 2, 3, 4, 6, and 7) had higher average scores than alternatives with smaller buffers (Alternatives 1 and 5). For one species, the yellow-billed cuckoo, all alternatives have a weighted mean score of Outcome Class 5 (Figure 4-40). This species is closely associated with large cottonwood trees with dense shrubby understories. The yellow-billed cuckoo was given more than 50 points in Outcome Class 5 under Alternatives 1, 2, 3, 5, and 7, and 48 and 46 points in Outcome Class 5 under Alternatives 4 and 6 respectively. This species is at risk due to disjunct small populations, limited habitat, and from pesticide spraying on non-federal lands. Fragmentation of habitat continues, and quality and quantity of habitat have decreased.

Under a **cumulative effects** analysis, species associated with riparian habitats would have less favorable predicted outcomes than are typical for other species groups. This reflects continued loss of riparian habitat on non-federal lands, as well as effects of pesticides, grazing, and loss of habitat on wintering grounds.

Bats and Small Mammals

The scientific panels considered 11 species of bats and small mammals in their evaluation. Two other bat species were considered earlier, but were not analyzed here. One, the western pipistrelle, was dropped from further consideration because it was judged that the alternatives would not influence its habitat, while the second species, the Yuma myotis, was recommended for finer-scale analysis.

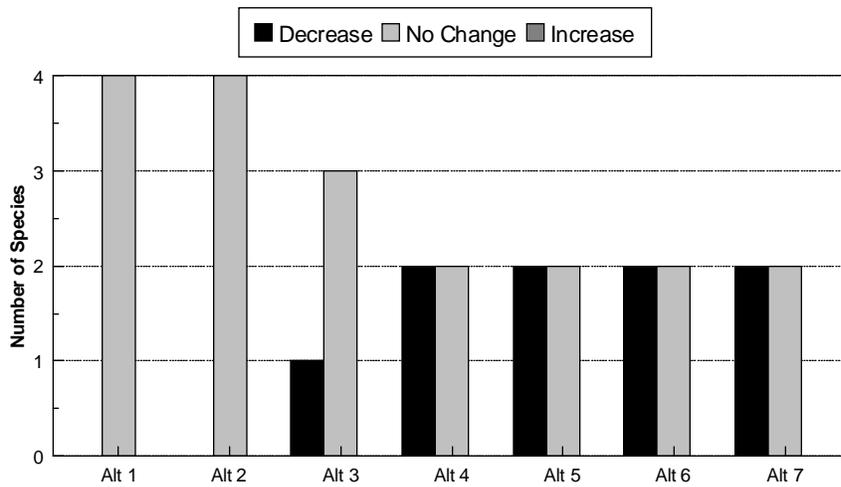


Figure 4-37. Woodland Birds, Change in Habitat from Current Conditions, 4 Species, Eastside Planning Area.

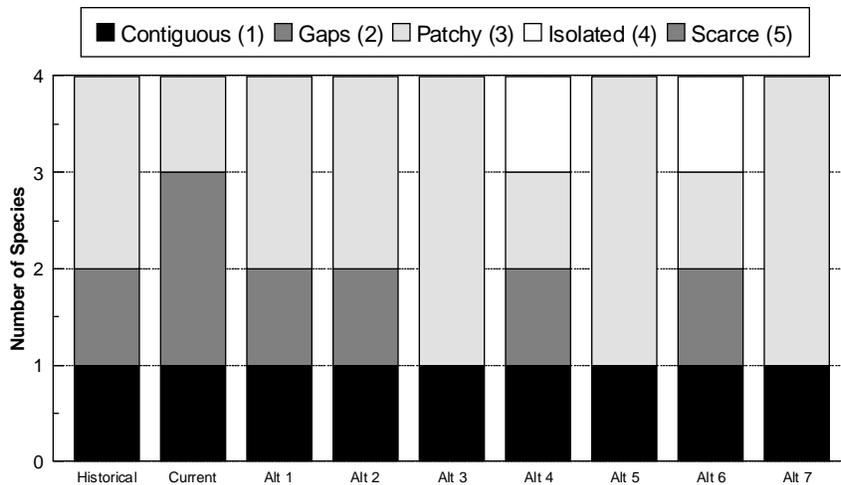


Figure 4-38. Woodland Birds, Weighted Mean Outcome Scores (1-5), 4 Species, Eastside Planning Area.

Important habitat components for most bats include: large green trees and snags particularly in clumps with understory intact, riparian buffers, downed logs, and protection of hibernacula. The combination of these components in sufficient amounts would generally produce the most favorable habitat for bats. Habitat for four species (fringed bat, hoary bat, long-legged bat, and western small-footed bat) that historically had wide-spread, patchy distribution, apparently has been reduced to habitat that is isolated with strong limitations on interactions among populations.

Projected impacts on bats and small mammals would vary widely across the alternatives (Figures 4-41 and 4-42). All alternatives would result in a likelihood of extirpation for some species (Figure 4-42). Alternatives 1 and 5 would result in the greatest reduction in habitat conditions for this group (Figure 4-41).

Alternatives 2 and 3 would result in minimal change from current conditions. Alternatives 4, 6, and 7 would result in a modest improvement in habitat conditions for bats and small mammals (Figure 4-41).

Carnivores

Twenty two species of carnivores exist in the project area. Six species of carnivores were selected for a detailed analysis: American marten, fisher, lynx, wolverine, gray wolf, and grizzly bear. This group includes several listed or candidate species (under the Endangered Species Act), all of which are listed as “sensitive” under Forest Service or BLM policy (see Appendix 2-1). Additionally, three of these species (fisher, lynx, and American marten) are associated with late-seral successional stage forest structures.

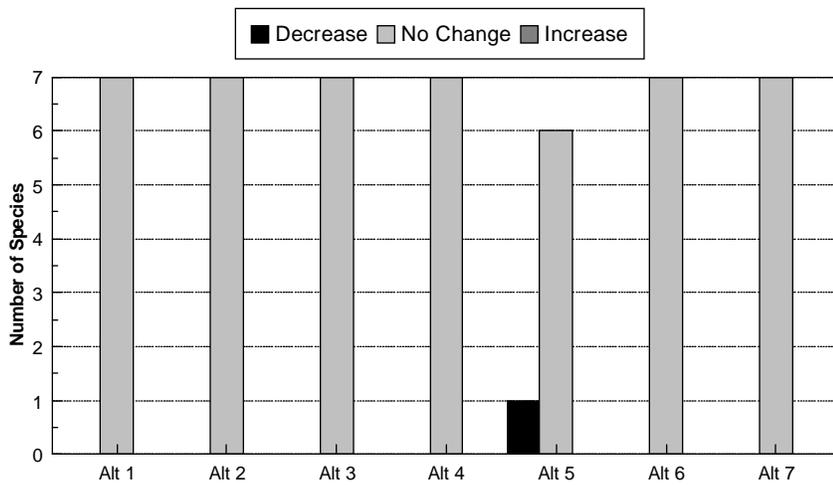


Figure 4-39. Riparian Birds, Change in Habitat from Current Conditions, 7 Species, Eastside Planning Area.

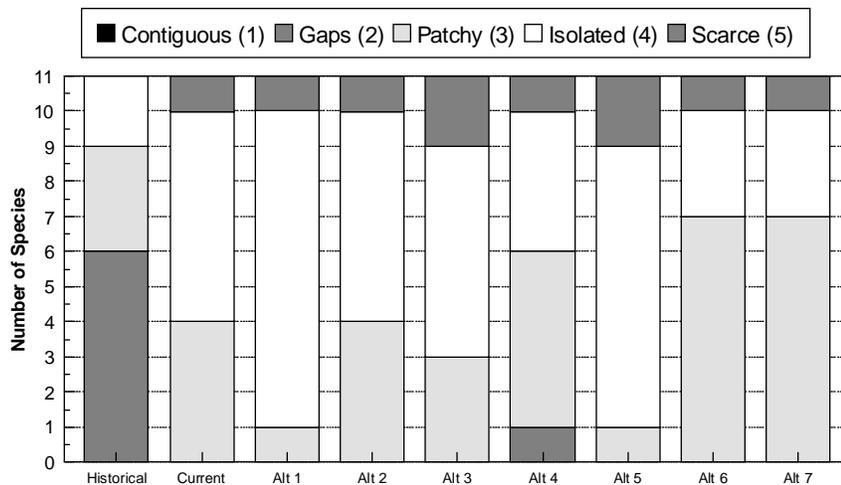


Figure 4-40. Riparian Birds, Weighted Mean Outcome Scores (1-5), 7 Species, Eastside Planning Area.

The results of the analysis for this group are shown in Figures 4-43 and 4-44. None of the alternatives would approach historical habitat conditions for these species. Generally the carnivore group would benefit from any alternative which prescribes reductions in road densities, thereby reducing the potential for contact with humans. Alternatives 1, 2, 3, and 5 would result in no change in status, compared to current conditions for all six carnivore species (Figure 4-43). Within this set of alternatives, Alternatives 1 and 5 are predicted to have the lowest outcome score because of continued fragmentation of late-successional forest and a predicted lack of improvement in riparian conditions (Figure 4-44). Conversely, Alternatives 4, 6, and 7 are predicted to improve habitat conditions for the six species in the carnivore group. As a group,

the carnivores have less favorable outcomes scores compared to all other species groups considered in the analysis.

Declines of the fisher in the project area appear to be a result of heavy trapping and habitat deterioration. Fishers are found in a diversity of forest types but occur mostly in riparian habitats in landscapes dominated by mature and late-successional forests. Alternatives 4 and 6 are predicted to improve fisher habitat due to predicted improvements in both riparian conditions and distributions of late-successional forests.

American martens are closely associated with late-successional conifer forests with complex physical structure near the ground. Therefore, fragmentation of older forests reduces

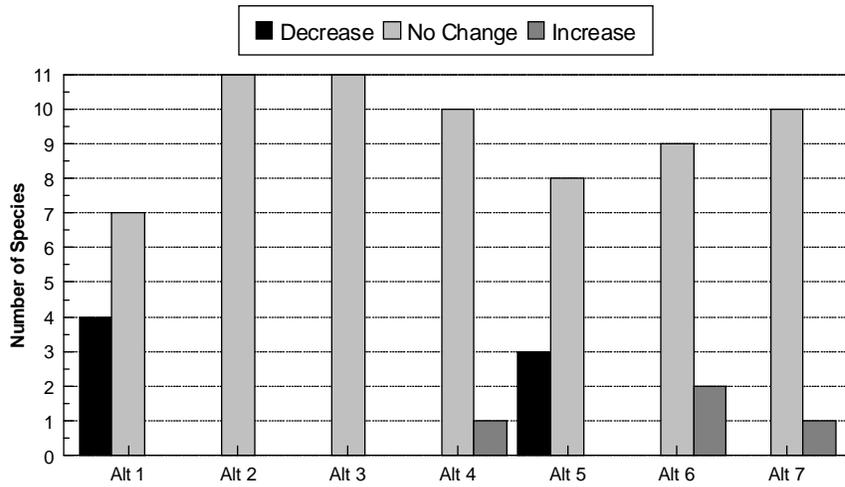


Figure 4-41. Bats and Small Mammals, Change in Habitat from Current Condition, 8 Bat and 3 Mammal Species, Eastside Planning Area.

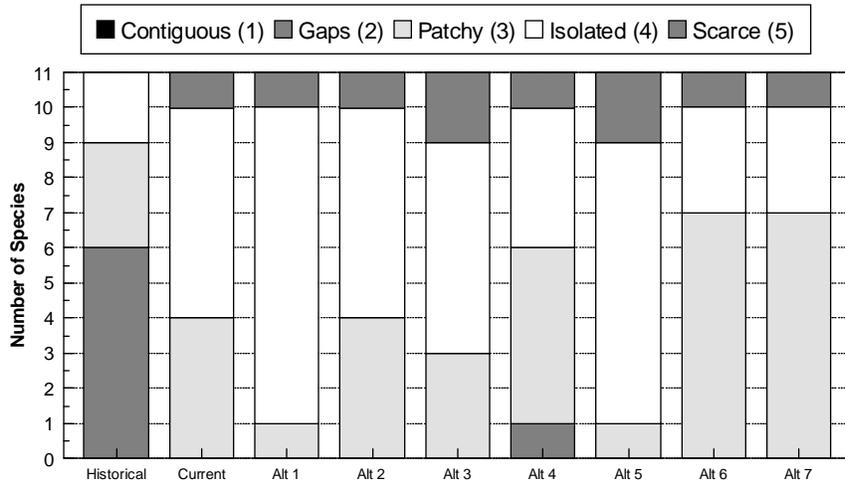


Figure 4-42. Bats and Small Mammals, Weighted Mean Outcome Scores (1-5), 8 Bat and 3 Mammal Species, Eastside Planning Area.

availability of suitable habitat. For this reason, Alternative 7 is predicted to provide the best marten habitat. Conversely, Alternatives 1 and 5 are predicted to have lower results due to continued fragmentation of late-successional forests.

Lynx are highly specialized predators closely associated with snowshoe hare populations. Exploitation for fur and deterioration of habitat conditions due to logging have been suggested as reasons for population declines and concern for continued persistence. Under Alternative 7, reserves are designated in portions of critical lynx range. The natural fire prescription in Alternative 7 would also benefit snowshoe hare populations. Alternatives 1, 2, and 5 would result in continued decline of lynx habitat, which may result in a non-recoverable

bottleneck for lynx populations. Alternative 6 would restore habitats above current levels through management treatments designed to create better snowshoe hare habitat.

Wolverines were historically widespread in the project area, however, current populations occur in low densities. Wolverines are scavengers and depend upon large predators and natural mortality for carrion. Refugia or large reserves that are capable of providing source populations combined with additional habitat suitable to support dispersing animals could provide the best strategy for wolverine conservation. Under Alternative 7 established reserves protect roadless areas greater than 1,000 acres, and would provide the best wolverine habitat.

Gray wolves use a wide variety of habitats. Availability of prey and freedom from direct human-caused mortality are important considerations for the gray wolf. Outcomes for Alternatives 1, 3, and 5 are predicted to decline slightly, and Alternatives 2, 4, and 6 would result in no change to gray wolf habitat conditions.

Grizzly bears were listed as threatened under the Endangered Species Act in 1975. A recovery plan was approved in 1982, then revised in 1993. Threats to grizzly bear persistence are related to human activities.

Ungulates

Twelve species of ungulates are known to exist in the project area. Three of these ~ woodland caribou, California bighorn sheep, and pronghorn antelope ~ were selected for detailed evaluation. The predicted effects are shown in Figures 4-45 and 4-46.

Alternatives 3, 4, and 6 would result in no change for these species. The woodland caribou is the only species in this group that is predicted to improve under Alternative 7. There would be a continuing risk of extirpation for both woodland caribou and California bighorn sheep under all alternatives because their populations are small, isolated, and disjunct. Human developments are predicted to continue to increase in major river valleys resulting in further barriers for pronghorn antelope.

Threatened and Endangered Terrestrial Species

Threatened and endangered species occur in various habitats within the project area. The alternatives would generally have little effect on the viability of this group of species. Predicted effects differ by alternative and species.

The BLM and Forest Service requested information on threatened and endangered species from the U.S. Fish and Wildlife Service, which identified seven species of mammals or birds and four plants as threatened or endangered in the Eastside planning area. The northern spotted owl and marbled murrelet (both threatened) were not assessed in this effort because they are covered under the Northwest Forest Plan. The areas where these two species occur will be managed according to

that direction under all alternatives. For the purpose of this analysis, the EIS Team assumed that recovery zones shown in approved recovery plans have the same management status as designated critical habitat (see Appendix 2-1).

Regardless of the alternative selected, all future federal projects that result in a judgement of “may affect” for threatened, endangered, or proposed species will be required to enter into consultation with the U.S. Fish and Wildlife Service (per Section 7 of the Endangered Species Act).

The effects on threatened and endangered species described in the previous sections were based on the *Evaluation of Alternatives*. Under the Endangered Species Act, federal activities that may have an effect on threatened, endangered, or proposed species are subject to consultation with the U.S. Fish and Wildlife Service. Requirements for consultation would remain in effect under the selected alternative. If the selected alternative could have an effect on threatened, endangered, or proposed species, then biological assessment(s), appropriate for the scale of the decision, will be submitted to the U.S. Fish and Wildlife Service for consultation. Consultation will be completed prior to any ground-disturbing activities.

Plants

MacFarlane’s four-o’clock (*Mirabilis macfarlanei*) is a threatened local endemic plant found only in the Snake River Canyon in Idaho and Oregon. Alternative 7 would result in some improvement compared to other alternatives (Figure 4-47). Competition from exotic plants is a concern in all alternatives.

Water howellia (*Howellia aquatilis*) is a species of scattered distribution that occurs in highly specialized and restricted habitat of wetlands associated with glacial potholes and former river oxbows in Montana, Idaho, and Washington. The existence of specific riparian standards would contribute to protection of occupied habitats and the long-term persistence of this species regardless of the alternative.

Malheur wire lettuce (*Stephanomeria malheurensis*) is a local endemic species in eastern Oregon. The taxonomic status of this species has recently been changed in the

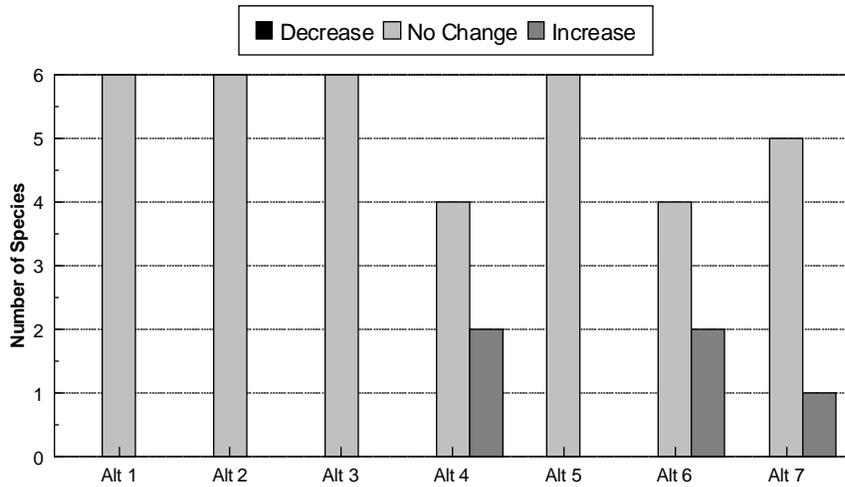


Figure 4-43. Carnivores, Change in Habitat from Current Conditions, 6 Species, Eastside Planning Area.

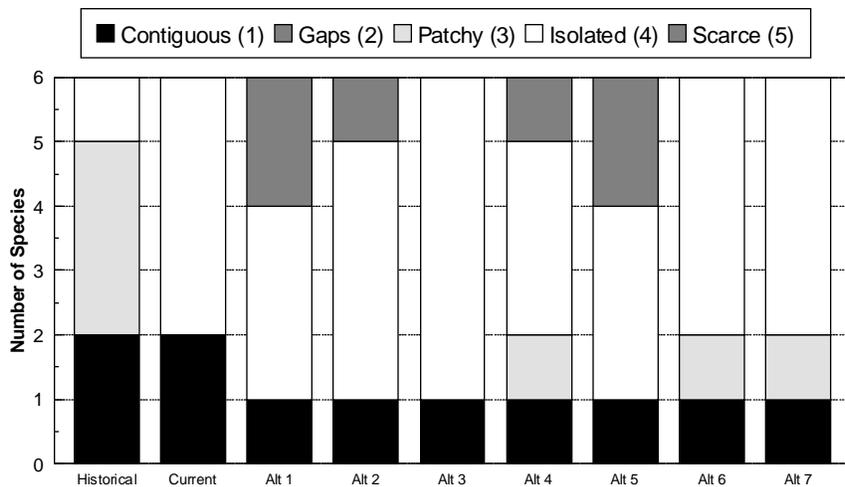


Figure 4-44. Carnivores, Weighted Mean Outcome Scores (1-5), 6 Species, Eastside Planning Area.

literature. It is currently treated as a synonym of a more common, wide-ranging species, *S. exigua*. This taxonomic change may eventually have a bearing on the federal listing of Malheur wire lettuce, but until such time as the U.S. Fish and Wildlife Service formally recognizes this change, the species will be addressed as a federally listed taxon. Effects of alternatives are displayed in Figure 4-47.

Applegate’s milk-vetch (*Astragalus applegatei*) occurs only on private lands in Oregon and therefore was not included in this analysis.

Wildlife

The grizzly bear (*Ursus arctos horribilis*) is generally located in five recovery zones within the project area, two of which occur within the Eastside planning area. Critical habitat has not been designated for the grizzly bear by the U.S. Fish and Wildlife Service. The major potential

effect on grizzly bears is from human activities, as opposed to changes in vegetation composition and structure. Human access disturbs the bears’ normal movement patterns and may expose them to increased risk of mortality.

None of the alternatives would substantially affect conditions for grizzly bear on federal lands in the Eastside planning area (Figure 4-48). Establishment of reserves and retention of large unroaded areas would result in improved habitat needed and reduced contact with humans by bears.

The gray wolf (*Canis lupus*) uses a wide variety of habitats and is primarily dependent on an adequate prey base and areas where there is little human-caused mortality. Wolves live in three management zones as outlined in the Final EIS for the *Reintroduction of Gray Wolves to Yellowstone National Park and Central Idaho*

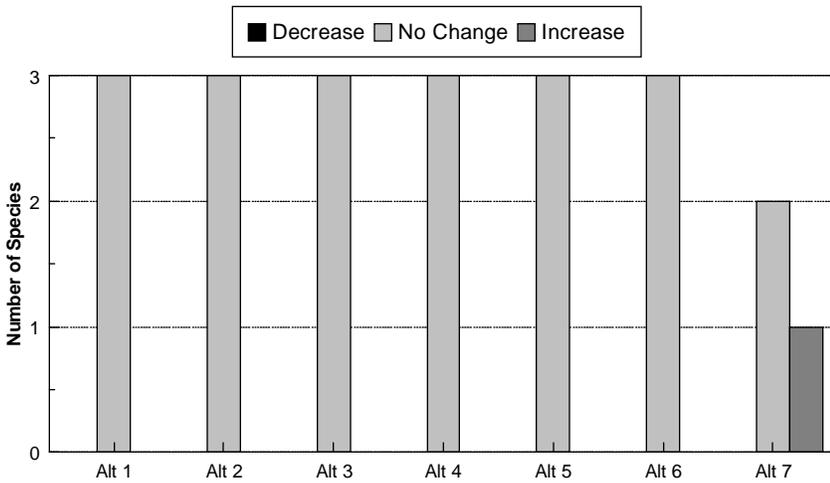


Figure 4-45. Ungulates, Changes in Habitat from Current Conditions, 3 Species, Eastside Planning Area.

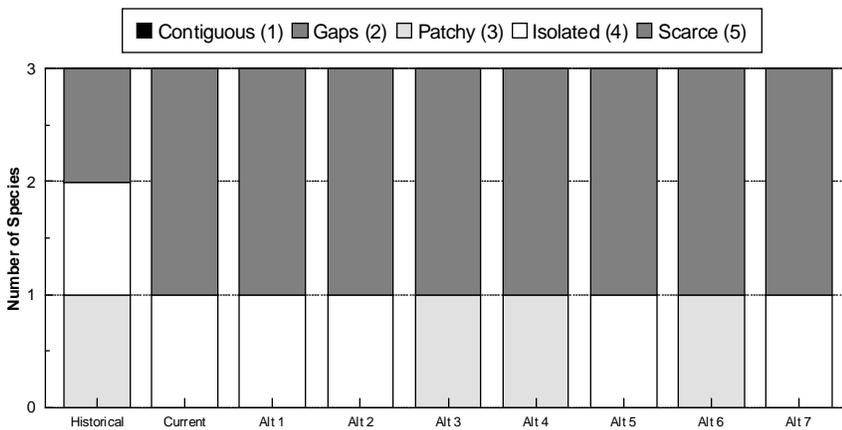


Figure 4-46. Ungulates, Weighted Mean Outcome Scores (1-5), 3 Species, Eastside Planning Area.

(USFWS 1994). Two of the areas contain experimental/"non-essential" populations. One area would be managed as a naturally recovering, fully endangered population. Critical habitat has not been designated in any of these management zones by the U.S. Fish and Wildlife Service.

Outcome scores for wolves were predicted to be similar for all alternatives (Figure 4-48). The most improvement would occur in Alternative 7, although not substantially more than other alternatives. Wolves are habitat generalists; therefore, all alternatives would provide adequate vegetation conditions, including habitat for prey populations. Wolves are documented to avoid human contact and spend a disproportionate amount of time in remote areas, especially when raising young at den sites.

The woodland caribou's (*Rangifer tarandus caribou*) occupied habitat area overlaps with the Selkirk Grizzly Bear Recovery Area. Critical habitat has not been designated for woodland caribou by the U.S. Fish and Wildlife Service. All alternatives would have limited benefit to caribou because the population is extremely small and isolated (Figure 4-48). Existing late-successional habitat for caribou is limited in amount, distribution, and continuity, so large fires, insect and disease outbreaks, or timber harvest have the potential to reduce existing woodland caribou habitat. Restoration of late-successional forest proposed in Alternatives 3, 4, and 6 would increase available habitat and improve existing conditions. Alternative 7 would result in some habitat restoration due to the overlap between occupied caribou range and late-successional reserves.

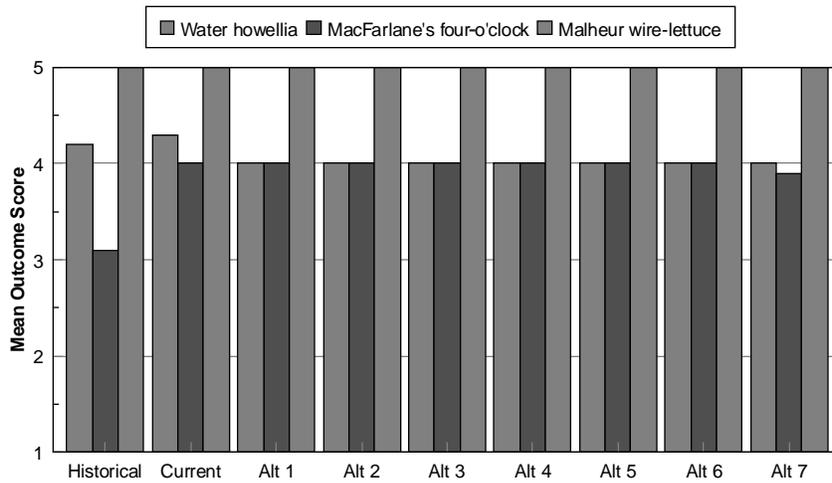


Figure 4-47. Threatened or Endangered Plant Species, Mean Outcome Score, Eastside Planning Area.

A recovery plan has been in effect for the bald eagle (*Haliaeetus leucocephalus*) since 1986, and has resulted in upward trends in both habitat and populations. These trends are expected to continue under all alternatives. None of the alternatives are expected to restore habitat or populations to historical conditions, but all alternatives would reduce the likelihood of population isolation and extirpation. Alternatives 4 and 6 would result in the greatest improvement compared to the other alternatives due to increased riparian emphasis, although the amount of improvement is predicted to be limited (Figure 4-48).

The peregrine falcon (*Falco peregrinus*) occurs throughout the project area. The peregrine falcon was not included in the evaluation because there is no identified broad-scale

habitat concern on BLM- or Forest Service-administered lands. Improving trends for the species are expected to continue under any alternative.

Cumulative Effects

Activities on non-federal lands are predicted to negatively influence grizzly bear populations. Human developments are expected to continue to expand in major valleys, resulting in barriers to movement of bears and increased risk of bear mortality. Bear populations will likely become more isolated as human development increases.

Activities on non-federal lands are predicted to negatively influence gray wolf populations. Actions that would result in very high road densities, high volume interstate highways, and

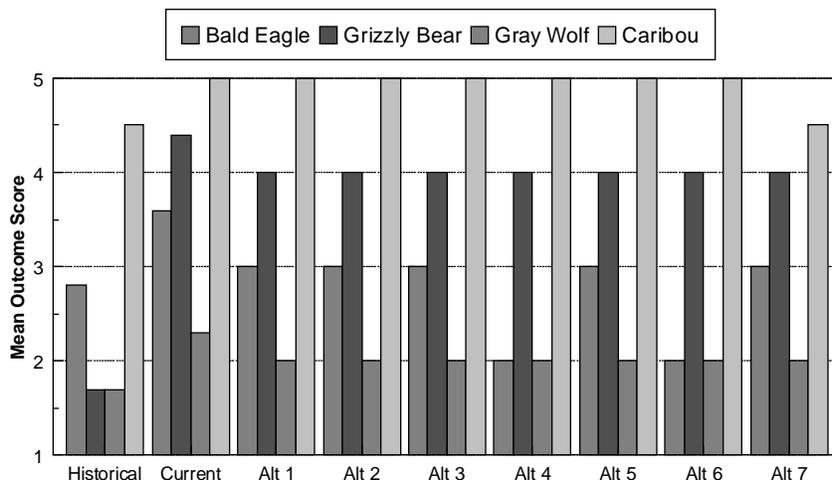


Figure 4-48. Threatened or Endangered Wildlife Species, Mean Outcome Score, Eastside Planning Area.

residential development in large river valleys would contribute to these negative effects because of increased risk of mortality.

Effects of the alternatives for the woodland caribou would be no different when non-public lands are considered.

Alternatives 1, 2, and 7 would have less desirable outcomes for the bald eagle than Alternatives 4 and 6, but only to a minor degree. Loss of riparian habitat is predicted to continue on non-federal land. Alternatives would have similar outcomes as on BLM- or Forest Service-administered lands.

Habitat conditions would improve from current conditions under all alternatives for water howellia because of the increased amount of private habitat that contains this species.

Habitat conditions would decrease under all alternatives for MacFarlane's four-o'clock, however the amount of decrease is minimal.

Malheur wire-lettuce is the most endangered plant species in the project area. There is, however, a concern for its taxonomic validity.

Cumulative Effects

The vast majority of the species analyzed in this evaluation would not have substantial changes in viability status as a result of implementation of any of the action alternatives. This generally indicates that viability is more of a factor for most species at the mid and fine scales. However, when the outcomes of all species are compared by alternative, differences among alternatives are more apparent. Compared in this manner, Alternative 1 is projected to have the highest number of species at risk; Alternatives 4, 6, and 7 have the lowest number of species at risk; and Alternatives 2, 3, and 5 are intermediate.

Threatened or Endangered Species

Habitat conditions for threatened or endangered species would not change significantly from the current conditions. Existing recovery plans are assumed to be effective in maintaining or restoring populations of threatened and endangered species. Many aspects of habitat for listed species are outside

the control of federal land managers; for example, road densities and human habitation would continue to encroach on federal land boundaries, and under any circumstance isolated populations would have little chance of improved interactions. Direct mortalities off federal land are likely to continue, improvements in federal highways are likely to continue to present barriers to recolonization of recovery areas, and social realities that affect implementation of recovery plans are likely to continue.

Mid-Seral Multi-Story Forest

The high amounts of this forest type compared with historical range of variability/desired ranges of future conditions could have potentially profound effects on terrestrial wildlife and rare plant communities. Numerous pathways are possible, such as intense and frequent crown fires, conversion to late-successional multi-story stands, and conversion to late-successional single-story stands. Predictions are that the amount of this vegetation type will remain high. This will have both positive and negative effects on different species.

Aquatic Priority Areas in Alternative 5

Terrestrial species associated with riparian habitats should benefit from the aquatic priority areas in Alternative 5. Some of these species are: amphibians, waterbirds, passerine birds, cavity nesters such as the Williamson's sapsucker, and the fisher. Implementation of Fish 2000 (see Chapter 3) outside the aquatic priority areas in Alternative 5 is not anticipated to show the same level of benefit to terrestrial species as aquatic management priority areas, because of its more specific aquatic emphasis. The EIS Team believes that the less favorable outcomes for some terrestrial species were over estimated by the SIT in their evaluation of the effects of Alternative 5, especially those species that exist in aquatic priority areas.

Fire Occurrence and Habitat Stability in Alternative 7

Alternative 7 is similar to Alternatives 4 and 6 in having more improving outcome scores for species analyzed. As a group, carnivores are

predicted to have more favorable outcomes in Alternative 7 because of establishment of reserves. Most of the species in this group are expected to benefit from Alternative 7 because of reduced roading and an anticipated decrease in human use. The reduction in human activities and associated mortality risks to species are more important than the vegetation pattern and characteristics that may be present within reserves. Other groups showing improving outcomes also would benefit from reduced human activities and are usually habitat generalists. Bird species more closely associated with specific vegetation characteristics and pattern may not benefit from Alternative 7 over the long term because vegetation patterns are unpredictable due to the potential extent of large crown fires.

Noxious Weeds and Exotic Plants

The extent and rapid rate of exotic plant invasion have implications for habitats used by terrestrial species. Exotic plants reduce the quality and extent of many habitats. The extent of many grasslands and shrubland habitats have been greatly reduced because of conversion to agriculture. Terrestrial species are at increasing risk due to reduction in habitat quality and quantity. Exotic plants also occur in forests, especially along disturbance corridors such as roads, and in openings such as clearcuts. Exotic plants can reduce the quality and quantity of habitat, especially the dry forest types such as interior ponderosa pine.

Known Bottlenecks, Fragmentation, and Corridors

Two types of habitat fragmentation occur in the project area. The first type occurs among large blocks of federal ownership, such as between mountain ranges. Examples of this type of

fragmentation are the construction of large multi-lane highways, constructed or modified waterways such as reservoirs, and farming that results in the elimination or disruption of native vegetation. These types of activities create islands of habitat and reduce or eliminate interactions between islands for some species. In these cases, migration, population interactions, and recolonization may be disrupted. Maintaining connectivity is believed to enhance species richness and interactions of species between blocks of habitat.

The second type of fragmentation occurs within a block of vegetation: (1) when the size of the block decreases, (2) when the extent of the interior habitat is modified or reduced, or (3) when the shape of the same amount of area is changed to one in which the distance from the center to the closest edge has been reduced (such as a circular shape being converted to a linear shape). This type of fragmentation can disrupt species interactions within blocks of similar habitat. It may also allow different species to use the habitat and compete with or displace the original inhabitants.

Alternatives 4 and 6, which emphasize restoration, are most likely to improve connectivity and increase habitat block size with similar characteristics between and within stands of similar vegetation. Alternative 7, with a system of reserves, would improve connectivity for areas of representative vegetation. Alternatives 1 and 5 would continue to increase fragmentation of similar habitats, and decrease block sizes of similar habitats because of traditional management. Alternative 2 would improve connections among riparian and forested habitats (with implementation of the Eastside Screens), but not for rangelands. Alternative 3 would be better than Alternative 2 because of anticipated improvements in both riparian and upland connectivity.

Effects of the Alternatives on Aquatic Aspects of the Ecosystem

This section presents the effects of alternatives on aquatic systems and aquatic species.

Aquatic Systems

Assumptions

The following major assumptions were made by the Science Integration Team during their evaluation of alternatives and subsequent review of changes to the alternatives.

- ◆ For Alternatives 3 through 7, assessments of road conditions and road-related risks (as specified in RM-S3), appropriate for the scale, will be completed prior to or in concert with sub-basin review and Ecosystem Analysis at the Watershed Scale to support modification of access and travel

Summary of Key Effects and Conclusions for Aquatic Systems

- ◆ Specific outcomes (such as water quantity, water quality, instream and riparian area habitat conditions) from the alternatives pertaining to lakes, streams, rivers, and riparian areas and wetlands were not predictable without site-specific NEPA analysis.
- ◆ In Alternatives 1 and 2, ecosystem management would not be emphasized, and there would not likely be watershed-scale consideration and protection of hydrologic and riparian area/wetland processes and functions. This would likely result in continued degradation of lakes, streams, and rivers.
- ◆ In Alternatives 3 through 7, ecosystem management would be emphasized, thus facilitating management for multiple ecological goals and long-term ecological sustainability on a landscape basis. Ecosystem management would provide a mechanism to effectively prioritize activities and weigh multiple risks to various resources. Furthermore, ecosystem management direction in Alternatives 3 through 7 would more readily foster implementation of adaptive management and analysis of cumulative effects than the approaches of Alternatives 1 and 2. It is expected that these features of Alternatives 3 through 7 would aid in overall improvement in lakes, streams, rivers, and riparian areas and wetlands.
- ◆ Alternative 4, with its higher activity levels, could pose greater short-term risks to aquatic ecosystems than would the slower activity rates and amounts of Alternative 6 and the restrictive and passive approach of Alternative 7, although lack of watershed and road restoration in Alternative 7 could pose greater risks to aquatic ecosystems in the long term.
- ◆ Watershed restoration levels would be greatest for Alternatives 4 and 6 and are expected to result in greater long- and short-term benefits to lakes, streams, rivers, riparian areas, and wetlands compared to other alternatives. However, greater uncertainty would be associated with Alternative 4, because requirements for Ecosystem Analysis at the Watershed Scale are less and therefore the context to reduce risk and maximize potential benefits from restoration actions may not be provided.
- ◆ In Alternatives 3 through 7, adjustment of standards supported by Ecosystem Analysis at the Watershed Scale in concert with broad-scale planning and sub-basin review would likely meet the intent of ecosystem management and integration of landscape, terrestrial, aquatic, and social objectives. Alternatives 4, 5, and 6 would offer more flexibility than Alternative 7 with respect to activities permitted in riparian areas and wetlands. Alternative 6 would provide the most management options because site-specific NEPA analysis could be used in some areas for up to four years to adjust ICBEPM standards. This adjustment process would maximize opportunities for adaptive management. Since less hierarchical analysis would be required in Alternative 4, implementation of restoration actions would occur faster than in other alternatives. However, uncertainty of meeting the intent of ecosystem management and integration of objectives would be greater than Alternative 6 because of the lack of incentive to modify and integrate objectives and standards that fit watershed-scale processes and functions. There would also be risks associated with the lack of active landscape and watershed restoration in Alternative 7, especially in the long term.
- ◆ Alternatives 2 through 7 would adequately protect ecological functions within riparian areas and wetlands except for the timber priority areas of Alternative 5. Within timber priority areas of Alternative 5, the size of the riparian conservation areas would not likely be adequate to fully protect aquatic resources, primarily because of their limited widths and lack of protection for intermittent streams. Within livestock priority areas of Alternative 5 (including large parts of the Northern Great Basin, Columbia Plateau, and Owyhee Uplands ERUs), priority areas for protection of riparian areas would not be established. Even so, to meet proper functioning condition objectives within timber and livestock priority areas, degradation of riparian areas would cease and some restoration would begin.

(Continued)

- ◆ Alternative 1 would have no consistent planning-area-wide direction for riparian area protection and is predicted to not adequately protect riparian functions.

Summary of Key Effects and Conclusions for Aquatic Species

- ◆ The current composition, distribution, and status of most native fish species within the planning area would remain stable under Alternative 2 and remain stable or improve under Alternatives 3, 6, and 7. The greatest potential for improvement occurs with Alternatives 6 and 7. Alternative 4 has similar potential to benefit native species as Alternatives 6 and 7, but uncertainty in the ability to prioritize management actions and evaluate risks, coupled with high levels of activities, decreases confidence in successful ecological outcomes. Improvements in distribution and status are linked to levels of watershed and riparian restoration and other management activities within the species' current range. Most native fishes' distribution and status would continue to decline under Alternatives 1 and 5 inside timber and livestock priority areas due to inconsistent and inadequate riparian and aquatic protection measures in all or part of species' current ranges.
- ◆ Benefits of any alternative are linked to improved instream and riparian conditions resulting from better riparian management, higher levels of watershed and riparian restoration, and Ecosystem Analysis at the Watershed Scale. Successful ecological outcomes from Alternatives 4 and 6 depend on efficient prioritization of restoration actions and maximizing adaptive management to minimize risk. Alternative 7 could pose risks to isolated and fragmented populations because of the lack of active forest, rangeland, and watershed restoration, raising uncertainty about long-term improvements in the more depressed and fragmented portions of species' ranges.
- ◆ Alternatives 1, 2, and 5 would result in the continued decline in the overall status and distribution of steelhead and stream-type chinook salmon stocks due to a minimal emphasis on restoration and continued land disturbance in portions of the current range over the long term. None of the alternatives address the need for a comprehensive approach to alleviate mortality outside BLM- or Forest Service-administered lands to ensure persistence and viability of steelhead or stream-type chinook salmon stocks.
- ◆ Downstream stresses associated with the hydropower system are one of the major causes of declining Snake River anadromous fish populations (NPPC 1986; NMFS 1992). Federal efforts are underway to address these problems through increased spill, barging, and monitoring. Mid-Columbia anadromous stocks (for example, John Day and Deschutes Rivers) are influenced less by hydropower due to a lower number of dams below spawning and rearing areas. Maintenance of high-quality habitats is vital to the persistence of populations, but the magnitude of effects varies from sub-basin to sub-basin. In general, it remains important to restore degraded watersheds where habitat is most limiting to fish, to improve egg-to-smolt survival over current conditions. High-quality habitat alone, however, is no guarantee of increased persistence without a comprehensive approach that addresses all mortality factors. Additional high quality habitat alone could increase abundance of individual fish, but it would not likely reverse current negative population trends in the short-term. Salmon population numbers in much of the interior Columbia Basin are far below what current habitat conditions could likely support under a scenario of increased downriver survival.
- ◆ None of the alternatives would be expected to measurably affect the habitat needs of ocean-type chinook salmon because they inhabit lower-elevation mainstem river habitats that are less responsive to federal land management. Alternatives 6 and 7 have the most conservative approach and might result in some benefit to ocean-type chinook salmon if management actions improve water quality and quantity. None of the alternatives address the need for a comprehensive approach to alleviate mortality outside BLM- or Forest Service-administered lands to ensure persistence and viability of ocean-type chinook salmon stocks.

management plans (as specified in RM-S4) and watershed restoration.

- ◆ For Alternatives 3 through 7 where ecosystem analysis, site-specific NEPA analysis, and associated planning documents result in changes to Riparian Conservation Areas (RCAs) delineation, or changes in applicable standards for actions within RCAs, such changes would not degrade aquatic and riparian resources or impede restoration.
- ◆ Proper functioning condition (PFC) achieves hydrologic function first; land managers' decision space is between this level and attainment of site-specific vegetation potential. For purposes of aquatic and terrestrial communities, conservation and restoration of riparian areas includes managing towards advanced successional stage of native riparian vegetation consistent with the ecological capability for the site. Determination of proper functioning condition is an interdisciplinary team process.
- ◆ Effects on aquatic ecosystems and communities on non-federal lands would be limited to indirect effects, primarily from improved water quality downstream of BLM- or Forest Service-administered lands. Thus,

many non-federal areas are expected to remain degraded, or possibly decline further.

- ◆ Watershed restoration can benefit aquatic resources, but risk is inherent in all management and restoration actions. High restoration alternatives (Alternatives 4 and 6) would be pursued with an approach that maximizes learning while minimizing risks (that is, adaptive management). Restoration activities would be prioritized during sub-basin review and Ecosystem Analysis at the Watershed Scale, and restoration would focus on first securing strongholds and currently productive habitats at risk. Both Alternatives 4 and 6 use the sub-basin scale for prioritization, but Alternative 6 would rely much more on the watershed scale for prioritization.
- ◆ In Alternatives 4, 5, and 6, active management of riparian areas could be used to reduce severity of fire, where appropriate, by re-creating a more natural mosaic of stands in different conditions that offer natural firebreaks and less concentrated food sources for forest insect pests. The large tree standards (AQ-S6, AQ-S7, AQ-S8) take precedence over fire regime and severity direction within riparian areas.

Discussion: This assumption does not imply that all riparian areas need active management to reduce severity of uncharacteristic fire. However, the EIS Team recognized that active management may be needed in some situations and therefore did not preclude this option at the broad-scale planning level. In addition, the EIS Team assumed that if active management occurred within riparian areas where large trees were lacking, retention of large trees of any species would occur to maintain aquatic and riparian functions and processes as described in standards AQ-S6 through AQ-S8 and associated rationale. Objective AQ-O1 addresses the intent of riparian area management.

- ◆ Declines in status and occurrence would occur for some species regardless of future land management activities.

Discussion: Risks for fishes would be associated with future land management

activities that change habitats, as well as with past management and the current condition of habitats and landscapes. The effects of land disturbance in watersheds may not be evident in streams for years afterward. Catastrophic events that either precipitate such changes or directly influence mortalities of some species are likely rare and largely unpredictable. Land management effects in aquatic environments may be evident for some time after land management activities have stopped. Populations that are stable, but small are also vulnerable to chance environmental events. Even populations isolated in high quality habitats are vulnerable to permanent extinction through time. Some species are likely to experience further local extinctions even without any further habitat losses because of past disturbances that resulted in fragmentation and isolation of habitats.

- ◆ The key salmonids are useful indicators of the integrity and status of aquatic ecosystems in general. Activities that effectively manage risks and restore healthy and diverse populations and habitats for salmonids would benefit other species in similar ways.
- ◆ Species that are listed and proposed for listing at the time of the evaluation are assumed to be listed at the time of implementation. This assumes that no currently listed species would be delisted prior to implementation, and also that a species currently proposed for listing would be listed at the time of implementation.
- ◆ Ecosystem Analysis at the Watershed Scale, which might lead to changes in riparian protection widths and standards, would be more effective in conserving and restoring watershed and riparian processes relevant to the maintenance of healthy aquatic ecosystems than default riparian protection widths.
- ◆ Trends in resident species such as bull trout, westslope cutthroat trout and redband trout are reasonable indicators of spawning and rearing conditions for stream-type chinook salmon and steelhead that share the same freshwater habitats.

Causes of the Effects of Each Alternative on Aquatic Ecosystems

The effects on aquatic ecosystems were determined from anticipated outcomes resulting from implementation of the seven alternatives described in Chapter 3, given the assumptions described previously. Each alternative prescribes a different level of protection, maintenance, and restoration of aquatic and riparian resources. When combined with the degree, rate, and method of land management activities, effects on aquatic and riparian resources can be qualitatively and quantitatively described for each alternative. The following list describes factors which substantively differ among alternatives, and thus causing different effects on aquatic ecosystems within areas administered by the Forest Service or the BLM.

- ◆ The prescribed level of protection and restoration of watershed and riparian functions and processes.
- ◆ The quantity and scale of ecosystem analysis.
- ◆ The rate, spatial extent, and prioritization of management activities.
- ◆ Conservation and protection activities directed at key salmonid strongholds and fringe populations, at-risk fish populations and habitats, and narrow endemic and sensitive fish species.

Methodology: How Effects on Aquatic Systems were Estimated by the Science Integration Team

A brief summary of the evaluation procedure is given here; for a more detailed description of the evaluation methods, see the *Evaluation of Alternatives* (Quigley et al. 1997). The evaluation was conducted on the basis of interpretation of both quantitative and qualitative information collected solely for the purpose of alternative evaluation, and on the

basis of information generated as part of the *Scientific Assessment* (Quigley et al. 1996a,b). Participants in the evaluation included Forest Service and BLM scientists from the SIT and additional invited scientists from the Forest Service, U.S. Environmental Protection Agency, National Marine Fisheries Service, and U.S. Fish and Wildlife Service. The evaluation of effects consisted of three steps, each of which built on the preceding step.

Qualitative Evaluation of the Overall Level of Protection, Maintenance, or Restoration of Aquatic and Riparian Habitats

The first step of the evaluation addressed overall effects on hydrology, watershed processes, and aquatic, riparian and wetland processes and function. This component of alternative evaluation was based primarily on proposed activity levels (including harvest, precommercial thinning, decreases in road density, watershed restoration, prescribed fire, livestock management, improved rangelands, and riparian restoration), riparian area management, and ecosystem analysis requirements, which provide the mechanism and ability to prioritize activities from a holistic ecosystem perspective. These combined factors were used to assess the overall level of risk to aquatic and riparian environments.

Quantitative and Qualitative Evaluation of Expected Changes in the Distribution and Status of Key Salmonid Species

The second step includes assessment of expected trends in distribution and status for bull trout, redband trout, westslope and Yellowstone cutthroat trout, ocean-type and stream-type chinook salmon, and steelhead. As discussed in the *Scientific Assessment* (Quigley et al. 1996a,b), these species are viewed as important broad-scale indicators of aquatic integrity throughout the project area. The large amount of existing information for these species allows general analysis of population changes in response to land management. The qualitative component of this part of the

alternative evaluation was based on consideration on the level of overall protection of aquatic systems as defined in step one above, and the spatial distribution of special emphases defined in the alternatives regarding protection and restoration of aquatic ecosystems, including core and fringe areas of the seven individual species.

The quantitative component of this aspect of alternative evaluation was aimed at predicting expected distribution and status outcomes of key salmonid species on BLM- or Forest Service-administered lands 100 years after alternative implementation. The basis for quantitative analysis was the activity tables and rule sets specified in Chapter 3 (Tables 3-6, 3-7, 3-10, 3-11, 3-12) derived from projected forest and range management activities that are known to influence aquatic habitats. These activities (and associated activity tables) vary in intensity by alternative, and vary spatially within and among alternatives by forest and range clusters. The spatial allocation of management activities derived from the activity tables was associated with the distribution of key salmonids to indicate the potential influence of management activities. These activity tables and rule sets were further used to predict outcomes in fish distribution and status through predictions of future road density patterns and statistical models relating current patterns of fish distribution and road density. It was assumed in this analysis that future distributions of fish would be influenced by future road density patterns in a manner similar to the present correlations. In this analysis, road density was assumed to be a proxy for many management-related landscape effects for which there are no direct measures or projections. Changes in distribution and status outcomes were a possible indication of modifications in habitat condition.

The SIT judgement in overall trends in species distribution and status was based on quantitative model outcomes, an interpretation of risks associated with intensity and allocation of management activities, and the degree of aquatic and riparian protection.

Evaluation of Narrowly Distributed Endemic or Sensitive Taxa

The third step involved evaluation of 18 narrowly distributed endemic or sensitive taxa that are sensitive to federal land management practices and occur in more than one National Forest or BLM District. Similar to key salmonids, spatial allocation of management activities derived from the activity tables (Tables 3-6 and 3-7) was associated with the reported distribution of narrow endemic and sensitive species to indicate the potential influence of management activities. This information was used in combination with the level of riparian and aquatic protection, known biological requirements of the species, and professional judgement, to evaluate the effects on individual or groups of narrow endemic or sensitive species habitats.

EIS Team Application of SIT Information

The SIT addressed habitat outcomes and population outcomes. The EIS Team used the SIT information as a basis to further evaluate alternatives and to infer whether habitat would support viable populations of fish. Rationale presented in Appendix 4-2 was also used to support viability determinations.

- ◆ Changes in population distribution and status of key salmonids and changes in habitat for narrowly distributed, endemic, or sensitive fish species were used to address the viability requirements of the National Forest Management Act (NFMA) planning regulation 36 CFR 219.19. These methods are reasonable for addressing NFMA viability requirements for broad-scale programmatic planning.
- ◆ Cumulative effects analysis, under NEPA requirements, was used to make inferences about change in populations, population persistence, and habitat on non-federal and federal lands.

Effects of the Alternatives on Aquatic Systems

Alternatives 1 through 7 were evaluated relative to: (1) anticipated effectiveness in maintaining and protecting aquatic ecosystem function, structure, and processes; and (2) their expected effects on the distribution and population abundance of 25 native fish species and subspecies. The effects of the alternatives on aquatic ecosystems were evaluated by the Science Integration Team (SIT) and are reported in the *Evaluation of Alternatives* (Quigley et al. 1997). The EIS Team, in consultation with the SIT, further evaluated the alternatives on the basis of the SIT evaluation.

Effects on Hydrology, Watershed Processes, and Riparian Areas and Wetlands

Overall effects of the alternatives on hydrology, watershed processes, and riparian areas and wetlands were qualitatively assessed from consideration of the alternatives with respect to the following: (1) the overall intent and activities associated with the alternative; (2) the roles and requirements associated with finer-scale analysis processes; (3) protection of riparian areas and wetlands through designation of Riparian Conservation Areas (RCAs), and the specific direction for activities within these areas; (4) distribution and treatment of areas designated for aquatic resource emphasis; and (5) the role and application of Riparian Management Objectives (RMOs). An assumption of this analysis is that desirable outcomes with respect to water quantity, water quality, stream channel processes and conditions, and the overall integrity of aquatic and riparian resources would coincide with the level of overall protection of watershed and riparian processes and conditions identified in this component of the alternative evaluation. However, specific and quantitative predictions of outcomes for many aquatic and riparian attributes were not possible at this scale.

Overall Intent of the Alternatives

In Alternatives 1 and 2, ecosystem management would not be emphasized at the broad and mid scale, and therefore would have no comprehensive strategy for addressing ecosystem interactions. Except in areas covered by the Northwest Forest Plan, Alternative 1 would have no mechanism for watershed-scale ecosystem management and would provide little consideration of watershed-scale processes and functions. Alternative 2, continuation of PACFISH/INFISH direction, would focus protection on riparian corridors and begin restoration of aquatic and riparian systems. In Alternatives 3 through 7, aquatic and riparian systems would be blended with watershed and upland processes at the broad and mid scale as a result of the ecosystem management emphasis defined by the objectives and standards. This emphasis could facilitate management for multiple ecological goals and long-term sustainability on a landscape basis. Furthermore, ecosystem management, as intended for Alternatives 3 through 7, would more readily foster implementation of adaptive management and analysis of cumulative effects than the approaches of Alternatives 1 and 2. Alternative 4, with its higher activity levels, could pose greater short-term risks to aquatic ecosystems than would the slower activity rates and amounts of Alternative 6 or the more restrictive and passive approach of Alternative 7. Watershed restoration levels would be greatest for Alternatives 4 and 6, with consequent benefits to aquatic ecosystems.

The effect of the levels of watershed restoration activities would also correlate to the time required for water quality improvements for water bodies currently listed as water quality limited under Section 303(d) of the Clean Water Act. More active restoration activities could shorten the time for compliance, while passive restoration strategies such as in Alternative 7, may lead to an extended time period where water bodies continue to be water quality limited. However, the rate and effectiveness of restoration of water quality would be dependent upon competing priorities and overlap with areas requiring ecosystem analysis. The flexibility to prioritize restoration would be limited in alternatives having higher amounts of prescribed Ecosystem Analysis at the Watershed Scale, especially where these

prescribed areas do not overlap with 303(d) listed water bodies. Coordination of active restoration activities would lessen reliance on appropriated funds and accelerate improvements in water quality.

In Alternative 7, the $\geq 1,000$ -acre unroaded areas would be managed similarly to the large reserves; activities would be limited. Lack of forest, rangeland, and watershed restoration in Alternative 7 would pose risks that may outweigh the benefits of the alternative's restrictive approach; the legacy of historical management activities may place some ecosystems at risk without active restoration. These risks would likely be most important in the more fragmented portions of watersheds (see Effects on Aquatic Species), and would likely increase where watersheds have high sensitivity and high percentages of roaded area.

Application and Role of Ecosystem Analysis

The role of ecosystem analysis is to increase the likelihood of ecologically appropriate outcomes in two ways: (1) by providing a context for management actions that are within the capabilities and limitations of a specific watershed, and (2) as an effective mechanism for prioritizing actions and weighing multiple risks to specific resources within the ecosystem. Although ecosystem analysis can be accomplished at multiple scales, the sub-basin and watershed scales have been determined to be especially important to reduce risks to aquatic and riparian systems. Sub-basin review, a validation and prioritization process, is required in Alternatives 3 through 7.

All alternatives require Ecosystem Analysis at the Watershed Scale prior to project implementation within key watersheds covered by the Northwest Forest Plan (Figure 4-49). There are no additional requirements for ecosystem analysis outside Northwest Forest Plan Key Watersheds in Alternative 1. In Alternative 2, although Ecosystem Analysis at the Watershed Scale is intended to provide consideration of watershed-scale processes and functions, site-specific NEPA analysis could be used to adjust RCA boundaries and Riparian Management Objectives (RMOs) values without the watershed-scale context. In Alternatives 3 through 7, it is intended that ecosystem analysis at multiple scales would be conducted to facilitate understanding of ecosystems and

ecosystem processes, and would provide a basis for efficient and effective prioritization of management actions. In Alternatives 3, 4, 5 (outside timber and livestock priority areas), and 7, RCA boundaries and RMO values may only be adjusted after conducting Ecosystem Analysis at the Watershed Scale. In Alternative 6, adjustment of RCA boundaries and RMO values would require completion of Ecosystem Analysis at the Watershed Scale on most BLM- or Forest Service- administered lands.

On the remaining BLM or Forest Service land area of Alternative 6, site specific NEPA analysis could be used to adjust RCA boundaries and RMO values during a four year transition period, if such action would provide equal or greater achievement of ICBEMP objectives. After the transition period, modifications would only be made after conducting Ecosystem Analysis at the Watershed Scale. It is assumed that full use of ecosystem analysis would benefit aquatic ecosystems more than the limited role specified in Alternatives 1 and 2. The potential amount of Ecosystem Analysis at the Watershed Scale varies among Alternatives 1 through 7 (Figure 4-49). Alternative 6 would potentially have the greatest amount of Ecosystem Analysis at the Watershed Scale followed by Alternatives, 3, 4, 5, and 7. Consequently, implementation of ecosystem analysis as specified in Alternatives 3 through 7 is expected to benefit aquatic systems more than under Alternatives 1 and 2.

However, the lack of specificity regarding (1) ecological outcomes required of finer-scale planning processes, and (2) connections between planning processes results in some uncertainty in outcomes, especially for Alternatives 3 through 6. Ecosystem Analysis requirements for Alternative 5 are similar to those of Alternatives 4 and 6, except within timber priority areas, where watershed-scale or site-specific NEPA analysis of hydrologic and geomorphic functions are required, and within livestock emphasis areas, where the only analysis requirement is that necessary for evaluating attainment of proper functioning condition. In Alternative 7, peer-reviewed Ecosystem Analysis at the Watershed Scale would be required before many management activities in RCAs.

No alternative gives clear direction regarding trade-offs between fire risk and risk to aquatic resources. Research in this area is limited, and

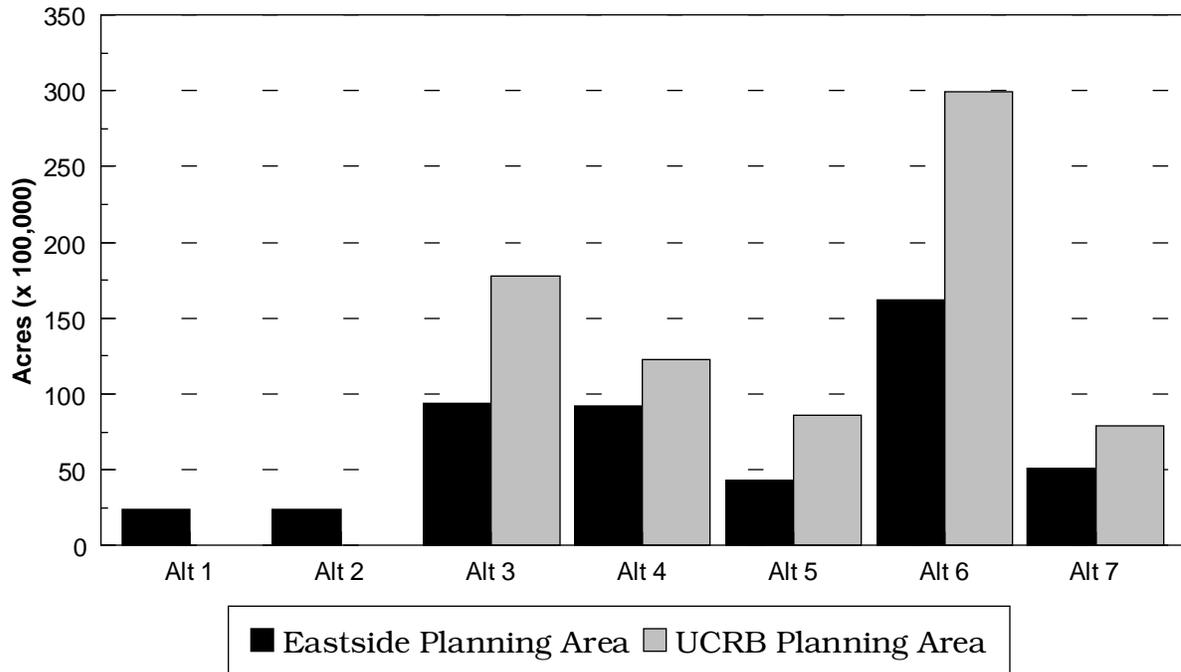


Figure 4-49. Potential Acres of Ecosystem Analysis at the Watershed Scale, Eastside and UCRB Planning Areas.

This figure shows the number of acres of Forest Service- and BLM-administered land where ecosystem analysis is potentially required before conducting management actions. Acreage values for threatened, endangered, and proposed terrestrial species are not included for Alternatives 3 through 7. Also, acres of large blocks of native rangeland are not displayed for Alternative 6.

All acreage values were determined from 1 kilometer (250 acres) resolution data. The acreage values do not reflect ecosystem analysis requirements due to certain actions within or conditions of Riparian Conservation Areas outside the designated watersheds summarized in this graph.

opinions vary on where the greater risk lies: risk from uncharacteristic fire, or risk from activities to reduce uncharacteristic fire. Wildfire is not viewed as a particular threat to healthy aquatic systems, but depressed and strongly isolated populations could be vulnerable to the effects of intense or large fires. Present aquatic species have evolved in response to and in concordance with fire (Gresswell, draft). Besides the mechanisms through which fish populations respond to wildfire described in the “effects to aquatic species” section, mechanisms that affect watershed response following fire, such as the occurrence of high intensity storms and delivery of sediment to a stream network, are important in determining outcomes, and are highly variable. Usually watershed effects from wildfire are short term and may be offset by compensating watershed responses; for example, where riparian vegetation is burned and shade is reduced, increased streamflow heating may be offset by increases in cooler water from subsurface flow and loss of evapotranspiration. Although fuel loading may be high in some riparian areas, they are generally more moist and have different disturbance patterns, intensities, and intervals than the upslopes. Nevertheless, watershed effects from fire can be substantial, and may have long-lasting effects. Studies have shown that the most prominent effect at the watershed scale may be increases in water yield (Gresswell, draft). Some areas present higher risk than others. The interface between roaded and unroaded areas is an area where uncertainty of outcome is high. Other areas of uncertainty of outcome include highly erosive landscapes and smaller confined streams, and headwater areas where riparian vegetation is similar to upland vegetation conditions that are highly susceptible to fire.

Riparian Conservation Areas (RCAs) and Activities Permitted Within

All alternatives have goals, objectives, and standards pertaining to protection of riparian areas and wetlands. The extent of the areas given riparian consideration and emphasis varies by alternative (Figure 4-50). On the basis of the objectives, the width of riparian areas, and the permitted activities within them, Alternatives 2 through 7 would adequately protect ecological functions within riparian areas and wetlands. This is because

conservatively managed riparian areas of one site potential tree height or the floodprone width are considered adequate to maintain most key aquatic and riparian functions.

An exception would be the commodity priority areas of Alternative 5. Within timber priority areas (including large parts of the Northern Glaciated Mountains and Lower Clark Fork ERUs), riparian process and function would not likely be adequately protected, primarily because of the limited widths and lack of protection for intermittent streams. Within livestock priority areas of Alternative 5 (including large parts of the Northern Great Basin, Columbia Plateau, and Owyhee Uplands ERUs), special priority areas for protection of riparian areas would not be established, although the direction for obtaining and moving beyond proper functioning condition is intended to protect, maintain, and restore aquatic and riparian function and process.

There are differences among the alternatives in terms of the actual standards for managing RCAs. Under Alternative 1, there would be no consistent area-wide planning direction for riparian area protection. Standards for activities within RCAs in Alternatives 2, 3, 4, 5 (outside of timber and livestock priority areas), 6, and 7 would likely protect most ecological functions within riparian areas, but there are differences among the alternatives that could affect local risks to aquatic ecosystems. The standards for activities in riparian areas under Alternative 2 cannot be adjusted on the basis of subsequent analysis; therefore, there would be little short-term risk to aquatic ecosystems from management actions with RCAs. Management disturbance of riparian and wetland ecological processes under Alternative 7 would be less than all other alternatives because of conservative direction for activities within riparian areas. In Alternatives 2 and 7, long-term risks could increase because of less flexibility to address other ecological issues such as forestland and rangeland health, thus potentially setting the stage for uncharacteristic ecological disturbances that could adversely affect aquatic ecosystems. Because of similarity among riparian management standards for Alternatives 3, 4, 5 (outside of timber and livestock priority areas), and 6, there would be little expected difference among these alternatives in terms of risks to aquatic and riparian resources within RCAs.

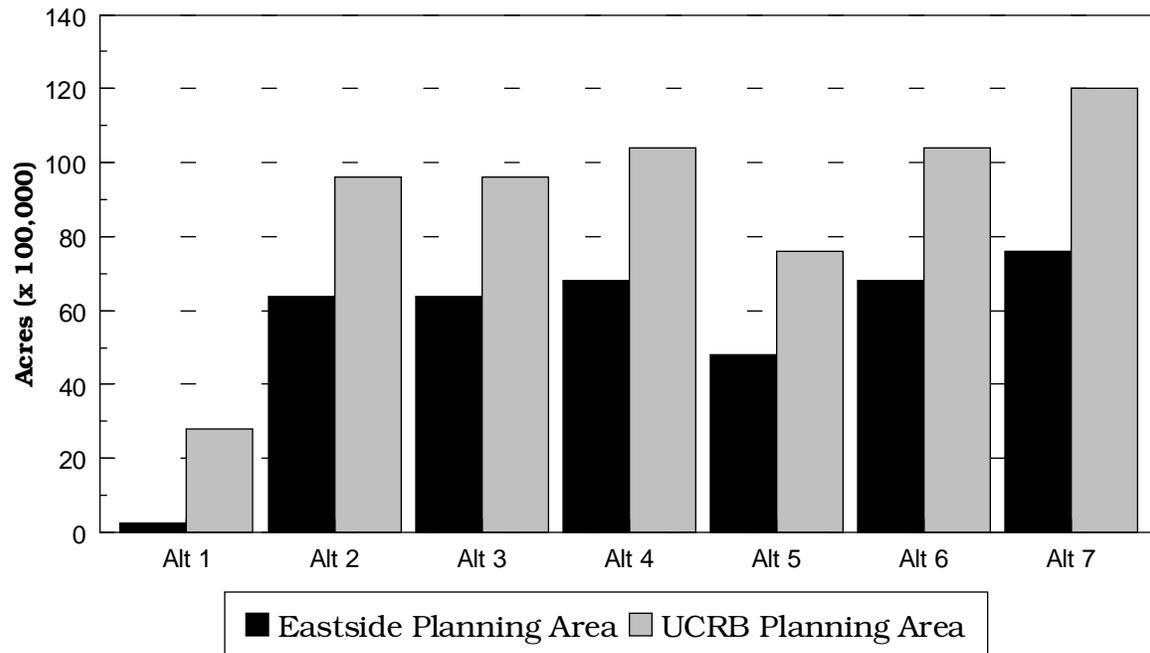


Figure 4-50. Estimated Acres of Forest Service- and BLM-administered Lands Within Riparian Conservation Areas (RCAs), Eastside and UCRB Planning Areas.

Acreage was estimated on the basis of the 1:100,000 stream hydrography, and multiplied by a factor of four to account for under estimation of the actual stream network. This factor was obtained by comparing stream density from 1:24,000 hydrography to 1:100,000 hydrography and relations between stream order and map scale. Riparian widths were estimated for each alternative on the basis of the Riparian Conservation Area standards. Alternatives 2 through 7 do not account for landslide prone areas which would increase acreage. Also, the slope adjustment factor is not included in Alternatives 4, 5, and 6 which would increase acreage.

Alternatives 4 and 6 provide direction for side slopes adjacent to riparian areas which would further reduce risks to riparian areas as compared to Alternatives 2, 3, and 7.

Alternatives 3, 4, 5 (outside of timber and livestock priority areas), 6, and 7 promote Ecosystem Analysis at the Watershed Scale, which would allow for modification of standards. This would benefit aquatic ecosystems in the long term through implementation of integrated ecosystem management and standards that are watershed- and landscape-specific. Riparian delineation under Alternative 4, 5 (outside of timber and livestock priority areas), and 6 is based on a zone concept that uses site-potential tree heights and slope based sediment travel distances to establish RCAs in forested landscapes. This would facilitate integration of ICBEMP direction more readily than the other alternatives because it accounts for direct and indirect processes that influence aquatic, riparian and upland environments. However, there would be greater short-term uncertainty associated with Alternative 4 because there is less incentive to conduct Ecosystem Analysis at the Watershed Scale that would integrate objectives and standards to accomplish ecosystem management.

Key, Stronghold, Priority and Category Watersheds, and Unroaded Areas

All alternatives establish priorities for protection and restoration of aquatic resources through watershed designations, although the area and conditions of aquatic resource emphasis vary considerably among alternatives. In both Alternatives 1 and 2, designation of Key and Priority Watersheds would be based primarily on individual fish species status rather than overall aquatic conditions and priorities. The only prioritization within Alternative 1 is the Northwest Forest Plan Key Watersheds, which are restricted to the east flank of the Cascade Range. Consequently, the Key Watershed designations in Alternative 1 would not adequately address prioritization objectives on a project-area-wide basis. Alternative 2 includes PACFISH Key Watersheds and INFISH Priority Watersheds in addition to the Northwest Forest Plan Key Watersheds. This would result in more of a basin-wide establishment of aquatic priorities than Alternative 1, thus benefiting many watersheds that contain native salmonids.

Prioritization for protection and restoration of aquatic resources in Alternatives 3 through 6 would be defined on the basis of Sub-basin Categories identified by the SIT. These sub-basin categories, which were determined on overall aquatic conditions, would provide a better mechanism to prioritize protection and restoration activities on a basin-wide basis. Objectives and standards in Alternatives 3 through 7 emphasize protection of Category 1 sub-basins and aquatic strongholds within these sub-basins and would probably protect existing core areas of many species, and help prioritize restoration activities. In addition to Category 1 sub-basin direction, Alternative 3 requires completion of Ecosystem Analysis at the Watershed Scale prior to activities that require an environmental assessment or environmental impact statement in subwatersheds containing wild populations of anadromous fish, Snake River salmon and bull trout priority watersheds, salmonid strongholds or subwatersheds containing fringe populations of bull trout. Alternatives 4, 5 (outside of timber and livestock priority areas), 6, and 7 require completion of Ecosystem Analysis at the Watershed Scale prior to activities that would affect federally listed and proposed species and their habitats or their recently occupied or currently accessible habitats. In Alternative 6, there are additional ecosystem analysis requirements for candidate species and for stronghold and fringe populations for redband trout, westslope cutthroat and Yellowstone cutthroat.

Alternatives 6 and 7 require Ecosystem Analysis at the Watershed Scale prior to a net increase in road density in subwatersheds with less than 0.7 road miles per square mile. This requirement would likely benefit aquatic ecosystems. Also in Alternative 7, protection emphasis would be provided for 1000 acre or greater unroaded areas regardless of condition of aquatic resources. Such protection would probably result in benefits to aquatic ecosystems within these areas, but may not result in substantial project area-wide improvements in aquatic resources because of lack of prioritization of activities with respect to project area-wide issues such as habitat connectivity, restoration potential, and fringe and core fish populations. The original intent for protection of unroaded areas greater than 1,000 acres was for terrestrial ecosystem components such as old forest structures and

was not part of the aquatic recommendations from the Eastside Scientific Societies Panel (Henjum et al. 1994).

Riparian Management Objectives

Quantitative Riparian Management Objectives (RMOs) are measures of riparian and stream conditions that serve as management targets. It is assumed that aquatic and riparian habitat conditions are satisfactory for native fish species where riparian areas and stream channels meet RMOs. It is also assumed that for watersheds where stream channels and riparian areas are below RMOs, future management actions would not impede attainment of RMOs. In the overall evaluation of the protection of aquatic resources, little weight was given to RMOs because their effectiveness was anticipated to be realized many years to decades after the life of the plan, and time frames for attainment of RMOs were not specified.

Higher certainty of outcomes was expected to result from integrated ecosystem management approaches of Alternatives 3 through 7 than from using instream variables to measure watershed, riparian, and aquatic condition. Alternative 1 provides no project area-wide RMOs. Alternatives 2, 3, 4, 6, and 7 specify project area-wide adoption of RMOs. Alternatives 2 and 3 provide RMOs for pool frequency, width-to-depth ratio, temperature, bank stability, wood, and bank angle as specified in PACFISH and INFISH. Alternatives 4 and 6 have similar RMO variables as Alternatives 2 and 3 but bank angle is not included and RMO variables for fine sediment and riparian vegetation have been added. Most RMO values in Alternatives 4 and 6 come from near pristine stream habitat data collected within the planning area. Alternative 7 specifies RMOs for the same variables as Alternatives 2 and 3, but for some variables such as bank stability and temperature, the RMO values would be more conservative. Additionally, Alternative 7 would include RMOs for cobble embeddedness and sediment delivery. Because of the additional and more conservative RMOs in Alternative 7, and the restrictions on management activities until RMOs are attained, implementation of Alternative 7 could result in greater short-term benefits to aquatic resources than Alternatives 2, 3, 4, and 6. RMO values could be modified

only after conducting Ecosystem Analysis at the Watershed Scale in Alternatives 3, 4, 5 (outside of timber and livestock priority areas), portions of 6 and 7. Development of RMOs appropriate to local conditions would result in greater benefit to aquatic resources than project area-wide prescriptions. Direction specified in Alternative 5 regarding RMOs is identical to Alternatives 4 and 6, except RMOs are not applied in timber and livestock priority areas.

Several important caveats on the use of RMOs for determining risks and certainty of outcomes should be taken into consideration. First, reliance on RMOs tends to focus management on RMOs and not on the goal of maintaining proper ecosystem processes and conditions. Second, establishment of numerical criteria as a target implies that there are known and quantifiable biophysical response thresholds (such as “good” versus “bad” habitat). This is generally not the case: response thresholds are really not known and may not even exist. Third, focus on single values or ranges of values from a small number of instream variables is overly simplistic and potentially misleading because of factors such as natural variability, complex interactions, and the dynamic nature of streams and watersheds. (Aquatics chapter of the Assessment of Ecosystem Components, Lee et al. 1996).

Aquatic Species

Overall effects of the alternatives on aquatic species were qualitatively and quantitatively assessed with respect to: (1) the overall intent and activities associated with the alternative; (2) the expected levels of overall protection offered by the alternatives for watershed and riparian processes and conditions; (3) current status and trends of aquatic species; and (4) the relative importance of federal land in the full distribution of species.

Introduced Fish Species

Effects analyses were not conducted for introduced fish species. The distribution and status of introduced fish species tend to be influenced by repeated stocking and therefore are not good indicators of changes in habitat condition.

Native Fish Species

Effects analyses and outcomes were directed exclusively at native fish species. The SIT evaluation of native fishes was directed at two major groups: key salmonids, and narrow endemic and sensitive fish species. The key salmonids (bull trout, westslope cutthroat trout, redband trout, steelhead, and stream- and ocean-type chinook salmon) were selected for analysis because of their importance as broad indicators of aquatic integrity and the large amount of existing information for these species. The analysis for narrow endemic and sensitive species focused on 18 of the 39 identified species in the *Aquatics* (Lee et al. 1996) chapter of the *Assessment of Ecosystem Components*. The basis for species selection is described in the Methods section and in the *Evaluation of Alternatives* (Quigley et al. 1997). Expected changes in outcomes for reported species do not account for all factors acting upon their distribution and status, and the likely response may vary widely based on landscape characteristics, allocation and implementation of activities, and current status and trends in populations.

The following discussion is derived from the species-specific narratives and other information provided in the *Evaluation of Alternatives* (Quigley et al. 1997). Basic information used by the SIT in their evaluation included projected management activities within the range of the examined species, and estimated long-term changes in distributions of key salmonids that would follow changes in road densities consistent with the intent and direction of each alternative. Such changes are not expected in the short term (10 years), but rather reflect judgements about how land use patterns might change over the long term (50 to 100 years) if the alternatives were enacted and the intent of the alternatives followed in coming decades. For most species, 10 years is an insufficient time frame to expect substantive differences in effects among alternatives.

Key Salmonids

Bull Trout

Many remaining population strongholds are found within wilderness areas and would likely persist under all alternatives. The riparian management requirements in 2, 3, 4, 6, and 7

would likely conserve strong populations; Alternatives 1 and 5 would not (Table 4-44). Alternatives 2 through 7 provide some potential for active restoration that could benefit depressed bull trout populations. Although Alternative 2 would conserve most core areas and would generally protect aquatic and riparian functions, it is anticipated that little rebuilding of habitat networks would occur, because of low watershed restoration in the long term. The explicit recognition of priority and fringe subwatersheds under Alternative 3 would benefit many populations within those areas. The more extensive restoration activities proposed under Alternative 4 would benefit depressed populations most where they overlap with federally listed species, steelhead and chinook salmon. Implementation of Alternative 4 leaves some uncertainty regarding the benefits expected for depressed populations. Alternative 6 would provide the greatest opportunity to effectively focus restoration of depressed populations across the species' range. The lower rates of activities and moderate levels of restoration activities suggest some important gains could be made under this alternative. Under Alternative 7, risks to small fragmented and isolated populations would exist due to the lack of restoration activities causing an uncertainty about long-term improvements in the depressed portion of the range. Competition with introduced species and current watershed condition makes it uncertain that any alternative could fully ensure no future declines in depressed populations. None of the alternatives would provide strong guidance or opportunities for securing or restoring migratory corridors in areas outside of federal lands, which may isolate some populations. Habitat for viable populations of bull trout throughout the core distribution would be expected under Alternatives 2, 3, 4, 6, and 7 with the greatest potential improvement under Alternatives 3, 4, 6, and 7.

Westslope Cutthroat Trout

Westslope cutthroat trout would likely persist throughout most of their current distribution under all alternatives. The distribution and status of healthy populations, however, would be affected by differences among alternatives in terms of riparian and stream protection and levels of land-disturbing activities (Table 4-45). Further population declines would be expected

Table 4-44. Projected Long-term Effects of the Alternatives on Bull Trout, Project Area.

Will the Alternative?	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
1. Maintain and restore aquatic and riparian habitat and ecological processes on FS/BLM-administered lands?	No	Yes	Yes	Yes	Yes, in non-production priority areas No, in production priority areas	Yes	Yes
2. Protect and restore habitat for strong populations in the central or core portions of the species' range on FS/BLM-administered lands?	No	Yes	Yes	Yes	Yes/No	Yes	Yes
3. Prevent declines in habitats or populations throughout the entire species' range?	No	Uncertain	Uncertain	Uncertain	Uncertain/No	Uncertain	Uncertain
	For reasons beyond Federal land management, some populations may continue to decline. The population condition, trend, and isolation at the subwatershed scale will not be able to improve rapidly enough to prevent population declines in the short-term, given the long time lags required for watershed, rangeland, and forest improvement						
- if "no," where are declines most likely to occur (on FS/BLM-administered lands)?	Outside wilderness and other protected areas	Forest Clusters 3 and 4	Varying levels of success across species' range	Depressed areas subject to high activity outside the range of steelhead and chinook (primarily Forest Cluster 4)	Commodity-emphasis areas and depressed outside the range of steelhead and chinook	Forest Cluster 4	Depressed and fragmented populations outside reserves
4. Restore habitats to support depressed populations?	No	Yes	Yes	Yes	Yes	Yes	Yes
- if "yes", where? INFISH		PACFISH/ Clusters Priority watersheds	Forest levels 2, 4, and 5	Varying of success across species' range	Category 1; Forest Cluster 1 and 2; range of steelhead & chinook	Varying levels of success across species' range	
What is the role of factors other than habitat?	Competition and introgression with introduced fishes can seriously threaten depressed populations, particularly in degraded habitats, and may undermine efforts to rebuild populations in good habitats. Highly-fragmented and isolated populations may risk extirpations even with no further habitat loss.						

under Alternative 1. Although Alternative 5 would likely conserve much of the core of strong populations in the current range, some healthy populations and the fringe populations found in commodity priority areas would be at risk. It is uncertain if Alternative 2 would conserve core populations because high priority watersheds for both INFISH and PACFISH do not cover all important populations. Alternatives 3, 4, 6, and 7 would likely conserve most of the strong populations and could benefit depressed populations through passive improvement of watershed conditions associated with better riparian management. Populations in highly degraded watersheds or in competition with introduced fishes, however, could continue to decline. Alternatives 3, 4, 6, and 7 offer some potential for strengthening populations and reducing fragmentation of strong populations through expanded watershed restoration, ecosystem analysis, and reduction of land-disturbing activities. Under Alternative 3, such gains would be limited to areas within Category 1 sub-basins, strong populations, or to those supporting wild salmon or steelhead, or priority bull trout populations. A greater emphasis on active restoration under Alternatives 4 provides a greater opportunity to restore depressed populations, but would be less likely to benefit populations outside the range of federally listed species, steelhead and chinook salmon. The extensive application of ecosystem analysis under Alternative 6 would offer the best opportunity for active restoration of westslope cutthroat across the range, including the fringe distribution. Long-term effects of Alternative 7 on fragmented and isolated populations would be uncertain due to the lack of restoration actions. Habitat for viable populations of westslope cutthroat trout throughout most of its range would be expected under all alternatives; however, the greatest potential improvement would be expected to occur under Alternatives 3, 4, 6, and 7.

Redband Trout

Since redband trout are relatively resilient to disturbance, populations on BLM- and Forest Service-administered lands would likely persist throughout most of the present distribution under all alternatives (Table 4-47). Many populations could remain depressed and declines could continue, however, regardless of alternative because of competition with introduced species and latent effects of past

management. Alternatives 2, 3, 4, 6, and 7 would conserve most of the core of strong populations; some restoration of depressed populations would be expected through the passive benefits of riparian protection. Similar benefits would be expected under Alternative 5, except in timber and livestock priority areas with increased activities and less riparian and watershed protection. Declines in Alternative 5 would most likely occur where populations overlap livestock priority areas. Increased activity levels imply both greater potential benefits and risks under Alternatives 3, 4, and 6. The uncertainty would be greatest under Alternative 4. Benefits would be most likely under Alternative 6, where extensive requirements for ecosystem analysis would benefit fringe distributions and populations outside the range of steelhead. Habitat for viable populations of redband trout would be likely under all alternatives.

Steelhead

Steelhead have been extirpated from the majority of their historical range. Most remaining steelhead populations are depressed and the long-term persistence of remaining populations is highly uncertain. Because of high mortalities associated with dams and other factors in the ocean and migratory corridors, freshwater habitats could make the important difference between populations that persist and those that go extinct. Conservation or restoration of currently occupied habitats could be critical to the persistence of the remnant populations. All of the alternatives except Alternatives 1 and 5 would conserve most of the habitats that currently support strong populations (Table 4-48). Each of the alternatives would also protect habitats supporting depressed populations to varying degrees, with mixed results. Alternatives 2 and 3 would provide extended protection to steelhead habitats but would provide relatively little emphasis on habitat restoration. Alternatives 1, 3, 4 and 5 involve high levels of timber harvest and thinning activities, which would increase risks for some populations. Increased emphasis on watershed restoration activities under these alternatives would mitigate much of the risk and provide important restoration of current and potential future habitats. The ecosystem analysis requirements of Alternatives 3 through 7 would provide such opportunities. Alternative 6

Table 4-45. Projected Long-term Effects of the Alternatives on Westslope Cutthroat Trout, Project Area.

Will the Alternative?	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
1. Maintain and restore aquatic and riparian habitat and ecological processes on FS/BLM administered lands?	No	Yes	Yes	Yes	Yes, in non-production priority areas No, in production priority areas	Yes	Yes
2. Protect and restore habitat for strong populations in the central or core portions of the species' range on FS/BLM-administered lands?	No	Uncertain	Yes	Yes	Yes/No	Yes	Yes
3. Prevent declines in habitats or populations throughout the entire species' range?	No	Uncertain	Uncertain	Uncertain	Uncertain/No	Uncertain	Uncertain
- if "no" where are declines most likely to occur (on FS/BLM-administered lands)?	Outside wilderness and other protected areas	Outside INFISH Priority watersheds; Forest Clusters 3, 4, and 5	Outside the application of EAWS; Forest Clusters 3 (western MT) and 4, and Upper Clark Fork	Fringe and depressed populations outside the range of listed species, steelhead and chinook; Western MT	Category 1; overlap with listed species; commodity-emphasis areas		
4. Restore habitats to support depressed populations	No	Yes	Yes	Yes	Yes	Yes	Yes
- If "yes", where?		INFISH and PACFISH Priority watersheds	Forest Cluster 2 and some of 4	Category 1; Forest Clusters 2, 3, and 4	Category 1, overlap with chinook & steelhead	Varying levels of success across species' range	
What is the role of factors other than habitat?	Competition and introgression with introduced fishes can seriously threaten depressed populations, particularly in degraded habitats, and may undermine efforts to rebuild populations in good habitats.						

Table 4-47. Projected Long-term Effects of the Alternatives on Redband Trout, Project Area.

Will the Alternative?	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
1. Maintain and restore aquatic and riparian habitat and ecological processes on FS/BLM-administered lands?	No	Yes	Yes	Yes	Yes, in non-production priority areas No, in production priority areas	Yes	Yes
2. Protect and restore habitat for strong populations in the central or core portions of the species' range on FS/BLM-administered lands?	No	Uncertain	Yes	Uncertain	Uncertain in non-production priority areas/ No in production priority areas	Yes	Yes
3. Prevent declines in habitats or populations throughout the entire species' range?	No	No	Uncertain	Uncertain	Uncertain/No	Uncertain	Uncertain
- if "no" where are declines most likely to occur (on FS/BLM-administered lands)?	Outside wilderness and other protected areas	Allopatric form outside INFISH priority areas, and Range Cluster 6	Allopatric form outside INFISH priority areas, and Range Cluster 6	Allopatric distribution outside the range of listed species, steel-head, and chinook especially range Cluster 6	Allopatric distribution outside listed species especially EEIS and Wood and Kootenai; Range Cluster 6	Range Cluster 6	Western portion of Range Cluster 6; Harney and Goose Lake sub-basins
4. Restore habitats to support depressed populations	No	Yes	Yes	Yes	Yes	Yes	Yes
- If "yes", where?		Varying levels of success across species' range depending on intensity of riparian restoration and livestock management activities.					
What is the role of factors other than habitat?	Competition and introgression with introduced fishes can seriously threaten depressed populations, particularly in degraded habitats, and may undermine efforts to rebuild populations in good habitats.						

contains lower levels of land-disturbing activity and a more conservative and adaptive approach, which would benefit populations across the range. Continuing declines would most likely occur under Alternatives 1 and 5, particularly in timber and livestock priority areas outside Forest Clusters 1 and 2. Alternative 7 with the implementation of conservation reserves, reduced land-disturbing activities, and a restrictive riparian management strategy would likely conserve much of the remaining habitat. Some degraded habitats, however, may be restored more slowly or even decline further with limited emphasis on active restoration. It would be unlikely that any activities on federal lands would result in strong rebuilding of steelhead trout populations without substantial improvements in other factors influencing these populations. If conditions outside spawning and rearing habitats remain poor, it is possible that many remaining stocks would continue to decline. Also see the Cumulative Effects on Aquatic Ecosystems discussion at the end of the Aquatics Effects section. Habitat for viable populations and habitat trends toward viability for federally listed stocks would be likely under Alternatives 3, 4, 6, and 7, however the greatest potential habitat improvement would be expected to occur under Alternative 6.

Stream-type Chinook Salmon

Most remaining stream-type chinook salmon populations are depressed and strong populations are rare. In the absence of strong populations, subwatersheds that retain high genetic integrity and those supporting naturally reproducing populations are vital to the species' persistence (Lee et al. 1996). Alternative 1 would likely contribute to continued declines in stream-type chinook salmon across their range (Table 4-48). Alternative 2 would likely protect the few remaining strong populations, but would be unlikely to prevent declines in other portions of the species' range or to help rebuild depressed populations in areas with degraded habitat. Alternative 3 would conserve remaining strong populations, but may not prevent further declines in areas in need of aggressive restoration. Alternative 4 can conserve strong populations, prevent further declines in habitats and populations, and help rebuild depressed populations in degraded areas but only if watershed restoration, guided by ecosystem analysis, is effective in improving

habitat conditions. Alternative 5 would not be expected to conserve remaining strong populations or prevent further declines in populations, though it could help rebuild some depressed populations. Alternative 6 is similar to Alternative 4, but would apply a more conservative and adaptive approach to restoration that would benefit stream-type chinook salmon stocks throughout their range. Alternative 7 would provide a system of reserves to conserve core areas and restrictive RCAs that would protect strong populations, but depressed populations in currently degraded habitats outside of reserves may continue to decline. None of the alternatives would address the needs and opportunities for restoring habitat conditions outside federal lands, nor do they address the need for a comprehensive approach to restoring stream-type chinook salmon habitat and alleviating causes of mortality in freshwater spawning and rearing areas, migration corridors, estuaries, and the ocean. Without a comprehensive approach, even those alternatives that most benefit stream-type chinook salmon could not be expected to ensure persistence. Also see the "Cumulative Effects on Aquatic Ecosystems" discussion at the end of the Aquatics Effects section. Habitat for viable populations and habitat trends toward viability for federally listed stocks would be likely under Alternatives 3, 4, 6, and 7, however the greatest potential habitat improvement would be expected to occur under Alternative 6.

Ocean-type Chinook Salmon

It is expected that none of the alternatives would provide for the habitat requirements of the species, manage perceived threats, or ensure persistence of ocean-type chinook salmon populations. Unlike stream-type chinook, ocean-type chinook salmon are less affected by Forest Service or BLM land management because the species is dependent on lower-elevation mainstem river habitats. The species is proportionally more affected by a large number of other factors outside of BLM- or Forest Service-administered lands in freshwater, estuaries, and the ocean. Recent declines in ocean-type chinook stocks can be attributed primarily to the construction and operation of mainstem dams on the Columbia and Snake Rivers. With some exceptions, the resilience, persistence, and viability of ocean-type chinook salmon stocks would be largely

Table 4-48. Projected Long-term Effects of the Alternatives on Steelhead Trout and Stream-type Chinook Salmon, Project Area.

Will the Alternative?	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
1. Maintain and restore aquatic and riparian habitat and ecological processes on FS/BLM administered lands?	No	Yes	Yes	Yes	Yes, in non-production priority areas No, in production priority areas	Yes	Yes
2. Protect and restore habitat for strong populations in the central or core portions of the species' range on FS/BLM-administered lands?	No	Uncertain	Yes	Yes	Yes/No	Yes	Yes
3. Prevent declines in habitats or populations throughout the entire species' range?	No	Uncertain	Uncertain	Uncertain	Uncertain/No	Uncertain	Uncertain
	For reasons beyond Federal land management, some populations may continue to decline. The population condition, trend, and isolation at the subwatershed scale will not be able to improve rapidly enough to prevent population declines in the short-term, given the long time lags required for watershed and forest improvement.						
- if "no" where are declines most likely to occur (on FS/BLM-administered lands)?	Outside wilderness and other protected areas	Forest Cluster 3	Forest Cluster 5	Forest Clusters 3, 4, and 5	Commodity priority areas	Forest Clusters 3, 4, and 5	Outside reserves in currently degraded watersheds
4. Restore habitats to support depressed populations	No	Yes	Yes	Yes	Yes	Yes	Yes
- If "yes", where?		PACFISH priority watersheds; Forest Clusters 1 & 2	Category 1 subbasins, Forest Clusters 1, 2, and 5			Varying levels of success across species' range	
What is the role of factors other than freshwater habitat?	The combined effects of hydropower operations, hatcheries, and harvest may limit increases in wild populations in areas where freshwater spawning and rearing habitats are restored. Similarly, protection of high-quality freshwater habitats will not guarantee population persistence without mitigation of other factors. Fluctuating ocean condition may mask habitat related responses. Depensitory effects could restrict populations even when other factors are positive.						

dependent on the quality and diversity of mainstem habitats outside of BLM- or Forest Service-administered lands. Because Alternatives 6 and 7 would most likely benefit aquatic ecosystems, these alternatives could result in some benefit to ocean-type chinook salmon, primarily because of improved water quality and quantity on BLM- or Forest Service-administered lands and because of reductions in road densities, reduced timber harvest, improved grazing practices, and protection of riparian areas. Mainstem areas might benefit from land management actions that greatly reduce sediment and ensure an abundant supply of water with suitable chemical and physical characteristics during key life history stages of ocean-type chinook. It is uncertain if these effects would benefit species persistence and viability. The remainder of the alternatives (Alternatives 1 through 5) would not benefit ocean-type chinook salmon because these alternatives continue land-disturbing activities. To ensure persistence and viability, a comprehensive approach is needed that addresses the host of factors that affect ocean-type chinook both on and off BLM- or Forest Service-administered lands.

Narrow Endemic and Sensitive Native Fish Species

Pacific Lamprey

Since Pacific lamprey spawning and rearing areas tend to overlap with steelhead spawning and rearing areas and both are affected by dams and hydroelectric operations, it is assumed that effects would be similar to steelhead. Refer to the preceding section on steelhead for effects on Pacific lamprey.

Pit-Klamath Brook Lamprey

Relatively little is known about the status and life-history requirements of Pit-Klamath brook lamprey. Based on its distribution and an assumption that it is similar to other native stream-dwelling fishes within the upper Klamath and Goose Lake basins, effects would be similar to those reported for the Klamath Basin sensitive fish species and the Goose Lake sucker. Refer to the following discussions for Klamath Basin sensitive fishes and Goose Lake sucker, for how alternatives would affect Pit-Klamath brook lamprey.

Lahontan Cutthroat Trout

Since this cutthroat trout subspecies is federally listed as threatened, it is assumed that requirements under Section 7 of the Endangered Species Act and recovery planning documents would remain in place regardless of the alternative. No adverse effects to the subspecies are expected under any alternative.

Pygmy Whitefish

Persistence and habitat to support viable populations of pygmy whitefish would occur under any alternative; however, Alternatives 1 and 5 would offer less stream and riparian habitat protection than other alternatives.

Oregon Lakes Tui Chub

Little information was available to assess population status; therefore, effects on the species were not evaluated.

Klamath Basin Sensitive Fishes

Because of similar distributions, habitat requirements, and/or threats, the following Klamath Basin fishes were considered as one group for effects analysis: shortnose sucker (endangered), Lost River sucker (endangered), Klamath largescale sucker, and slender sculpin.

Under Alternatives 1 and 5, Klamath Basin habitat would continue to decline due to high levels of timber harvest and livestock grazing and low stream/riparian protection measures.

Alternatives 2 and 3 would generally maintain existing habitat conditions due to moderate levels of timber harvest and low to moderate levels of watershed restoration.

Alternatives 4 and 6 would result in the largest improvement to Klamath Basin fishes and habitat due to the high levels of watershed and riparian restoration. Improved habitat conditions are expected under Alternative 7 due to greater stream/riparian protection and restrictions on livestock grazing. Habitat to support viable populations would likely occur under Alternatives 2, 3, 4, 6, and 7 with the greatest potential for improvement in Alternatives 6 and 7.

Goose Lake Sucker

Goose Lake sucker and redband trout in the Goose Lake sub-basin occupy similar habitat and are affected in the same manner by land management activities. The analysis for Goose Lake sucker is similar to that of redband trout in the Goose Lake sub-basin.

Under Alternatives 1 and 5, habitat conditions would continue to decline due to high levels of timber harvest and livestock grazing and low stream/riparian protection measures. Habitat conditions under Alternatives 2 and 3 would improve as compared to Alternative 1 due to greater stream/riparian protection measures and increased watershed and riparian restoration emphasis in Alternative 3. Alternatives 4 and 6 would improve habitat above conditions in Alternatives 2 and 3 because of a decrease in livestock grazing impacts and higher levels of watershed and riparian restoration. Alternative 7 would result in the greatest habitat improvement for the Goose Lake sucker and Goose Lake redband due to greater stream/riparian protection measures and more restrictions on livestock riparian grazing as compared to other alternatives; however, core areas are not included in reserves.

Habitat to support viable populations would likely occur under Alternatives 2, 3, 4, 6, and 7 with the greatest potential for improvement in Alternatives 6 and 7.

Warner Sucker

Warner sucker (threatened) and redband trout in the Warner sub-basin occupy similar habitat and are affected in the same manner by land management activities. The analysis for Warner sucker is similar to that of redband trout in the Warner sub-basin.

Under Alternatives 1 and 5, habitat conditions for both species would continue to decline due to high levels of livestock grazing and low stream/riparian protection measures. Habitat conditions under Alternatives 2 and 3 would improve as compared to Alternative 1 due to greater stream/riparian protection measures and increased watershed and riparian restoration emphasis in Alternative 3. Alternatives 4 and 6 would improve habitat above conditions in Alternatives 2 and 3

because of a decrease in livestock grazing impacts and higher levels of watershed and riparian restoration. Alternative 7 would result in the greatest habitat improvement for the Warner sucker due to greater stream/riparian protection measures and more restrictions on livestock riparian grazing as compared to other alternatives.

Habitat to support viable populations would likely occur under Alternatives 2, 3, 4, 6, and 7 with the greatest potential for improvement in Alternatives 6 and 7.

Malheur Sculpin

Malheur sculpin and redband trout in the Harney sub-basin occupy similar habitat and are affected in the same manner by land management activities. The analysis for Malheur sculpin is similar to that of redband trout in the Harney sub-basin.

Both Alternatives 1 and 5 would result in the continued decline in habitat conditions for both species because of high timber harvest combined with low stream/riparian protection measures. Habitat conditions under Alternative 2 would improve as compared to Alternative 1 due to lower levels of timber harvest and greater stream/riparian protection measures. Alternative 3 would be similar to Alternative 2 except that watershed and riparian restoration levels are slightly higher. Effects of Alternatives 4 and 6 are similar and would result in better habitat conditions than Alternatives 2 and 3 because of higher watershed and riparian restoration levels. Alternative 7 would result in the greatest habitat improvement for both species because of greater stream/riparian protection measures and more restrictions on livestock riparian grazing and timber harvest; however, core areas are not within reserves.

Habitat to support viable populations would likely occur under Alternatives 2, 3, 4, 6, and 7 with the greatest potential for improvement in Alternatives 6 and 7.

Torrent Sculpin

Current distribution and status information is limited. Since the torrent sculpin inhabits many of the same habitats as and has similar habitat requirements to westslope cutthroat trout or redband trout, effects and changes in viability would be similar. Unlike westslope

cutthroat or redband trout, however, if eliminated from a river system torrent sculpins are unlikely to recolonize without human assistance. For successful restoration, transplants of sculpin into restored areas may be necessary. Refer to preceding sections on westslope cutthroat trout or redband trout, depending on overlap of distribution, for how alternatives would affect torrent sculpin.

Shorthead Sculpin

Current distribution and status information is limited. Since the shorthead sculpin inhabits many of the same habitats and has similar habitat requirements to bull trout, alternative effects and changes in viability would be similar. Unlike bull trout, however, if eliminated from a river system shorthead sculpins are unlikely to recolonize without human assistance. For successful restoration, transplants of sculpin into restored areas may be necessary. Refer to the preceding section on bull trout for how alternatives would affect shorthead sculpin.

Margined Sculpin

Current distribution and status information is limited. Since the margined sculpin inhabits many of the same habitats and has similar habitat requirements to redband trout, alternative effects and changes in viability would be similar. Unlike redband trout, however, if eliminated from a river system margined sculpins are unlikely to recolonize without human assistance. For successful restoration, transplants of sculpin into restored areas may be necessary. Refer to the preceding section on bull trout for how alternatives would affect margined sculpin.

Threatened and Endangered Aquatic Species

All federally threatened and endangered species whose occupied ranges overlapped more than one National Forest or BLM District and could be affected by land management activities were selected for effects and viability evaluation by the Aquatic staff of the SIT. Discussion of effects for selected listed species are presented in preceding sections. Five federally listed species did not meet the selection criteria: white sturgeon (Kootenai River), Hutton tui chub, Borax Lake chub, Foskett speckled dace, and

sockeye salmon (Snake River). Of these five species, white sturgeon and sockeye salmon were deemed to be minimally affected by land management activities, while the remaining three species would be best addressed by individual administrative units.

The effects on threatened and endangered species described in the previous sections were based on the *Evaluation of Alternatives*. Under the Endangered Species Act, federal activities that may have an effect on threatened, endangered, or proposed species are subject to consultation with the U.S. Fish and Wildlife Service or National Marine Fisheries Service. Requirements for consultation would remain in effect under any selected alternative. If the selected alternative may have an effect on threatened, endangered, or proposed species, biological assessment(s), appropriate for the scale of the decision, will be submitted to U.S. Fish and Wildlife Service and National Marine Fisheries Service for consultation. Consultation will be completed prior to any ground-disturbing activities.

Cumulative Effects

No alternative specifically addresses the role of non-federal lands with respect to aquatic ecosystems. For assessing the role of non-federal lands in the maintenance of aquatic ecosystems, it was assumed that there would be no systematic and project area-wide strategy for protecting ecological processes on non-federal lands, and that aquatic ecosystem conditions would likely remain degraded where conditions are presently below ecological potential. This conclusion was based on the following considerations as described in the *Evaluation of Alternatives* (Quigley et al. 1997).

- ◆ The goals of states' natural resource agencies are generally not specifically aimed to protect aquatic ecosystems and biodiversity, but to meet societal needs while disrupting ecological processes and conditions as little as possible.
- ◆ State regulations for forest and range practices do not fully protect riparian processes and functions.
- ◆ Site-specific information regarding aquatic species conditions and habitat requirements

on non-federal lands is generally not sufficient for effective management.

- ◆ Implementation of state requirements for protection of aquatic ecosystems are uncertain.
- ◆ The current lack of a comprehensive multi-agency and landowner aquatic conservation approach limits the opportunity to effectively conserve and restore wide-ranging fish species.

However, it is recognized that states have begun development of conservation strategies to reduce threats and restore habitat for rare or imperiled aquatic species. For example, most states are developing bull trout conservation plans cooperatively with federal agencies, tribal governments, and other landowners. The effects of these plans are unknown since most are not yet fully developed or implemented.

On a relative scale, Alternatives 6 and 7 would provide the highest short-term benefits to riparian and aquatic environments because of riparian area protection requirements and reduced rates of management activities that could negatively affect these resources on federal lands. Alternatives 4 and 6 would provide the highest long-term benefits. The lack of active watershed, rangeland, and forest restoration in Alternative 7 could pose risks to riparian and aquatic environments in the long term. Alternative 4 would have similar benefits to Alternatives 6 and 7, but has a greater uncertainty of ecological outcomes due to higher amounts and rates of activities over the short term, and reduced reliance on ecosystem analysis relative to Alternative 6. Alternatives 2 and 3 would benefit riparian and aquatic environments due to riparian area protection requirements, but to lesser degrees than Alternatives 4, 6, and 7. However, conservation and restoration emphasis in Alternative 2 would be based in fine-scale standards and would not integrate landscape and watershed considerations into a coherent management strategy consistent with disturbance regimes. Alternative 3 would provide slightly greater benefits than Alternative 2 due a greater emphasis placed on ecosystem management and watershed restoration. Alternatives 1 and 5 would provide the least overall protection to riparian and aquatic environments. Alternative 1 would not be expected to lead to recovery of

aquatic and riparian environments because of a lack of a comprehensive riparian protection and recovery strategy. Although aquatic, wildlife, and recreation priority areas in Alternative 5 would have the same level of protection as Alternatives 4 and 6, reduced riparian protection outside these priority areas would be expected to result in broad-scale fragmentation of aquatic and riparian environments.

Generally, the greatest short-term improvement in threatened and endangered and native fish distribution and status on federal lands would occur under Alternatives 6 and 7, mainly due to greater riparian protection measures and lower rate of land disturbance. Alternatives 4 and 6 would provide the highest long-term benefits and improvements. Long-term effects of Alternative 7 could pose an uncertain risk to isolated and fragmented populations due to a lack of an active restoration emphasis. Effects of Alternatives 4 and 6 on distribution, status trends, and habitat would be similar to Alternative 7, except that improvements in habitat would be at some risk in the short term under Alternative 4. Generally under Alternative 3, distribution and status trend increases would be less than Alternative 4 due to the lower rates of restoration and higher levels of land disturbance within portions of species' ranges. Trends under Alternative 2 would be uncertain because many important populations are not covered by INFISH and PACFISH priority watersheds and the alternative lacks an ecosystem approach. Alternative 1 and Alternative 5 inside livestock and timber priority areas would result in a decrease in species distribution and status due to low protective measures for riparian areas and inadequate ecosystem management planning. None of the alternatives would address needs and opportunities for restoring habitat conditions on other land ownerships.

No alternative would ensure the persistence and viability of ocean-type chinook salmon, but Alternatives 6 and 7 may provide some benefits to mainstem river spawning and rearing habitat. Alternatives 3, 4, 6, and 7 would improve existing habitat conditions for steelhead and stream-type chinook salmon while the other alternatives would result in a continued decline in condition. However, no alternative addresses the need for a comprehensive approach to restoring

anadromous fish stocks on federal and non-federal lands and alleviating causes of mortality in all life stages. Snake River stocks of ocean and stream-type chinook are federally listed as threatened, and steelhead are proposed for federal listing. Recent declines in anadromous fish stocks can be attributed primarily to construction and operation of mainstem Columbia and Snake River dams.

In Chapter 2, a sidebar discusses the effects of hydropower, hatcheries, harvest, and habitat on interior Columbia River Basin anadromous fishes. This sidebar is summarized below to address cumulative effects on anadromous fishes.

- ◆ Downstream stresses associated with the hydropower system are one of the major causes of declining anadromous fish runs in the Snake River, notwithstanding land use activities in the watersheds. Federal efforts are underway to address these problems through increased spill, barging, and monitoring. Other potential confounding stresses come from situations beyond human control, such as ocean conditions and drought. Mid-Columbia anadromous stocks (for example John Day and Deschutes Rivers) are influenced less by hydropower due to a lower number of dams below spawning and rearing areas. Habitat degradation is another important factor in the decline of salmon and steelhead.
- ◆ Maintenance, expansion, and reconnection of high-quality habitats are vital to the persistence of populations but the magnitude of effects varies from sub-basin to sub-basin. High quality habitat alone is

no guarantee of increased persistence without a comprehensive approach that addresses all mortality factors acting upon individual populations. Additional high quality habitat alone could increase abundance of individual fish but it would not likely reverse current negative population trends in the short-term. Assuming mainstem conditions are resolved in the longer term, and if the objective is to support the full expression of life histories and species, then it would be necessary to conserve and restore broader habitat networks than currently exist.

- ◆ Salmon population numbers in much of the interior Columbia Basin are far below what current habitat conditions could likely support under a scenario of increased downriver survival. Some remote areas (wilderness and other protected areas) in central Idaho and northern Cascades, potentially could support hundred-fold increases or better in adult numbers. However, this is not the case everywhere. Existing habitat conditions in some areas, such as the John Day, Deschutes and Grande Ronde Rivers and Panther Creek, would likely not be sufficient to support increases in returning adults resulting from improvement in downstream survival. In such places, there is a need to increase egg-to-smolt survival where it is currently depressed by habitat degradation.

Without a comprehensive approach that addresses all causes of mortality, the expected benefits from Alternatives 3, 4, 6, and 7 would not ensure persistence of anadromous fish stocks within the project area.

Effects of the Alternatives on Landscape Health

Introduction

Healthy landscapes are those landscapes whose processes (including the production of human commodity and amenity values) are in balance (ecological cause and effect). This balance is dynamic; humans have the opportunity to work strategically with changing landscape conditions to receive a predictable and reliable flow of both commodities (such as timber and livestock production) and amenities (such as scenic values, clean air and water, and recovery of habitats for rare fish and wildlife). In essence, balance represents the “best fit” of dynamic interactions of human land use, fish and wildlife habitats, and ecosystem health within the limitations of the biophysical system and inherent disturbance processes. Systems with a healthy balance show a resilience to disturbance and predictable changes that follow “expected” ecological cause-and-effect relationships, which can be observed or predicted based on the historical system or understanding alterations of that system. Assessing landscape health is a process which links the “driving variables” of key ecological processes and predicts responses at various landscape scales. Key processes can be categorized into hydrologic and land systems, carbon-nutrient systems, human systems, terrestrial and aquatic food webs, and evolutionary systems.

In the *Evaluation of Alternatives* by the Science Integration Team, the summary of data within hierarchical spatial scales (looking at geographical areas in context with larger and smaller areas) provided:

- ◆ broad-scale contexts within the Interior Columbia Basin Ecosystem Management Project area;
- ◆ connections within and among sub-basins; and
- ◆ information about:
 - ◆ elements (such as large trees and snags),
 - ◆ processes (such as productivity, fire, and drought),
 - ◆ functions (such as trees that provide perching and nesting habitats), and
 - ◆ patterns (mosaics of succession and disturbance).

The Science Integration Team also used temporal scales (looking at different points in time), which provided an understanding of ecological causes and effects; these temporal scales included the historical range of variability, early and recent historical periods, and current period. Temporal scales for future projections considered the short term (next 10 years), and the long term (50- to 100-years). The SIT’s evaluation of landscape health was used to determine outcomes for selected variables that integrate the ecological causes and effects on the landscape.

For more detailed information on the analysis process, the models used, and the reasons for selecting the specific variables, see the appropriate sections for Proper Functioning Landscape Systems in the *Landscape Ecology* (Hann et al. 1996) chapter of the *Assessment of Ecosystem Components*.

What is Landscape Health?

Consider building a house with no plan except for the individual visions of the carpenter, plumber, and electrician. There is high risk that the outcome would not represent the house desired by the homeowner. Having a house plan, on the other hand, provides a way to compare different possible outcomes so a choice can be made on what type of house to build. The house plan can be used by the carpenter, plumber, and electrician to produce the chosen outcome. The landscape health (proper functioning landscape systems) assessment in the *Assessment of Ecosystem Components* (Quigley et al. 1996b) provides a framework, much like a house plan, for modeling future landscapes and strategically planning (over time and in various places) ecological conservation, restoration, or production activities, or traditional production or protection activities.

Variables and Predicted Results

The landscape health evaluation was based on 20 variables, which are indicators of one or more of the key landscape systems: human, hydrologic, carbon-nutrient, food web, and evolution (see Table 4-49).

In the next 10 years, none of the alternatives would change **rangeland landscape patterns** to healthy landscapes because landscape patterns of rangeland vegetation composition and structure respond very slowly to changes in management. In the long term (50- to 100-years), Alternatives 4 and 6 would show a high rate of transition toward healthy landscapes, and Alternative 3 would show a moderate trend toward healthy landscapes. Alternatives 5 and 7 would have a low rate of transition, and Alternatives 1 and 2 would result in no change.

Forest landscape patterns respond faster than range landscapes. While Alternatives 1, 2, 3, 5, or 7 would show no change in trend toward healthy landscapes in the next 10 years, Alternative 4 would produce a moderate transition in the short term and a high transition rate to healthy landscapes in the long term. Alternative 6 would result in low achievement of healthy landscapes in the short term but moderate in the long term. Alternative 6 would respond at a slower rate in the long term than Alternative 4, because the low rate of activities in the next 10 years would result in substantial differences in disturbance and succession. The long-term trend for forest landscape patterns in Alternatives 1 and 2 would not change, while Alternatives 3, 5, and 7 would result in a low rate of transition to healthy landscapes.

The **forest-rangeland landscape mosaics** are similar to the range landscapes in that none of alternatives would result in a transition to healthy landscapes in the short term, because of slow response to changes in management. However, in the long term, the response of the forest-rangeland landscape mosaics would differ from either forest or rangeland landscapes. Alternative 4 would produce a high positive trend toward healthy landscapes, and Alternatives 3 and 5 would show a low trend toward healthy landscapes, with Alternative 6 ranking as moderate. Alternatives 1, 2, and 7

would result in continued transition away from healthy landscapes; Alternative 7 would not produce a net transition because the dynamics of fire, fuels, exotic plants, and succession within reserves would not trend toward a healthy balance in the long term.

In the short term, Alternatives 3 and 4 would result in a moderate trend toward healthy landscapes in **dry grass and dry shrub potential vegetation groups**, due to the strong emphasis on perennial grass and shrub restoration through control of noxious weeds and management to reduce cheatgrass and other exotic annuals. In contrast, there would be no trend toward healthy landscapes for Alternatives 1 and 2, and only a low rate of transition to healthy landscapes for Alternatives 5, 6, and 7. In the long term, Alternative 4, with its high restoration emphasis, would result in a high transition toward healthy landscapes. Alternatives 3, 6, and 7 would reach a moderate transition level to healthy landscapes in the long term, and Alternative 5 would remain low in its ability to achieve healthy landscape systems. Alternatives 1 and 2 would continue their trend away from healthy landscapes in the long term.

In the short term under Alternatives 3, 4, 5, and 7, the **cool shrub potential vegetation group** would result in a moderate trend toward healthy landscapes due to relatively rapid response of cool shrublands to treatments such as improved grazing management or weed control compared to the dry shrub and grass potential vegetation groups. Alternative 6 has a low trend because of a lower level of activities in the next 10 years. In contrast, cool shrublands would not trend toward healthy landscapes under Alternatives 1 and 2, in either the short or long term. In the long term, Alternatives 4 and 6 would result in a high transition to healthy landscapes due to a high emphasis on restoration, including livestock grazing management. Alternatives 3, 5, and 7 would show a moderate trend toward healthy landscapes.

In the short term under Alternatives 3, 4, 5, and 7, the **woodland potential vegetation group** would produce a low trend toward healthy landscapes due to limitations in technology. Alternative 6 would result in moderate transition to healthy landscapes due to emphasis on technology development; Alternatives 1 and 2 would show no trend

Table 4-49. Ranking of Action Alternatives For Ability to Achieve Landscape

Variable	Alternative 1		Alternative 2	
	1st decade	long-term	1st decade	long-term
Range Landscape Patterns	N	N	N	N
Forest Landscape Patterns	N	N	N	N
Forest-Range Landscape Patterns	N	N	N	N
Dry Shrub & Grass PVG Desired Sn/Dist Regime	N	N	N	N
Cool Shrub PVG Desired Sn/Dist Regime	N	N	N	N
Woodland PVG Desired Sn/Dist Regime	N	N	N	N
Range Riparian PVG Desired Sn/Dist Regime	N	L	L	M
Dry Forest PVG Desired Sn/Dist Regime	N	N	N	N
Moist Forest PVG Desired Sn/Dist Regime	N	N	N	N
Cold Forest PVG Desired Sn/Dist Regime	N	N	N	N
Alpine PVG Desired Sn/Dist Regime	L	L	L	L
Desired Reduction in Forest Soil Disturbance	N	N	L	L
Desired Reduction in Range Soil Disturbance	N	N	N	N
Forest Noxious Weed Risk Reduction	N	N	N	N
Range Noxious Weed Risk Reduction	N	N	N	N
Coarse-filter Terrestrial Habitats	N	N	L	L
Coarse-filter Riparian Habitats	N	N	L	L
Fire Risk Reduction in Wildland Interface	L	L	N	N
Desired Human Commodity Values	H	M	M	L
Desired Human Amenity Values	L	L	L	M
Summary	N	N	N	L

¹ Healthy landscape systems - those landscapes whose processes are in dynamic balance, such that the rates and routes of key processes and disturbances are resilient and have predictable responses to disturbance, while producing human values. The ecological systems that interact in dynamic balance include: the human system; hydrologic and land system; carbon-nutrient system; food web system, evolutionary system, and role of toxins in the system.

N=No trend to healthy landscapes; L=Low trend to healthy landscapes; M=Moderate trend to healthy landscapes; H=High trend to healthy landscapes

Health, Eastside Planning Area.

Alternative 3		Alternative 4		Alternative 5		Alternative 6		Alternative 7	
1st decade	long-term								
N	M	N	H	N	L	N	H	N	L
N	L	M	H	N	L	L	M	N	L
N	L	N	H	N	L	N	M	N	N
M	M	M	H	L	L	L	M	L	M
M	M	M	H	M	M	L	H	M	M
L	M	L	H	L	M	M	H	L	M
M	H	M	H	L	M	M	H	M	H
M	H	M	H	L	M	L	H	M	M
M	M	M	H	M	M	L	H	L	L
M	M	M	H	M	M	L	H	L	L
M	M	M	M	L	M	M	M	L	M
M	M	M	M	L	M	M	M	L	L
M	M	M	M	L	M	M	H	L	M
H	H	H	H	L	L	M	M	M	M
H	H	H	H	L	L	M	M	M	M
L	L	M	M	N	L	L	M	L	M
M	M	H	H	L	M	M	H	M	M
M	H	H	H	L	L	L	H	L	M
M	M	M	H	M	M	L	M	L	L
M	M	M	H	L	M	M	H	M	M
M	M	M	H	L	L	L	H	L	M

Abbreviations Used in this Table:

PVG = Potential vegetation group
 Sn/Dist = Succession/Disturbance

toward healthy landscapes. In the long term, Alternatives 4 and 6 would produce a high trend toward healthy landscapes; Alternatives 3, 5, and 7 would produce a moderate trend; and Alternatives 1 and 2 show no trend toward healthy landscapes.

In the short term, the strong emphasis on riparian restoration in Alternatives 3, 4, and 6 is predicted to produce a moderate trend toward healthy landscapes in the **rangeland riparian potential vegetation group**. A moderate transition to healthy landscapes is also predicted for Alternative 7 as a result of the removal of livestock grazing pressure. Alternatives 2 and 5 would have a low rate of trend, and Alternative 1 would show no transition toward healthy landscapes. In the long term, Alternatives 1 and 5 would result in a low, Alternative 2 in a moderate, and Alternatives 3, 4, 6, and 7 in a high trend toward healthy landscapes.

Historically, in the **dry forest potential vegetation group**, a mixture of stable and cyclic succession/disturbance regimes were produced with mosaics of open to somewhat closed forests dominated by ponderosa pine or Douglas-fir. Similar disturbance effects need to be restored or imitated for the dry forest potential vegetation group to trend toward healthy landscapes. In the short term, Alternatives 1 and 2 would result in no trend to healthy landscapes. Alternatives 3, 4, and 7 would produce a moderate trend to healthy landscapes, with Alternative 4 showing a quicker shift toward healthy landscapes because of its emphasis on restoration. Alternatives 5 and 6 show a low trend due to low rates of restoration. In the long term, Alternatives 3, 4, and 6 would produce a high trend toward healthy landscapes because of the emphasis on prescribed fire, thinning dense stands, and promoting early seral shade-intolerant and large trees. Alternatives 5 and 7 would show a moderate trend toward healthy landscapes, and Alternatives 1 and 2 would result in no trend to healthy landscapes in the long term.

The **moist forest potential vegetation group** includes some of the most productive land in the project area. In the absence of disturbance, biomass accumulates rapidly and competition for available carbon and water increases. Achieving healthy landscapes would mean

increasing the amount of late-seral forest with a corresponding decrease in mid-seral forest, as well as promoting ponderosa pine, western larch and western white pine. In the short term, Alternatives 3, 4, and 5 would result in a moderate trend to healthy landscapes, while Alternative 6 would be low. In the long term, Alternatives 4 and 6 would have a high transition toward healthy landscapes because of their restoration emphasis. Alternatives 3 and 5 would have a moderate transition rate toward healthy landscapes. In the short and long term, Alternatives 1 and 2 would show no trend toward healthy landscapes and Alternative 7 would show a low trend due to the imbalance of succession and disturbance in reserves and the lack of emphasis on western white pine restoration.

Unlike the dry and moist forests, the **cold forest potential vegetation group** has less frequent disturbance and slower succession rates; therefore, conditions generally are closer to the historical range of variability. However, traditional fire suppression practices have resulted in simplification of landscape patterns, and whitebark pine is declining rapidly from effects of blister rust and fire exclusion. In the short term, Alternatives 3, 4, and 5 would have a moderate trend and Alternative 6 would have a low trend toward healthy landscapes. In the long term, Alternatives 4 and 6 would have a high probability of transition to healthy landscapes because of their emphasis on restoration, while Alternative 5 would have a moderate trend. In the short and long term, Alternative 7 would result in a low transition to healthy landscapes because of imbalance between successional conditions and disturbance processes and the lack of emphasis on whitebark pine restoration; and Alternatives 1 and 2 would result in no trend toward healthy landscapes.

The **alpine potential vegetation group** is a sensitive ecosystem which has low productivity and slow rates of succession. Because of the slow rates of response to restoration, none of the alternatives would produce a high trend toward healthy landscapes in either the short or the long term. Alternatives 1 and 2 rated low, and Alternatives 3, 4, and 6 rated moderate in trend toward healthy landscapes in the short and long term. Alternatives 5 and 7 rated low in the short term and moderate in the long term.

Alternatives that would increase the amount and intensity of **forest soil disturbance** would be more likely to harm soil stability, function, and productivity. Soil disturbance can come from a number of sources, including timber harvest and thinning, wild and prescribed fires, roads, recreation, and livestock and wildlife grazing. Alternative 1 would have the greatest amount of soil disturbance in the long and short term with no trend toward healthy landscapes. Alternatives 2, 5, and 7 would result in low probability of reducing soil disturbance in the short term. This trend would remain low for Alternative 2 in the long term. Alternatives 3, 4, and 6 would result in a moderate trend to healthy landscapes in the short and long term, because of higher levels of restoration activities or mitigation for best management practices (BMPs) that resemble natural succession/disturbance regimes. Alternatives 5 and 7 would have low rates in the first decade increasing to moderate levels in the long term.

The emphasis on soil protection through improved vegetation management and livestock grazing systems, and the resultant improvements in residual cover, would produce a moderate trend toward reduction in **rangeland soil disturbance** in the short and long term under Alternatives 3 and 4. For Alternative 6, this moderate trend would improve to high in the long term. Alternatives 5 and 7 would produce a low trend in the short term because of their lack of restoration emphasis that would reduce exotic plant invasion or effects of severe wildfire. In the long term, both alternatives would increase to moderate. Alternatives 1 and 2 show no ability to achieve healthy landscapes in either the short or the long term.

In *forest and rangeland systems*, Alternatives 3 and 4, with their high emphasis on noxious weed control, would produce a high trend toward **noxious weed risk reduction** in both the short and long term. Alternatives 6 and 7, with less emphasis on activity levels that would reduce noxious weed spread, would produce a moderate trend toward healthy landscapes in both the short and long term. Alternative 5 would show a low trend and Alternatives 1 and 2 would show no trend toward weed reduction and healthy landscapes in both the short and long term.

In the short and long term, Alternative 4 would show moderate trends toward improving **landscape-scale terrestrial habitats** due to the emphasis on active restoration of those habitats. In the short term, Alternatives 2, 3, 6, and 7, which have a lower emphasis on restoration activities, would show a low trend and Alternatives 1 and 5 would show no trend toward improving landscape-scale terrestrial habitats. In the long term, Alternatives 4, 6, and 7 would produce moderate trends toward improvement, but none of the alternatives would produce high trends. The connectivity of terrestrial species populations has been altered by land uses and land ownership patterns that have fragmented many species habitats. This loss of connectivity prevents these fragmented populations from interbreeding, which puts them at risk. There is little that can be done on BLM- or Forest Service-administered lands alone, relative to landscape-scale conditions, to improve healthy landscapes above moderate levels.

Alternative 4 would show a high trend toward improvement of **landscape-scale riparian habitats** in both the short and long term. Alternative 6 would show a moderate ability to achieve healthy landscapes in the short term and a high rate in the long term. In the short and long term, Alternatives 3 and 7 would show a moderate trend and Alternative 1 would show no trend toward improvement of landscape-scale riparian habitats due to the lack of restoration. Alternative 5 has low and moderate trends for the short and long term, respectively. Although Alternative 2 would provide for more protection of riparian habitats, the lack of active restoration and fragmentation of terrestrial habitats would result in a low transition to healthy landscapes.

Risk reduction to human life and property from wildfire in the urban/wildland interface was a key variable for assessing healthy landscapes. Alternative 1 focuses on commodity elements, Alternative 2 on commodity elements with riparian and old forest protection, and Alternative 5 on economic efficiency. This would increase fragmentation of landscape mosaics, and would not focus on fuel conditions in the interface areas or on representation of disturbance regimes appropriate to healthy landscape systems. Therefore, there would be low or no levels of risk reduction under Alternatives 1, 2, and 5, in the short term; and in fact, it is

anticipated that long-term risk under these alternatives would actually increase. In direct contrast, Alternative 4 focuses on fuel conditions in the interface areas and on representation of succession/disturbance regimes to reduce vulnerability to wildfire, resulting in high levels of wildfire risk reduction in the short and long term. Alternative 3 would have moderate and high transition levels for the short and long term, respectively. Alternative 6 would show low ability to achieve healthy landscapes in the short term, but would improve to high in the long term. In the short term under Alternative 7, current risk conditions would increase because reduced active wildfire suppression efforts would be coupled with continued increase in high-risk fuel conditions on lands near reserves. Although as wildfires reduce fuels, the long-term risk would decline and the transition to healthy landscapes would increase to a moderate rate. This would occur at a very high cost of wildfire suppression, risk to homeowners, and severity of disturbance effects.

Healthy landscape system response for **desired human commodity values** (such as timber products and livestock forage) is a paradox. The short-term transition to healthy landscapes with regard to commodities would be high under Alternative 1 and moderate under Alternatives 2, 3, and 4. However, because landscape relationships would become imbalanced, in the long term the availability of these commodities would decline and the trend toward healthy landscapes would drop to a moderate rate for Alternative 1 and low for Alternative 2. In the short term, Alternatives 4 and 5 would produce a moderate rate of trend toward healthy landscapes, primarily as an offshoot of restoration activities. In the long term, Alternative 4 would transition to a high rate as conditions become balanced and commodity flows are produced with only low to moderate levels of restoration. However, Alternative 5 would decline to moderate as an imbalance develops in areas with low productivity and low restoration emphasis that are adjacent to areas where commodity production is a priority. Alternative 3 is moderate in both short and long term because of moderate levels of restoration and emphasis on connectivity. Alternative 6, with a short-term low trend, would increase to a moderate level in the long term. In the short and long

term, Alternative 7 would rank low in its ability to achieve healthy landscapes with regard to commodity production.

The production of **desired human amenity values** (such as scenic values, clean air and water, and recovery of rare habitats) in healthy landscape systems is almost directly opposite to the production of commodity values for Alternatives 1 and 2. Alternatives 3 through 7 display varying levels in ability to produce a sustainable flow of amenities. Alternatives 1 and 2 would respond with low ability to achieve healthy landscapes in the short term and would actually result in a long-term decline of amenity values. Alternative 7 would sustain moderate levels of amenity values in the short and long term. Alternatives 3, 4, and 6 would produce only a moderate flow of amenity values in the short term, because many restoration activities (such as prescribed fire, extensive thinning, and road closures) can detract from amenity values. Alternative 3 would remain moderate in the long term because of lower investment in restoration. In the long term under Alternatives 4 and 6, as more landscapes become native in appearance, high levels of amenity values would be available with only low to moderate levels of restoration.

Summary

Achieving a healthy landscape system, as measured by the 20 variables described above, is much like having a mutual fund made up of 20 stocks. At a landscape level all variables contribute to the mutual fund by improving the ability of management activities to work with the ecological tendencies (causes and effects) of landscapes. This results in ecological cause-and-effect relationships among the human, hydrologic, carbon-nutrient, food web, and evolutionary systems that maintain the complexity of native and desired non-native elements, functions, processes, and patterns. Any one of the variables (the stocks) may have little influence on landscape health (the mutual fund) when considered independently, but great influence when considered with all the other variables in the context of ecological cause-and-effect. In comparison, the rate of return on a mutual fund is exponentially higher when all variables are contributing. In contrast, if one

variable is dysfunctional, it may cause an exponential decline in the combined rate of return.

The opportunity to simultaneously achieve the ecosystem management goals in Chapter 3 using the lowest long-term investment in restoration and mitigation, appears to be highest with alternatives that have landscape patterns that are becoming consistent with their biophysical succession/disturbance regimes, soil disturbance and exotic species invasion are decreasing, landscape-scale terrestrial and riparian habitats are maintained, fire risk in the wildland interface has been reduced, and commodity and amenity

values are provided. Thus, Alternatives 1 and 2 would provide no or low ability overall to achieve healthy landscape systems in either the short or the long term. Alternative 3 would show moderate ability to achieve healthy landscapes in both the short and long term. Alternative 4 would have a moderate rating in the short term and a high rating in the long term. Alternative 5 would have a low ability to achieve healthy landscapes in the short or long term. Alternative 6 would have a low rating in the short term but a high rating in the long term. Alternative 7 would have low ability to achieve healthy landscapes in the short term and would show a moderate trend toward healthy landscapes in the long term.

Effects of the Alternatives on Human Uses and Values

Assumptions

The following assumptions were made by the SIT and the EIS Team:

- ◆ Production relationships were assumed as needed to translate management direction

and proposed activities into outputs (also referred to as benefits) useful to conduct an effects analysis. This analysis assumed that: harvest acreage midpoints from the activity tables (Tables 3-6 and 3-7) can be multiplied by simulated volume-per-acre to estimate future timber harvest amounts; that rangeland improvement, livestock management and related activities together with management direction can be used to estimate changes in livestock production; and that direction for changes in road density can be used to estimate shifts in recreation supply, which in turn can be combined with expected changes in recreation demand to estimate future recreation values. It is understood that these are broad-scale estimates used to

Summary of Key Effects and Conclusions

- ◆ Alternatives involving substantial change from current direction, especially if different from conventional management strategies, would likely be less predictable in their outcomes in the short term. In the long term, predictability would improve as experience is gained and new strategies are proven effective. Alternatives 4, 6, and 7, which emphasize restoring ecosystems by managing for more desirable and predictable disturbance regimes, would likely experience less short-term predictability in the delivery of services so that long-term predictability is improved. Alternatives 1 and 2 may be more predictable in the short term but would result in future disturbance regimes that are less predictable. Alternatives 3 and 5 may lie somewhere in between.
- ◆ Active restoration actions at the wildland-urban interface to reduce fire-related risks may increase risk of unintended disturbances in the short term. This would apply especially to Alternatives 4, 3, and 6. With successful restoration results, long-term risk in these areas should drop below current levels. However, a policy of lowering risk at the wildland-urban interface through public investments by the Forest Service and BLM may encourage more private investments and incursions in this zone, which could further increase risks to people and property.
- ◆ The current trend in livestock grazing shows a decline of 7 percent per decade. Only Alternative 5 would be expected to lessen this decline. Alternatives 2, 3, 4, and 6 would show a slight additional decline, with little difference among them. Alternative 7 would show the greatest decline because of restricted livestock grazing in reserves.
- ◆ Alternatives 1, 3, 4, 5, and 6 would show a first decade increase in timber volume harvested relative to the past few years. All alternatives would produce less than the 10-year average harvest level. All alternatives would show harvest volume outputs less than the combined National Forest allowable sale quantity value.
- ◆ Alternatives 3, 4, 6 and 7 would establish an extensive network of Riparian Conservation Areas (RCAs) that would likely result in a reduction in the suitable timber base and long-term sustained yield on National Forests. The extent and configuration of RCAs could also constrain operations in areas available for timber production and forest areas targeted for restoration treatments.
- ◆ Planned restoration activities would generate jobs — fewer than wood products manufacturing but more than ranching. Alternatives 4, 3, and 6 would concentrate a larger proportion of total restoration investments (and jobs) at the wildland-urban interface (generally areas with high socio-economic resiliency) than other alternatives. It is inferred that economically vulnerable areas (low socio-economic resiliency) would benefit proportionally less (in terms of jobs) under these alternatives.
- ◆ Recreation opportunities on Forest Service- and BLM-administered lands in the project area would not vary measurably by alternative, but some trends are evident. A slight shift would be expected from primitive-type use to roaded natural-type use where areas with very low road densities experience more road development. This outcome is most likely in Alternatives 1 and 5. There could be a small reduction in dispersed roaded recreation caused by road density reductions in Alternatives 3, 4, 5, and 6, with a substantial reduction in Alternative 7. There could be reduced opportunity for water-based recreation because of potential access restrictions associated with new standards for RCAs, especially in Alternatives 3 through 7.
- ◆ Changes in the economic resiliency of counties or communities resulting from implementing alternatives cannot be reliably predicted at this broad scale. The current economic vulnerability of counties can be determined and used to infer potential future effects. Areas identified as economically vulnerable (using a measure like socioeconomic resiliency) would benefit most economically from more management activities and from concentrating activities in these areas. Alternatives 1, 3, and 5 may be most responsive to this need. Economically vulnerable areas are expected to bear the most social and economic costs of changing land management strategies because they tend to be more economically reliant on employment in natural resource industries.

represent the intent of alternative themes and are not supply schedules.

- ◆ Employment generated from Forest Service and BLM management can be calculated from the estimated outputs (timber volume, livestock production, recreation value) or the amount of activity from activity tables (restoration activities), as appropriate. The former multiplies a ratio of jobs per unit of output times quantity of output, while the latter multiplies a ratio of jobs per million dollars spent times the total amount spent, assuming a constant capital-to-labor ratio.
- ◆ Alternative 1 is assumed to represent management direction in current Forest Service and BLM land use plans. Alternative 2 is used as a second No Action alternative to provide a modified current baseline that incorporates interim direction from PACFISH, INFISH, and Eastside Screens. It is assumed that Alternative 2 provides the most accurate basis for assessing the amount of change from current management predicted to result from the other alternatives. It is recognized that there are substantial differences in the management direction and implementation record among the many land use plans currently in effect throughout the project area.
- ◆ The Social Science staff of the SIT assumed that an evaluation approach using panels made up of experts and interest groups and conducted according to Social Impact Assessment methods could provide a basis for a social effects analysis.
- ◆ The effects analysis presumes that ICBEMP standards will be followed and necessary steps taken to achieve objectives.

Causes of the Effects on Human Uses and Values

The expected outcomes or effects of implementing alternatives are estimated based primarily on the following factors:

- ◆ The vulnerability of counties and communities to adverse effects on their economic and social well-being from

changes in use of Forest Service- and BLM-administered lands. Vulnerability with regard to counties is primarily assessed through a measure of socio-economic resiliency, although economic diversity and dependence on timber and rangeland resources are also employed. Vulnerability of communities is assessed through a measure of dependence of National Forest timber harvest and geographic isolation.

- ◆ The amount, type, and location of activities (Tables 3-6 and 3-7) prescribed to change existing conditions to those described by the goals, objectives, and desired range of future condition (DRFC). Most important to the effects analysis are the acres of timber harvest, forest stand density reduction (thinning), prescribed fire, road management, watershed restoration, and livestock and rangeland management.
- ◆ The standards that provide specific regional direction for management prescriptions and processes where judged necessary to achieve objectives. Prescriptive standards most important to the effects analysis are those that influence timber harvest (area available and management intensity), livestock grazing, road access, and management of riparian conservation areas.

Methodology: How Effects Were Estimated

Important sources for the effects evaluation in Chapter 4 include two documents produced by the Science Integration Team (SIT): *The Evaluation of Alternatives* (Quigley et al. 1997) and the *Assessment of Ecosystem Components* (Quigley and Arbelbide 1996b). More specifically, this evaluation blends the findings of the Economics and Social Science staffs of the SIT with additional analysis and interpretation provided by the EIS Team.

Economics Science Evaluation

The SIT's Economics Staff evaluation estimated the amount and value of a set of outputs expected to be produced from the seven alternatives. Outputs included livestock

produced, timber volume harvested, the value of recreation used, and the existence value of unroaded areas. Because of data limitations, unroaded values were not used in the effects evaluation. The number of jobs generated by livestock, timber, and recreation outputs also was estimated. An analysis of economic resiliency, together with predicted employment effects, was used to address economic well-being, including predictions of changes to county economic resiliency. Economic benefits produced from the alternatives were analyzed in the context of the larger project area economy to determine the regional importance of planned outputs. A limited evaluation of the economic efficiency of alternatives was done by comparing total willingness-to-pay values for the four measured outputs. The distribution of costs and benefits also was addressed.

Social Science Evaluation

The SIT Social Staff evaluation was based primarily on information collected through a panel process set up to support a Social Impact Analysis. Three panels were conducted. Two separate panels for the two EIS planning areas consisted of a variety of interest groups, consultants, college professors, county commissioners, sociologists, community development specialists, and state representatives. The third panel consisted of representatives from 14 tribes located in the project area. Social impact analyses are usually conducted for more site-specific projects where the scope of activities and their effects can be understood. This broad-scale plan could not provide the understanding panelists felt they needed to evaluate social effects, except in the broadest terms. Also, inadequate information about how plans would be implemented, what the economic impacts might be, and questions of the financial and operational feasibility of the alternatives, impeded attempts by the panel to estimate social effects.

EIS Team Effects Evaluation

As noted, factors used to estimate effects included objectives, standards, existing conditions, and prescribed management activities. The standards and activities deserve further elaboration because they guide

management strategies and treatment priority by forest and range cluster, in effect establishing how effects on human uses and values can be interpreted. Activities were assigned to clusters according to estimates of what was needed to move from current conditions (a product of the interaction of ecological potential and management history) to the desired range of future condition. Forest and range clusters are large and include numerous Forest Service and BLM administrative units, counties, and communities. Although clusters are groups of contiguous sub-basins, this is not always the case; sub-basins belonging to the same cluster may be found on opposite sides of the project area. An implication of this 'broad-scale' approach is that neither the activities nor outcomes expected to result from the activities can be 'placed' in or near a particular county or community. This means that local effects on human uses cannot be evaluated. The approach used by the EIS Team to overcome this spatial limitation was to infer potential effects of implementing alternatives from an analysis of current conditions. This approach identifies counties, communities, and occupations that may be economically or socially vulnerable to changing agency land uses. The timber and forage importance index, isolated timber dependent communities, and county social and economic resiliency measures are the types of information used to assess current economic and social vulnerability.

While aware of the spatial limitations of a broad-scale evaluation of alternatives, Alternatives 5 and 7 do offer slightly more 'place' orientation than Alternatives 3, 4, and 6 — Alternative 5 through priority use areas and Alternative 7 through designation of reserves. Alternatives 1 and 2 depart least from existing strategies, so the location of activities should be somewhat like current experience.

A set of evaluation criteria was chosen to measure how well the alternatives achieve the goals described in Chapter 3 of this Draft EIS. A set of variables considered most relevant to each evaluation criteria was used to explain and discuss effects. The choice of variables came from ICBEMP science findings, issues raised in ICBEMP scoping, and conditions described in Chapter 2.

For human uses, evaluating effects involves

more than objectively measuring expected outcomes. The relative desirability of an alternative varies for each individual, interest group, or government entity depending on personal values, occupation, economic status, and the degree to which people associate their welfare with management choices on Forest Service- and BLM-administered lands. For example, the effect of alternatives on the quality of life experienced by project area residents is expected to differ among those living in urban and growth counties compared those living in rural, isolated, and sparsely populated counties.

Effects on Annual Level of Goods and Services

All outputs were analyzed for the next ten years (the short term). Rough projections of what might be provided after 50 years (the long term) are discussed where possible. Because the Draft EIS is not spatially explicit, the effects on specific communities or counties from changing supply could not be predicted. However, inferences about county-level effects were made where reasonable. Annual supplies of benefits are averages of decade projections.

Benefits Expected from Alternatives

Measured Benefits

While 'goods and services' potentially represent a large array of priced and unpriced benefits provided from Forest Service- and BLM-administered lands, three major outputs are quantified here:

- ◆ livestock animal unit months (AUMs), representing the number of domestic livestock fed on Forest Service- and BLM-administered rangelands;
- ◆ acres supplied in each of three recreation opportunity spectrum (ROS) classes, which are a proxy for the supply of 12 major types of recreation use;
- ◆ wood volume produced from timber harvest

and vegetation management actions for each alternative, measured in billion board feet (bbf).

Table 4-50 displays the annual quantity of outputs and their estimated value in dollars for each alternative. Discussions that follow address how outputs were determined, the uncertainty associated with output production, and other factors relevant to interpreting effects of this production.

Unmeasured Benefits

In addition to the three measured benefits, other benefits would be provided through management activities (referred to here as 'restoration activities') designed to move current ecosystem conditions to the desired range of future condition developed for each alternative. The economic value of ecological outcomes cannot be reliably estimated, although if successfully produced they provide valuable human benefits. In the absence of an economic value for these outcomes, the restoration activities (inputs) in Table 4-51 represent intent to produce these ecological benefits. The ecological outcomes (both positive and negative) predicted from restoration are described under other subject headings in this chapter. The evaluation criteria, representing the full accounting of human goals for this Draft EIS, are the standard for judging the adequacy of these outcomes to meet human needs. In addition to ecological benefits, restoration activities also make an important human contribution through generating employment and economic activity.

Calculating Outputs

Livestock AUMs

Production Levels

Cattle production was calculated by adjusting current production according to the expected effects of implementing the objectives, standards, and land use priorities associated with each alternative. It is expected that investments in rangeland condition could improve the amount and quality of forage available for livestock grazing in the future, although this was not modeled. Compared to total livestock production project area-wide (measured by AUMs), the changes projected for

Table 4-50. Measured Annual Benefits for the First Decade, Eastside Planning Area.

Outputs	Measures	1a ¹	2a ¹	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Livestock	AUMs	—	—	684,970	673,617	681,186	673,617	730,383	673,617	378,437
	Value (\$ million)	—	—	6.2	6.1	6.2	6.1	6.7	6.1	3.5
Recreation (ROS Acres)	Primitive and Semi-Primitive	—	—	4,452,000	4,561,800	4,561,800	4,561,800	4,524,300	4,561,800	4,561,800
	Roaded Natural	—	—	7,316,400	7,206,600	7,206,600	7,206,600	7,244,100	7,206,600	7,206,600
	Urban/Rural	—	—	100	100	100	100	100	100	100
	Value (\$ million)	—	—	1,322	1,325	1,325	1,325	1,321	1,325	1,325
Timber ²	Billion Board Feet ³	0.887	0.393	1.65	0.792	0.724	0.765	0.923	0.625	0.313
	Acres Harvested	100,000	45,000	165,000	75,000	102,500	110,000	125,000	90,000	28,000
	Value (\$ million)	246	109	441	244	201	199	217	190	121

¹ Scenario 1a and 2a were added to more correctly portray management direction appropriate for Alternatives 1 and 2 using 'volume offered (from TSPIRS)' instead of 'volume harvested' as used for the original Alternatives 1 and 2 (which are also displayed here for reference and consistency).

² The summed ASQ for all national forests under current land management plans in the Eastside planning area is approximately 1.21 billion board feet.

³ BLM-administered lands contribute about 0.1 billion board feet annually in the Eastside planning area.

Abbreviations Used in this Table: AUM = Animal Unit Month; ROS = Recreation Opportunity Spectrum

Table 4-51. Annual Restoration/Management Activities, Eastside Planning Area.

	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Forest Prescribed fire (acres)	38,000	38,000	112,500	162,500	105,000	147,500	118,000
Non-commercial tree thinning (acres)	47,500	50,000	75,000	90,000	72,500	85,000	30,500
Forest road closures (miles)	322	716	1,090	1,156	747	909	1,106
Gated/bermed (miles)	273	322	436	347	299	454	995
Obliterated ¹ (miles)	45	386	600	717	411	364	77
Decommissioned ² (miles)	3	7	54	92	37	91	33
Rangeland road closures (miles)	247	247	264	716	335	515	672
Range prescribed fire (acres)	21,000	21,000	37,000	41,500	27,000	42,000	36,000
Livestock Mgmt ³ (acres)	42,000	123,000	123,000	206,000	114,000	206,000	76,000
Range Improvement ⁴ (acres)	28,000	28,000	83,000	113,500	63,000	70,000	28,000
Riparian Improvement ⁵ (acres)	4,000	4,000	10,000	11,000	10,000	11,000	8,000
Watershed Restoration (acres)	22,300	36,000	36,000	71,000	57,300	62,500	22,300

¹ Ripping road surfacing, seeding roadbed, and removing culverts.

² Reshaping of road prism to slope contour.

³ Includes grazing system, season of use, type of livestock, herding, and deferment.

⁴ Weed control, tree and brush control, fencing, and water developments.

⁵ Road management, seedings and plantings, in-channel restoration, fencing, and livestock management.

Forest Service- and BLM-administered lands under the seven alternatives would be very small. Even Alternative 7, which would show the greatest decline in federal AUMs in the short term (a 50 percent decrease), would cause only a 3.5 percent reduction in the total number of AUMs produced when all livestock production in the project area is considered. Of course, ranching operations most dependent on grazing federal range allotments would likely feel a more substantial effect from changes in federal grazing.

As noted, the greatest change in livestock AUMs grazed on Forest Service and BLM-administered lands would be under Alternative 7. The smallest change would be a 3.5 percent decline estimated for Alternative 5. Change in AUMs grazed would differ little among Alternatives 1, 2, 3, 4, and 6, with estimated declines of 9.5, 12.4, 10, 11, and 11 percent respectively. Table 4-50 shows the estimated livestock AUMs produced under each alternative.

Predictability and Sustainability of Livestock Production

Although predicted changes in livestock production were drawn in part from livestock-related activities (Tables 3-6 and 3-7), these activities were prescribed to improve ecosystem conditions, not to achieve a livestock production objective. Improving ecological conditions on rangelands depends more on grazing systems, season of use, and improvements than on strictly controlling the number of livestock grazed; however, changes in livestock production could result from implementing new operating standards and the rangeland restoration activities proposed in the alternatives, especially in Alternatives 3, 4, 5 and 6. New direction in Alternatives 3 through 7 would introduce additional uncertainty compared to continuation of current practices. Uncertainty could arise from changing the cost structure of private livestock operations or through questions of how agencies will implement new standards and administer (and pay for) the expanded rangeland restoration activities. Changing the way permittees use

and invest in their allotments would entail substantial planning, negotiation, and administration by the agencies, potentially reducing the predictability of outcomes in the short term.

Since it is not practical to estimate the exact cost effects on livestock operators or agencies from rangeland restoration activities, a ratio of acres treated per AUM produced was calculated for the four rangeland activities by alternative (Table 4-52). The ratio for Alternatives 2 through 7 were compared to Alternative 1 to represent how operator costs might increase for each alternative. This approach attempted to incorporate both increased costs and changes in production.

If short-term uncertainty for livestock operators is assumed to increase with the implementation of new standards and management activities, then the order from most to least predictable would be Alternative 1, 2, 5, 3, 7, 6, and 4. Alternative 4 would show the most change, with activity levels 2.5 to 5 times higher than existing levels. Short-term effects on the ranching industry that could result from proposed changes include: financially marginal operators departing, financially stable operators becoming marginal, and larger or more efficient operators buying out smaller or less efficient ones. In the long term, predictability for Alternatives 3 through 7 should improve as new allotment management plans are completed, rangeland conditions improve, and operators adjust to new direction.

There would be little difference in the distribution of livestock production among alternatives, other than Alternative 7, which would essentially eliminate livestock grazing in the reserves. The distribution of livestock production is relatively predictable because

federal grazing allotments are well-established. Rangeland restoration activities could lead to local redistribution of livestock grazing to different places or to grazing the same places at different times.

Recreation/ROS Acres and Scenery

ROS Acres and Predicted Recreation Use

The prediction of future recreation use on Forest Service- and BLM-administered lands, in type and dollar value, was based on the interaction of supply (represented by the number of acres in each ROS class) and demand (human population growth and demographic change). Very little change in ROS classes would be expected in the short term, and change thereafter is modest. Population growth would be the dominant factor affecting recreation uses during the next ten years, both in type and amount. In the longer term, demographic changes (especially an aging population) will become increasingly important.

Recreation Opportunity Spectrum (ROS) is built on road access, amount of development, density of recreation users, level of facility development, and management uses. It does not account for the main attractions that draw people to recreation settings, such as water, fish, and wildlife. For ICBEMP analysis, numerous ROS classes were collapsed into three categories:

- ◆ *Primitive/semi-primitive* (primitive, semi-primitive non-motorized, and semi-primitive motorized classes)
- ◆ *Roaded natural* (roaded natural and roaded modified)
- ◆ *Rural/urban*

Table 4-52. Increase in Rangeland Restoration Activities Compared to Current, Eastside Planning Area.

	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
	Changes from Current Activity Levels¹						
Livestock Management	Current	(x 3)	(x 3)	(x 5)	(x 2.5)	(x 5)	(x 3.3)
Range Improvement	Current	no change	(x 3)	(x 4)	(x 2)	(x 2.5)	(x 2)
Riparian Improvement	Current	no change	(x 2.5)	(x 2.5)	(x 2.5)	(x 2.5)	(x 3.5)

¹ Multiples of current activities based on a ratio of acres of activity per AUM for each type of activity.

Recreation activities associated with the three ROS classes were grouped into 12 types, each with a different value per user day and a different projection for future use (heavily dependent on changing recreation habits of an aging population). ICBEMP scientists limited the modeling of future ROS acres to predicted changes in road density (modeled by subwatershed). The current proportion of acres in the three ROS classes for the project area is: roaded natural, 59 percent; primitive and semi-primitive, 40 percent; and rural/urban, 1 percent. Only Alternative 5 identifies areas where recreation use would be emphasized (mainly in areas already experiencing heavy recreation use).

Alternative 7 should result in the most change in recreation opportunities because it would limit recreation opportunities in reserves to mostly primitive and semi-primitive types of use. The 40 percent of Forest Service- and BLM-administered lands included in the reserves would not permit most developed and road-based recreation; areas already designated as wilderness or that are essentially undeveloped would experience little change in recreation opportunities under Alternative 7. For the project area, there would be a very small (less than one percent) shift from recreation opportunities provided by the primitive/semi-primitive ROS class to uses associated with natural and roaded ROS classes in Alternatives 1 and 5, but the location of this shift cannot be determined at this scale.

There may be losses in water-based recreation stemming from extensive Riparian Conservation Areas (RCAs) and restrictive riparian management standards that imply access restrictions. Alternatives 2 and 7 would have the most strict (least flexible) approach to RCAs, followed by Alternatives 3, 4, and 6. Alternative 1 has the most flexible approach to RCAs, followed by Alternative 5.

Alternatives 3 through 7 could reduce opportunities for dispersed roaded recreation because of new standards requiring reduction of road densities. This reduction would be less likely to occur with Alternatives 1 and 2. Among Alternatives 3 through 7, Alternative 5 should show the least change, followed by Alternatives 3 and 4. Alternative 6 includes standards that would show relatively more change than Alternatives 3, 4, and 5.

Alternative 7 would show the greatest reduction in dispersed roaded recreation due to limited uses allowed in reserve areas.

Potential effects of RCAs and new road management standards on recreation were not modeled or predicted at this scale and would be more reliably assessed through local planning.

Predicted Changes in Scenery

The supply of scenery in the project area was measured in terms of landscape themes and degree of scenic integrity. Scenic integrity describes how 'intact' a scenic landscape is rather than whether the viewing public are likely to find the scene visually attractive or not. So while scenic integrity is not a measure of visual attractiveness, it is the closest proxy available for addressing scenery. In general, the scenic integrity of Forest Service- and BLM-administered lands in the project area is currently very good. Changes in scenic integrity predicted as a result of the alternatives are shown in Table 4-53.

Timber Volume

Production Levels

Timber outputs displayed in this Draft EIS are based on a simulation of disturbance processes (including timber harvest) from which landscape effects were analyzed. The simulation was unable to exactly model the 'midpoint' harvest acres displayed in Table 3-6, but results were adequate for broad-scale analysis. The simulation provided the volume-per-acre values that were multiplied times midpoint acres to get total volume.

The average National Forest System harvest acres (and volume) for the period 1985–1994 was used to calibrate the simulation harvest rate and became the basis for Alternative 1 and 2 timber outputs. It was later determined that 1985–1994 harvest volume was much higher than the timber program amounts offered for sale under current direction because harvest volume for the 1985–1994 period is inflated by past (higher) sale levels. Timber volume sold is often not immediately harvested, but 'stored' as uncut volume for some period by the purchaser. This provides the purchaser some flexibility (within the limits of the contract) to

Table 4-53. Changes in Scenic Integrity in the First Decade, Eastside Planning Area.

Scenic Integrity Class	1	2	3	4	5	6	7
Very High Scenic Integrity	+	+	+	+	+	+	+
High Scenic Integrity	-	-	++	++	-	-	++
Moderately High Scenic Integrity	-	-	-	-	-	-	-
Moderately Low Scenic Integrity	+	+	—	—	+	nc	—
Low Scenic Integrity	++	+	-	—	++	+	—

(++): Equal to or greater than a 20% increase in category acres.

(+): 0 to 19% increase in category acres.

(nc): no change.

(-): 0 to 19% decrease in category acres.

(—): Equal to or greater than a 20% decrease in category acres.

be market-responsive in their harvest decisions. A result is that annual harvest levels may be quite different than annual sale levels. Harvest rates have exceeded sales for several years as Forest Service timber sale levels have declined. Tying Alternatives 1 and 2 to this model calibration caused an overestimation of timber outputs for these alternatives, resulting in output levels too high to represent current management direction.

To be consistent with the landscape analysis, timber outputs for Alternatives 1 and 2 are still displayed here. However, other timber harvest scenarios ('1a' and '2a') were developed to better represent current timber management direction from land management plans (as amended by interim direction where applicable). These scenarios were used to compare the timber volume currently offered for sale (and jobs later generated from the harvest and processing of this volume) to what would be expected under Alternatives 3 through 7.

Timber volume and jobs associated with these scenarios are displayed in Tables 4-50 and 4-57, later in this section. Jobs associated with the original timber volume estimates for these alternatives are not displayed.

Changes in Log Grades and Harvest Efficiency

Current direction in timber management, represented by Alternatives 1 and 2, stresses efficiency in harvest design compared to other alternatives. These alternatives would be more likely to implement silvicultural prescriptions that emphasize wood production, resulting in the harvest of larger diameter trees and more volume per acre than other alternatives. Even so, timber production efficiency for Alternatives 1 and 2 is well below what might be considered a maximum, since current land management plans (as amended by new direction where applicable) include stringent management direction to protect scenic, aquatic, riparian, soil, and other resource values. Current approaches already make the Forest Service and BLM high-cost producers compared to other forest landowners. Alternatives 3 through 6 would likely implement silvicultural prescriptions that emphasize restoration of more desirable stand structures, cover types, and disturbance regimes. As a result, these alternatives would generally harvest smaller diameter trees and produce less volume per acre. Alternative 7 (outside reserves) would harvest smaller diameter trees and less volume per acre than other alternatives because of standards restricting removal of large trees. The silvicultural prescriptions for timber

priority areas in Alternative 5 would depart somewhat from Alternatives 3, 4, 6, and non-timber priority areas of Alternative 5 in the types of silvicultural prescriptions implemented. Timber priority areas would likely implement prescriptions that emphasize production over restoration, but less so than would be expected with Alternatives 1 and 2.

Shifting management objectives and silvicultural prescriptions from a timber production emphasis to a restoration emphasis would change both the timber product removed from the forest and the cost of removing it. Both log size and volume per acre removed are critical to the profitability of harvest operations and lumber manufacturing. Average diameter of trees removed has been shown especially important to the financial feasibility of a timber sale. The types of silvicultural prescriptions appropriate for achieving the restoration objectives of Alternatives 3, 4, 6, and especially 7, would have a higher risk of being unprofitable (and of going unsold when offered for sale) than would Alternatives 1 and 2. Alternative 5 would lie somewhat in between. An unprofitable (unsold) timber sale would either delay the accomplishment of restoration objectives awaiting better markets for small diameter logs, or shift the restoration work from timber sales to service contracts. Service contracts would be much more costly to the agencies than timber sales where timber sales are an appropriate means to accomplish restoration objectives.

Predictability and Sustainability of Timber and Other Ecosystem Benefits

Acres of timber harvest displayed in the Draft EIS activity table (Table 3-6) did not provide projections of timber volume outputs that could be interpreted as sustainable or predictable by conventional methods. The conventional way to address sustainability in forest management is through the ability to provide a regular or 'sustained' supply of timber volume in perpetuity. This traditional approach, founded in both law and policy, is part of the planning framework used by Forest Service and BLM land use plans that include a timber component. The broad-scale landscape disturbance approach used in this Draft EIS broadens the meaning of sustainability to include all parts of the ecosystem and to

account for the role of disturbance regimes in shaping how the ecosystem changes over time. With this shift, the Draft EIS did not account for the factors upon which conventional sustainability of timber supply is based. To show how the approach to predictability and sustainability change, some key differences between conventional timber planning and the landscape approach used in this Draft EIS are explained in Table 4-54. Sustainability and predictability of timber benefits will be determined when the Preferred Alternative is incorporated into local Forest Service and BLM land use plans.

The distribution of timber harvest volume among alternatives can best be inferred from treatment priorities described in Draft EIS standards together with the proportion of activities assigned to each forest cluster. The simulation of landscape disturbance did not specify timber harvest areas below the cluster and management region level, so the number of acres harvested were predicted, but not the location of the harvest. Evaluating how changes in timber harvest would affect particular communities or counties must await local implementation of regional strategies. A limited exception is the timber priority areas in Alternative 5 which, though broad, could permit some inferences about where timber harvest is more likely to occur.

Objectives and standards developed for Alternatives 3 through 7 would make short-term projections of future timber supply more uncertain. Most influential are those affecting riparian areas, road management, large tree retention, and unregulated harvest. The Forest Ecosystem Management Assessment Team (FEMAT) evaluation eventually led to the Northwest Forest Plan (NFP) alternatives, which included similar new direction. The Forest Ecosystem Management Assessment Team found that "it will be difficult in the future to achieve predictable supplies of timber from federal lands in the owl region (Johnson et al. 1993)." The same can be said for the predictability of timber supplies from the ICBEMP project area. Although uncertainty is highest in the short term, it should improve in the long term (assuming stability in plan implementation).

Table 4-54. Comparison of Planning Methods in Regard to Predictability of Timber Outputs

Projecting Timber Outputs in Conventional Planning	Projecting Timber Outputs in ICBEMP Broadscale Landscape Disturbance Planning
Management intensity and timber harvest rates are based on a formal forest regulation system designed to provide predictable timber volume outputs.	Forest regulation system is adapted to accommodate new landscape management approaches designed to provide more predictable landscape disturbance outcomes.
Sustained yield of wood fiber is used as a formal measure of sustainability based on the premise that sustained yield timber, properly constrained and mitigated, would sustain the underlying forest processes.	Sustained yield of wood fiber is still important, but not as a formal measure of sustainability. Sustainability is more broadly defined to account for ecosystem functions, processes, and landscape disturbance.
Assumes static ecosystems. ¹	Assumes dynamic ecosystems.
Pattern, timing, and type of disturbance designed to support sustained yield of wood in perpetuity by managing the age, size, species, and development of forest growing stock.	Pattern, timing, and type of disturbance designed to support desired disturbance patterns and ecosystem processes and conditions by managing cover types and structural stages across the landscape.

¹ Conventional timber projection methods did not account for rapidly changing conditions. Changes in forest health, natural disturbance events, scientific knowledge, public preferences, and funding have undermined many assumptions used in the present timber projections. The projection of timber outputs under broadscale disturbance planning recognizes that accounting for (and being responsive to) changing conditions limits the predictability of timber outputs.

Effect of Riparian Conservation Areas (RCAs) on the Long-Term Sustained Yield of Timber

The size and distribution of RCAs in Alternatives 2, 3, 4, 6, 7 and parts of Alternative 5 could substantially affect National Forest timber programs (BLM timber production is small compared to National Forest production in the project area). Potential effects would include: the amount of volume available for harvest; distribution of potential timber supply; cost of harvest and transportation; and calculation of the long-term sustained yield (LTSY) and allowable sale quantity (ASQ) required by the National Forest Management Act (NFMA) of 1976.

Forest Service and BLM timber harvest is principally of two kinds. The first kind is part of the 'sustained yield' calculation that provides

LTSY and ASQ (traditional measures of what is sustainable in perpetuity). This 'scheduled harvest' is meant to be most predictable over the long term. The other kind of harvest is that harvest done for resource protection as permitted by NFMA. This is typically 'unscheduled harvest' that may be done apart from sustained yield projections. It is generally less predictable because it is more opportunistic than planned (this potentially applies to much of the restoration harvest prescribed in Alternatives 3, 4, 6 and 7 and parts of 5). The RCAs proposed in Alternatives 2 through 7 would affect both scheduled and unscheduled harvest. Effects of the interim direction described in Alternative 2 are already being experienced on the ground, but much of that direction has not yet been formally integrated into Forest Service and BLM land use plans.

The RCAs have the potential to reduce the size of the suitable timber base and intensity of management applied to forest stands. The suitable timber base encompasses lands on which timber harvest can be regularly scheduled. This base, together with the silvicultural prescription used on these lands, are the primary determinants of long-term sustained yield volume. Thus, the effects on potential timber outputs from implementing aquatic conservation strategies (RCAs and RMOs) derive from both the changes in land base acres and the harvest intensity prescribed on these acres. It is unknown which factor would ultimately have a greater effect on the long-term sustained yield of Forest Service and BLM administrative units. It is likely that the administrative units in the timber priority areas of Alternative 5 would be less affected than units in other areas. Administrative units with much of their land base included in Alternative 7 reserves would likely experience the most change. No attempt was made to estimate the effects of these broad-scale strategies on individual administrative units. Adjustments to long-term sustained yield will be made through land use planning according to the National Environmental Policy Act (NEPA) and to planning regulations under NFMA and the Federal Land Policy and Management Act. Adjustments would vary by administrative unit based on differences in existing conditions and differences between current and new management direction.

Effect of Riparian Conservation Areas (RCAs) on Operational Feasibility

There is another factor affecting timber availability. An extensive network of RCAs (Table 4-55) managed primarily to achieve riparian and aquatic objectives could in some cases render the land between these areas, otherwise part of the timber base, inoperable for commercial timber harvest (including for restoration purposes). This situation arose with the riparian reserves in the Northwest Forest Plan. It caused a reduction in the timber volume expected to be available for sale (the Northwest Forest Plan did not calculate an ASQ, but did estimate what expected harvest volume might be). The FEMAT Report (1993) concluded that “it is difficult to fully capture the impact of these new rules, especially a more extensive riparian protection network, on the

area actually available for timber production.” While Draft EIS riparian conservation areas offer more flexibility than Northwest Forest Plan reserves, similar difficulties can be expected. Because effects vary on a site-by-site basis, it is difficult to predict detailed effects of the RCAs at this broad scale. Also, Draft EIS standards permit modifying RCAs through ecosystem analysis or site-specific NEPA analysis (depending on the alternative) to better fit local conditions if equal or greater protection can be achieved. For this effects analysis, it is assumed that the effect of RCAs on timber outputs (and other restoration activities) would vary in proportion to the percentage of total area involved.

With more area in RCAs, it is more likely that long-term sustained yield and operational feasibility would be affected. The percentages in Table 4-55 are rough averages calculated for forested lands using data from Figure 4-50. The actual percent area may be less where slopes are more gentle, soil is less erosion-prone, topography is less dissected, and trees are shorter than average for the project area. The percent area may be greater where slopes are steeper, soil is more erosion-prone, topography is more dissected, and trees are taller than average. These latter conditions often describe the most productive forest sites and the areas where the effect of RCA harvest restrictions on potential timber volume outputs and operational feasibility would be greatest.

Effects on Permitted Mineral and Energy Operations

Outputs resulting from exploration and development of minerals and energy resources (such as geothermal) on Forest Service- or BLM-administered lands were not estimated. Mineral operations are generally initiated by private entities, not by the land management agencies. Broad-scale effects on mineral and energy exploration and development can only be inferred from agency management direction that may hinder potential operations.

Aquatic and riparian protection under Alternatives 2 through 6 may increase the cost of mining and energy developments by limiting the location (or requiring relocation) of mining operations and facilities (such as mill buildings,

Table 4-55. Total Forested Land Area Encompassed by Riparian Conservation Areas, Eastside Planning Area.

Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
<i>Percentages</i>						
9	22	22	24	18	24	27

settling ponds, sanitary and solid waste structures, overburden piles). These alternatives may require relocating access roads or changing mine design and operation to avoid impacts to riparian areas. Aquatic objectives and standards in Alternatives 2 through 6 have the same potential to affect mining and energy operations.

Aquatic standards in Alternative 7 would affect transportation of chemicals used in mining. Some standards would increase transportation and storage costs to reduce risks of a spill to an insignificant level. The total prohibition on transport and storage of toxic chemicals in watersheds occupied by federally listed threatened or endangered species would effectively eliminate many existing mining operations in large portions of the project area, including operations which have already been permitted in accordance with the Endangered Species Act.

In Alternatives 2 through 7, the projected decreases in road density or prohibition of new roads in riparian areas could result in less access and greater costs associated with mineral and energy prospecting, exploration, and development activities.

The reserves designated in Alternative 7 would result in withdrawal of lands in these reserves from entry and operation under the 1872 Mining Law and the mineral leasing laws. There is currently no authority to do this. If this withdrawal were authorized, there could be substantial economic effects on mineral and energy operations as well as additional administrative burden on the Forest Service and BLM.

Effects on Utility Corridors

All alternatives share an objective to ensure that reliable and buildable utility corridors are available, now and in the future, to serve regional and local energy, communication, and transportation needs, and that essential access for energy repairs and maintenance is available. Restrictions on future siting of transportation and utility corridors are not explicitly addressed in the alternatives, although consideration for findings and direction in the 1993 Western Regional Utility Corridor Study or equivalent studies would be required in all alternatives. There is no direction in this Draft EIS indicating a substantial risk to current or future use of corridors under Alternatives 1 through 7. A related standard requires the Forest Service and BLM to maintain access to these corridors. With this requirement, it is expected that road management actions would not affect access to corridors for maintenance activities.

Effects on Long-Term Wildfire Management and Post-Fire Recovery Costs

Fire suppression and fire rehabilitation costs would likely show little, if any, decrease in the short term because of the amount of time and management action needed to substantially change landscape disturbance patterns. It could take several decades for management-induced changes in fire regimes to be evident apart from normal season-to-season variation in fire weather conditions. Over the long term, noticeable decreases in the acreage of severe wildfire and associated fire suppression and rehabilitation costs should be evident as restoration efforts lead to a progressive shift toward less severe fire regimes. Post-wildfire

watershed rehabilitation costs are correlated with wildfire suppression costs, as both reflect the size and severity of wildfires.

ICBEMP scientists estimated that Alternative 7 would result in the highest suppression and rehabilitation costs, even though neither fire suppression nor post-fire rehabilitation is planned in the reserves. Alternative 7 would pose the greatest short-term risk to increasing fire-related costs because of the potential that a catastrophic fire would escape reserves and demand a very costly suppression response. This risk is highest where reserves are established close to densely populated urban areas. Reserve boundaries could be modified to minimize this risk. An important rationale for using a reserve system is based on the assumption that in the long term, less severe fire regimes would naturally be re-established in reserves. The result should be much lower fire suppression costs in the long term. Alternatives 3 and 4 should result in the lowest cost, predicted to be approximately 50 percent of the cost of Alternative 7 over the long term. Alternatives 5 and 6 are predicted to experience approximately 60 percent of Alternative 7 costs. Alternatives 1 and 2 are predicted to be approximately 75 and 80 percent of Alternative 7 costs, respectively.

Ultimately, predicting specific long-term changes in severe wildfire acreage and the suppression and rehabilitation cost that could result is uncertain. It would depend on the complex interaction of natural disturbance processes, the intensity and location of restoration actions conducted by the Forest Service and BLM, and the management of private and other public lands in the project area. Landscape simulations suggest that an aggressive and well-targeted restoration program would be less costly than relying more on natural processes as proposed in Alternative 7, or through traditional suppression strategies as proposed in Alternatives 1 and 2.

Effects of the Alternatives on National Forest System Inventoried Roadless Areas

Inventoried Roadless Areas are National Forest System lands of 5,000 acres or more characterized by their undeveloped state. The

equivalent BLM roadless areas are termed Wilderness Study Areas (WSAs). Following the nationwide Roadless Area Review and Evaluation (RARE and RARE II) efforts in the 1970s, inventory of unroaded areas resulted in some Inventoried Roadless Areas being recommended for inclusion in the National Wilderness Preservation System. Congress enacted wilderness legislation for a number of areas in Oregon and Washington in 1984, prior to completion of land use plans. No similar legislation has been enacted by Congress for Idaho and Montana, leaving unroaded areas to be allocated to a variety of uses through land use planning. As a result, road development and resource extraction has occurred in some Inventoried Roadless Areas.

The alternatives neither prohibit nor prescribe development of Forest Service Inventoried Roadless Areas or Bureau of Land Management Wilderness Study Areas. The status of these areas remains as defined in current land use plans. Proposed changes to the status of Inventoried Roadless Areas is appropriately addressed through the land use planning process or through new Executive or Congressional direction. Alternative 7, because of the proposed system of reserves, is the only alternative that suggests a need to reconsider the allocation status of Inventoried Roadless Areas in land use plans. Alternative 7 would prohibit road construction in reserves or unroaded areas greater than 1,000 acres, essentially ensuring that the unroaded character of existing Inventoried Roadless Areas would be maintained. Because current Inventoried Roadless Areas are limited to areas greater than 5,000 acres, Alternative 7 would require that unroaded areas between 1,000 and 5,000 acres be identified and mapped.

Effects of Each Alternative on Community Vitality and Resiliency

Economic effects of the alternatives would not be substantial when measured against the project area-wide regional economy. The regional economy is strong, growing, and mostly immune from changes proposed in any

of the seven alternatives. Science findings noted “for most people in the Basin, expansion in other sectors means that the impact of FS/BLM decisions on their employment and income will be negligible (Haynes and Horne 1996).” This is not so for local areas, especially places that are geographically isolated from population centers and not experiencing the economic growth that characterizes the project area as a whole. This is also not so for economic sectors or individual firms that depend most on federal land outputs, such as wood products manufacturing or ranching. While the influence of these sectors on the regional economy is lessened by the rapid growth in other sectors, changes in federal land uses are still important to those economically (and culturally) tied to these industries. As discussed in Chapter 2, the smallest area considered a reasonably complete ‘economy’ is a Bureau of Economic Analysis (BEA) trade area. The BEA economies in the project area are mostly very economically resilient and growing. A focus on these resilient regional economies misses most of the economic concerns associated with Forest Service and BLM land management, which are more local than regional. Where concerns are local, they are as much social issues as they are economic ones.

In Chapter 2, community resiliency was described as a function of population size, economic diversity, attractiveness, amenities, leadership, and the community residents’ ability to work together and be proactive toward change. ICBEMP scientists added population density and lifestyle diversity as important factors, developing a measure of ‘socio-economic resiliency’ for project area counties (Table 4-56). In general, Forest Service and BLM land use decisions have little influence on the factors important to community resiliency. The agencies also have no mandate to set goals for changing community resiliency. However, the Forest Service and BLM can have a role in helping communities achieve their economic goals, which may include economic diversification. Alternatives 3 through 7 include objectives for this purpose.

ICBEMP scientists made an effort to predict how the economic resiliency (diversity) of counties could change for the seven alternatives, but the results were weak. At this broad scale, projections could not account for

most factors needed to predict changes in economic resiliency caused by the alternatives. Effects were predicted by using an assessment of current socio-economic resiliency (adaptability to change) to predict where economic vitality (well-being) might be at risk from changes proposed in the seven alternatives. The dependence of isolated rural communities on National Forest System timber also entered into this approach. The concept of vulnerability is used here as a comprehensive means of addressing how counties or communities might be affected by the alternatives. The discussion of vulnerability is preceded by a discussion of the employment generated by Forest Service and BLM land uses in the project area.

Employment

ICBEMP scientists compared the number of jobs generated from Forest Service and BLM-administered lands to the total number of jobs in the project area (Haynes and Horne 1996). Estimates of Forest Service and BLM-generated jobs were made for four employment sectors: recreation, wood products manufacturing, ranching, and mining. Scientists also estimated the economic importance of wood products manufacturing, ranching, and mining from all sources to the regional economy as a whole. As of 1990, Forest Service- and BLM-administered lands contributed approximately 240,000 jobs to the economy of the project area, or 16 percent the area-wide total of 1,500,000 jobs. Recreation provided by these public lands contributed about 225,600 of these jobs (15 percent of area-wide total jobs), mostly from hunting, motor viewing and day use. Wood products manufacturing, ranching and mining jobs generated from Forest Service- and BLM-administered lands accounted for a combined 14,400 jobs (1 percent of project area-wide jobs). Total employment in wood products manufacturing, ranching and mining from all producers combine to account for only 4 percent of total project area employment. The SIT found that no alternative would change the number of jobs generated from Forest Service- or BLM-administered lands by more 0.1 percent project area-wide.

ICBEMP scientists drew three main conclusions from their findings:

Table 4-56. Socioeconomic Resiliency Rating System, Project Area.

Population Density (persons per square miles)	Economic Diversity	Lifestyle Diversity	Composite Rating	Number of Counties
Very Low (<6)	L, M	L	L	44
Low (6 > x < 11)	L, M	L	L	10
Medium (11 > x < 33)	M, H	M, H	M	20
Medium-High (x > 33)	H	M, H	H	26

Abbreviations used in this table:

L = Low

M = Medium

H = High

Source: From *Integrated Scientific Assessment* (Quigley et al., 1996a)

- ◆ Recreation use generates far more jobs than other uses of Forest Service- and BLM-administered lands.
- ◆ The prosperity of the regional economy, as measured by total employment, is not dependent on employment levels in the timber, livestock, and mining industries. Scientists refer to this as the 'decoupling' of regional economic performance from the manufacturing sector, attributable to rapid growth in non-manufacturing sectors of the economy.
- ◆ Timber, livestock and mining jobs, although a small part of total regional employment, make up a larger portion of total employment in some communities and counties. Changes in outputs from Forest Service- and BLM-administered lands can have substantial economic and social effects in these areas.

These conclusions suggest that differences in Forest Service- and BLM-generated employment among the seven alternatives are very small relative to total employment in the project area. The number of jobs estimated to be generated from Forest Service and BLM management activities for the seven alternatives is shown in Table 4-57.

There has been some controversy over how ICBEMP scientists calculated job numbers with regard to the relative contribution to project area employment among timber, ranching, mining, and recreation-related industries. It

has been asserted that calculation of timber, ranching, and mining employment included only direct employment, whereas calculation of recreation jobs included both direct and indirect employment. The intent of ICBEMP scientists was to measure only direct employment for all sectors, but unlike the timber, ranching and mining industries, direct employment data for recreation is not available. Recreation employment must be distilled from employment in several other sectors, generating the concern that both direct and indirect employment is included. The issue is that the contribution of jobs from the timber and ranching industries are understated relative to the recreation industry. It has also been argued that since jobs in these industries generally pay higher wages than jobs associated with recreation, their economic contribution is more significant when measured by income than when measured by employment. A discussion of wages in Chapter 2 of this document supports this position.

Economically Vulnerable Areas

Areas that appear to be economically vulnerable to changes in the management of Forest Service- and BLM-administered lands have been identified. A number of ways to measure vulnerability (discussed in Chapter 2 of this document, in the *Assessment of Ecosystem Components* [Quigley and Arbelbide 1996b], and the *Integrated Assessment* [Quigley et al. 1996a]). In general, most measures indicate vulnerability in areas that are sparsely

Table 4-57. Estimated Number of Jobs Generated by Forest Service and BLM Activities, Eastside Planning Area.

Alternatives	1	2	3	4	5	6	7
Wood Products Manufacturing ¹	7,007	3,105	5,597	5,944	7,141	4,825	2,401
Restoration and Analysis	2,085	1,515	1,975	2,325	2,265	1,910	975
Ranching	247	243	245	243	263	243	136
Recreation	106,000	108,000	108,000	108,000	106,000	108,000	108,000

This table is based on Annual Productions for the first decade.

¹ Jobs in Wood Products manufacturing for Alternatives 1 and 2 are based on Timber Scenarios 1a and 2a as described in the Effects on Human Uses and Values Section and Table 4-50.

populated, distant from metropolitan areas, not economically diverse, and not experiencing much economic growth. Of these measures, the socio-economic resiliency index (Map 4-1), timber dependent communities (Table 4-58), and counties receiving federal revenue sharing in excess of PILT (Map 4-2) combine to represent areas economically vulnerable to changing management direction on Forest Service- and BLM-administered lands.

Socio-economic resiliency (a composite of population density, economic diversity, and lifestyle diversity) is a measure of adaptability to change. It does not describe current community vitality or well-being, which may be good even where resiliency is low. The premise of the ‘vulnerability approach’ is that changes can result in loss of jobs and county revenues that are not readily made up elsewhere.

Of particular concern is the vulnerability of sparsely populated counties whose ability to support infrastructure and social services can

be affected by how Forest Service- and BLM-administered lands are used. These so-called ‘frontier counties’ (44 in the project area) may lack sufficient population to finance needed services now or in the future. They are not expected to share much in the population growth projected for the project area as a whole. All of these 44 counties are among the 54 determined to have low socio-economic resiliency.

Judging the relative economic effects of the alternatives on people raises a dilemma — whether the number of people affected or number of counties affected should be more heavily weighed. Most of the project area population (83 percent) lives in 46 counties that have medium or high socioeconomic resiliency. Thus, if socioeconomic resiliency is used as an indicator, a relatively small proportion of the project area population is likely to feel economic and social consequences from Forest Service and BLM land use choices. Only 17 percent of the project area population live in counties with

Table 4-58. Isolated Timber Dependent Communities, Project Area.

Oregon	Washington	Idaho	Montana
Lakeview, Paisley, John Day, Long Creek, Mt. Vernon, Prairie City, Burns, Heppner-Kinzua	Colville, Ione, Kettle Falls, Republic	Kamiah, Kooskia, Weippe, Elk City, Grangeville, Bonners Ferry, Moyie Springs, Council, New Meadows	Darby, Eureka, Fortine, Rexford, Trout Creek, Seely Lake, Superior, Thompson Falls

Source: *Assessment of Ecosystem Components in the Interior Columbia Basin Including Portions of the Klamath and Great Basins* (Quigley, et al. 1996b,c).

low socioeconomic resiliency (Figure 4-51). However, this 17 percent lives in 54 counties, each with a responsibility to deliver social services and maintain the public infrastructure (Figure 4-52). While the number of people potentially affected may be relatively small, the number of county governments potentially affected is large.

Socio-economic resiliency, although considered a reasonable indicator of vulnerability at this broad scale, is not a direct measure of potential effects. Effects still depend on how the costs and benefits of changing Forest Service and BLM land uses are distributed across the project area.

Investing in Vulnerable Areas or the Wildland-Urban Interface

An objective common to Alternatives 3 through 7 is to reduce the risk of catastrophic events (especially fire) at the wildland-urban interface. This objective serves two purposes: (1) to reduce risk to people and property at the urban-wildland interface, while simultaneously reducing the trend toward difficult urban fire suppression by land management agencies; (2) to create a low risk 'buffer' around populated areas so that restoration activities in the interior can be conducted with less risk that unintended fire or smoke events will spread to the interface. Another (and potentially conflicting) objective common to these alternatives is to support economically vulnerable areas.

Balancing achievement of these objectives means setting priorities and recognizing the trade-offs. Areas where wildfire risk to humans is highest, if measured by the number of people and structures at risk, are the areas that least need the economic benefits of restoration-generated employment. These areas tend to have the highest socio-economic resiliency and rates of economic growth. Sparsely populated areas that have fewer people and structures at risk tend to have lower socio-economic resiliency. These areas would gain the most economic benefit from agency restoration expenditures.

In evaluating the alternatives, ICBEMP scientists assumed that Alternatives 4, 3 and 6 would concentrate a larger proportion of total restoration investments at the wildland-urban

interface compared to the other alternatives. It can be inferred that economically vulnerable areas would benefit proportionally less under these alternatives. Furthermore, reducing risk for those living at the wildland-urban interface through active management of wildlands can act as an incentive to encourage further development in these zones. The effect could be to decrease the risk on the wildland side while increasing the risk on the urban side.

Areas with High Risk at the Wildland-Urban Interface

The Science Integration Team classified areas according to risk of human ecological interaction (risk to human life and/or property from ecological restoration activities and risks to ecological integrity from human activities) (Map 4-3). This classification would presumably be used to set management priorities for reducing risk at the wildland-urban interface. Areas identified as having *very high risk of human ecological interaction* include: the Walla Walla, Washington to Pendleton, Oregon commuting area, and the Yakima and Spokane, Washington commuting areas. Both the socioeconomic resiliency and economic diversity of these areas are generally high or medium. Of these areas, only the far edges of the Spokane commuting area correspond to isolated timber-dependent communities.

Areas identified as having *high risk of human ecological interaction* include: the Bend to Redmond, Oregon commuting area; the Klamath Falls, Oregon commuting area; areas around John Day, Baker City, and La Grande, Oregon; and the outskirts of Wenatchee and Chelan, Washington. Many of these areas lie in counties with high or medium socioeconomic resiliency and economic diversity. Some do not. The community of John Day was identified as isolated and timber dependent. This area would presumably benefit from restoration activities in Alternatives 4, 3, and 6 meant to reduce risk of wildfire.

Rate of Implementation

Adverse effects on economically vulnerable areas could result from alternatives designed to have a slower rates of implementation or if implementation is slower than planned. Slow or delayed implementation postpones the

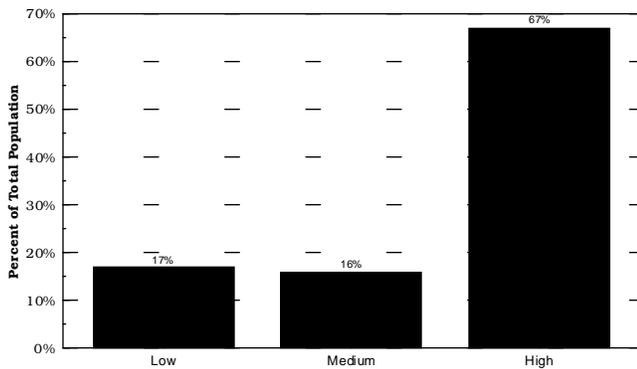
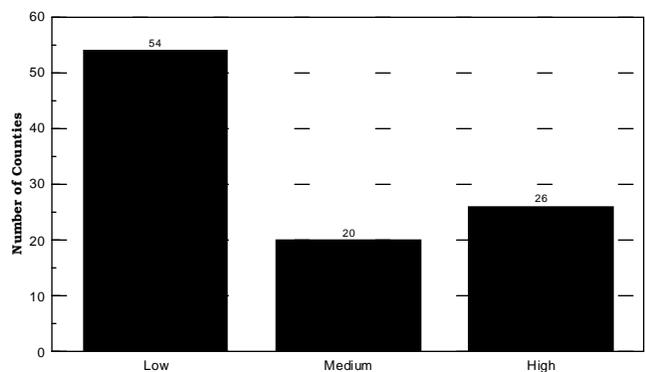


Figure 4-51. Socioeconomic Resiliency, Percent of Population, Project Area.

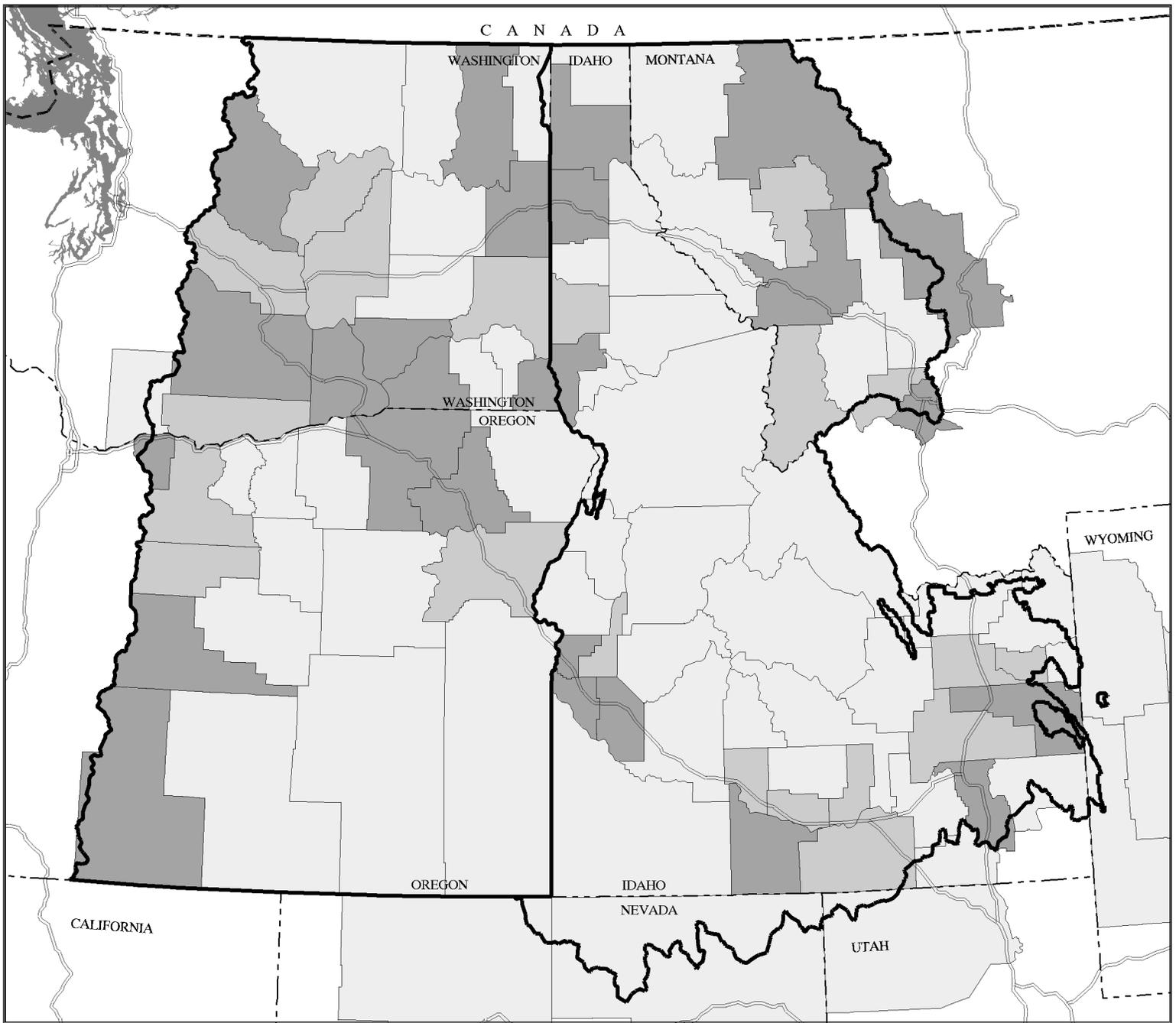
Figure 4-52. County Socioeconomic Resiliency, Number of Counties by Rating, Project Area.



benefits derived from activities. Possible reasons for a slow rate of implementation or unexpected delays include new standards for pre-project ecosystem analysis and new standards for collaboration with tribes, governments, Resource Advisory Councils (RACs), and public interests. How these standards would affect the rate of implementation once a plan was approved is difficult to predict because it depends on the location, amount, and distribution of activities.

Regarding Ecosystem Analysis at the Watershed Scale, the percent of area requiring analysis (which varies by alternatives, see Table 4-59) does not indicate how much would actually be conducted during the next 10 years for two reasons. First, it is not known whether activities would be proposed in areas requiring analysis or in less sensitive areas where ecosystem analysis is not required. Second, it is not known whether activities would be concentrated in fewer watersheds (less analysis) or widely dispersed over many watersheds

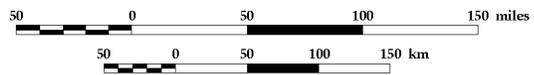
(more analysis). Alternatives 1 and 2 do not require ecosystem analysis. Alternatives 3 through 7 do require it, but with different timing. Alternatives 7 (outside reserves), 5, and 4 encourage rapid initiation of restoration actions early in the decade. Alternatives 3 and 6 encourage ecosystem analysis early in the decade, delaying some of the restoration actions to later in the decade. Alternative 6 has the additional requirement of completing all sub-basin review in the first year. From a risk perspective, it could be said that Alternatives 7, 5, and 4 would take the position that the risks associated with delaying the achievement of anticipated ecological, social, and economic benefits (pending more analysis) are greater than the benefits of additional up-front analysis, at least in the short term. Alternatives 3 and 6 take the opposite position. It is assumed that short-term up-front investments in ecosystem analysis (and slower initiation of activities) in Alternatives 3 and 6 would be rewarded with faster and more effective implementation of activities in the long



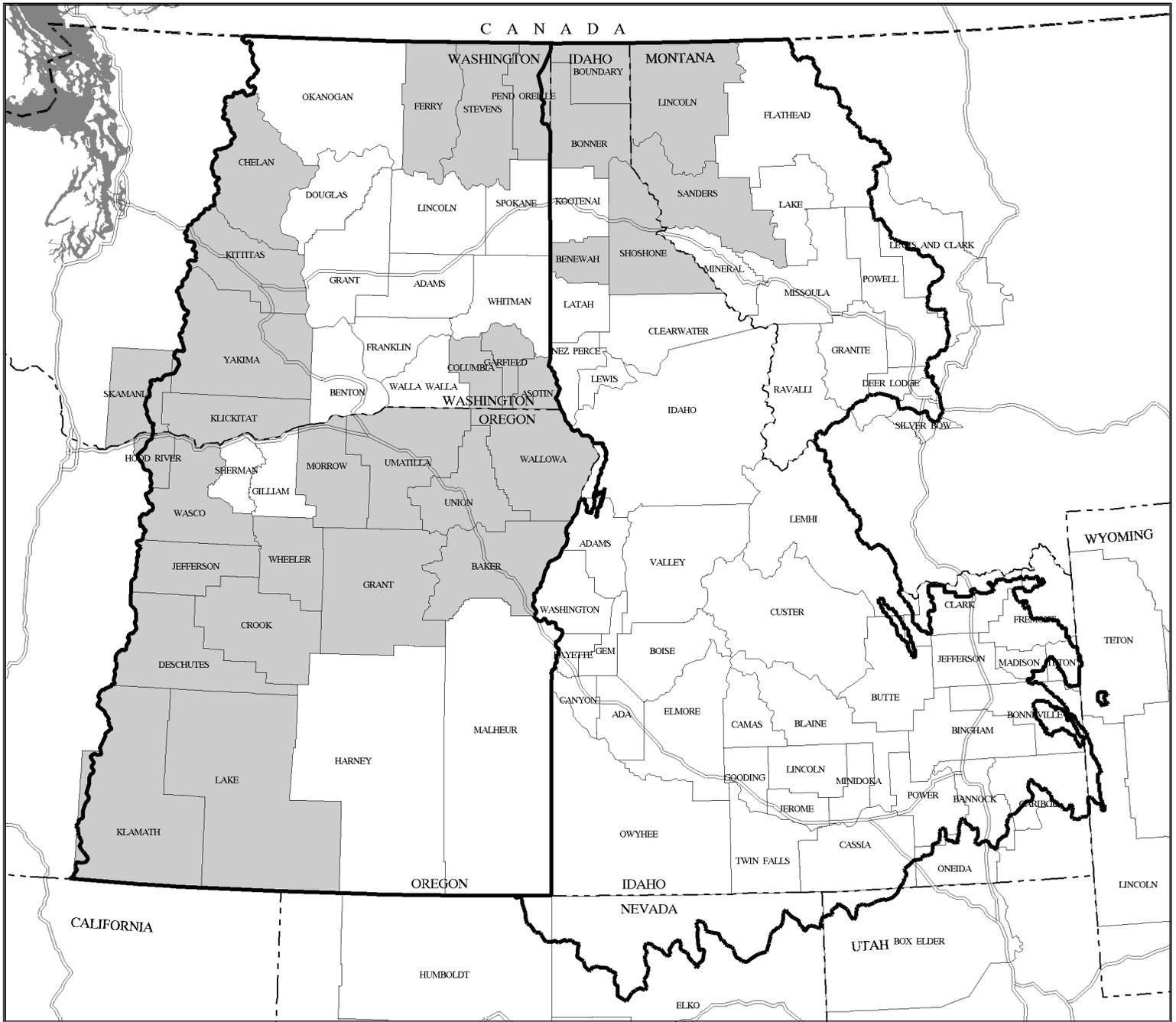
Map 4-1.
Socio-economic
Resiliency Ratings

INTERIOR COLUMBIA
 BASIN ECOSYSTEM
 MANAGEMENT PROJECT

Project Area
 1996



- High
- Moderate
- Low
- County Boundaries
- Major Roads
- ~ EIS Area Border



Map 4-2.
Counties Receiving Payments
from Federal Timber Harvest
in Excess of Payment in Lieu
of Taxes, 1992

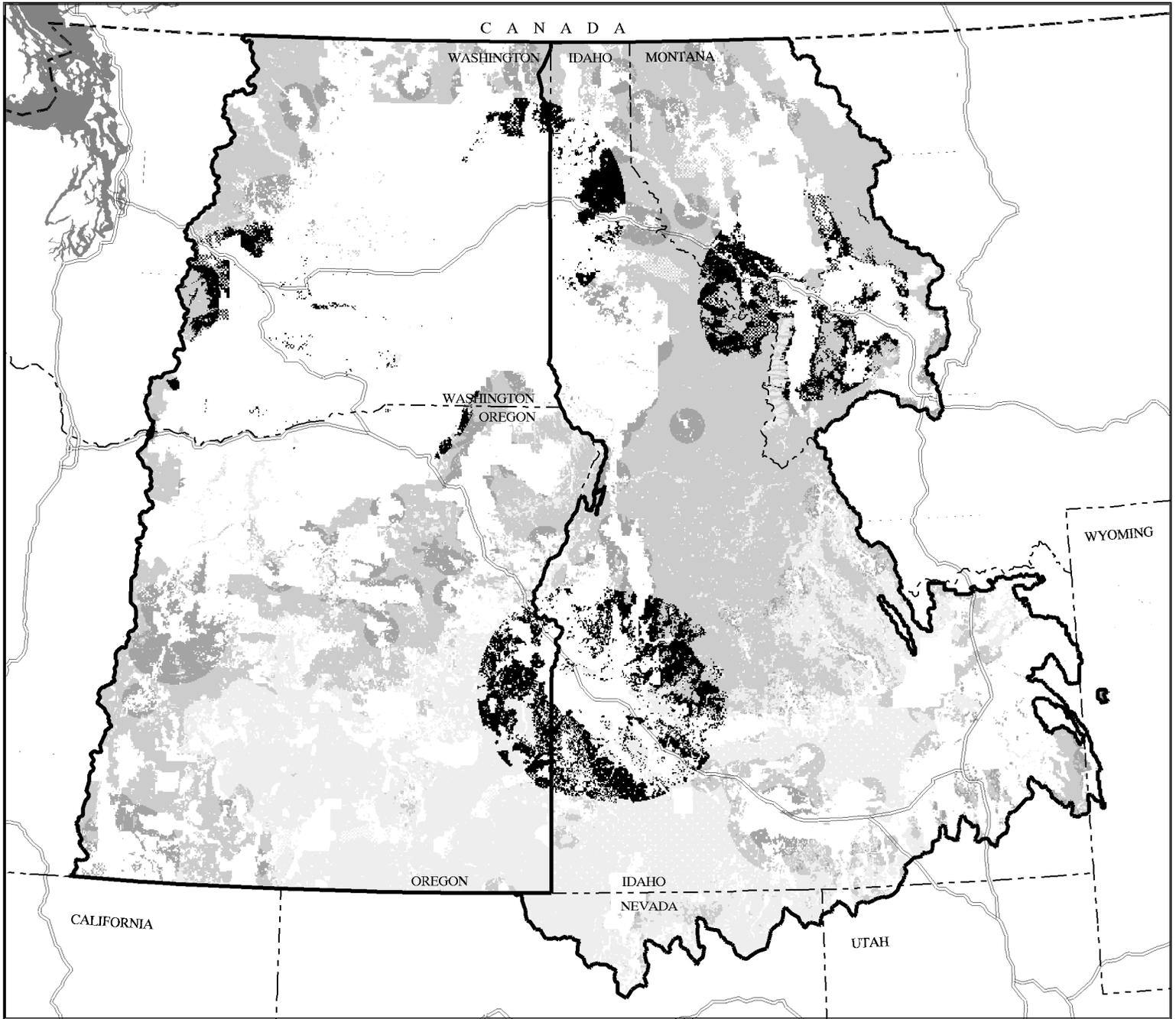
INTERIOR COLUMBIA
 BASIN ECOSYSTEM
 MANAGEMENT PROJECT

Project Area
 1996

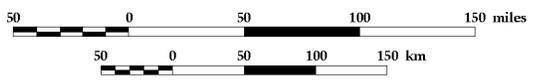


- County Boundaries
- Major Roads
- EIS Area Border

Source: Schmidt 1995



Map 4-3.
Risk of Human Ecological Interaction



*BLM and Forest Service
 Administered Lands Only*

INTERIOR COLUMBIA
 BASIN ECOSYSTEM
 MANAGEMENT PROJECT

Project Area
 1996

- Very High
- High
- Moderate
- Low
- Major Roads
- EIS Area Border

term. Alternative 7 could experience another source of delay—the difficult task of setting up the reserves. Considerable study and debate about final reserve boundaries can be expected.

A slow rate of implementation of timber harvest activities could especially be cause for concern. Slow or delayed initiation of activities, on top of changes in the timber programs experienced since 1990, could pose potential cumulative effects on the wood products industry and counties whose budgets depend on revenues derived from federal timber sales. For example, in the Eastside planning area, the timber sale program fell from 1.6 billion board feet (bbf) in 1990 to 316 million board feet (mmbf) in 1994, largely resulting from Eastside screens and other changes to Forest Service timber programs. Alternatives 1, 3, 4, 5, and 6 would show a first decade increase in timber volume harvested compared to the past few years (Figure 4-53). Firms and workers in the wood products industry that have persevered through recent declines could be permanently affected by slow initiation of activities for those alternatives that would show a first decade increase in timber volume. Temporary mill closures and layoffs can become permanent, resulting in a departure of labor and capital from some rural communities. This may be an inevitable cost of a long-term change in management strategy; however, such losses would represent an unintended consequence of the alternatives if they resulted from a short-term delay in implementing a strategy that would otherwise avoid this outcome. Of course,

mill closures and job losses can occur even with rapid implementation if new management direction shifts harvest out of a mill's supply area (assuming alternative timber sources are not available).

Public Participation and Collaboration

Alternatives 3 through 7 include several objectives meant to improve the participation of tribes, state and county government, federal agencies, Resource Advisory Councils, and public interest groups in the planning, implementation, and monitoring of land management strategies and activities. Some of these objectives refer to helping communities achieve their economic goals. Some refer to improving efficiency in the delivery of goods and services from Forest Service- and BLM-administered lands. Most of these objectives could probably be achieved through current management direction in Alternatives 1 and 2. However, instituting additional direction in Alternatives 3 through 7 should improve agency effectiveness at public participation and responsiveness to public needs. The objectives would not change the different values people hold, but they should improve understanding among the competing interests and improve the public acceptance of management strategies so that plans can be implemented with more consistency and predictability.

Table 4-59. Area Requiring Ecosystem Analysis at the Watershed Scale in the First Decade, Eastside Planning Area.

Alternative	1	2	3	4	5	6 ¹	7
Percentage of Forest Service- and BLM-administered land where Ecosystem Analysis would be required prior to conducting activities.							
Forest Service/BLM	8	8	32	32	15	56	18
Forest Service	15	15	57	51	27	66	14
BLM	0	0	5	10	1	44	22

The actual area requiring Ecosystem Analysis for Alternatives 3 through 7 could be less if activities would not affect species/habitats noted in Standard EM-S8. See Standards EM-S7, S8, S9, and S10 in Table 3-5.

¹ Alternative 6 does not include the large blocks of native rangeland area where Ecosystem Analysis is required under standard EM-S10.

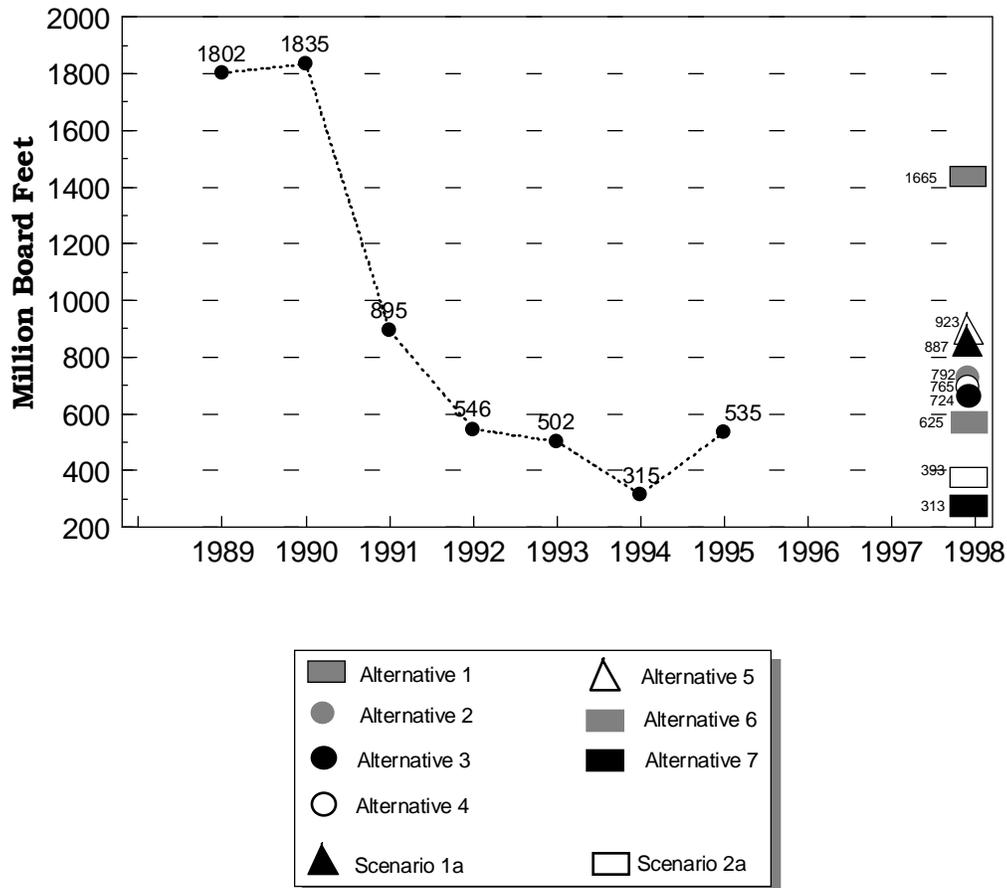


Figure 4-53. Timber Volume Offered, Historical and by Alternative, Eastside Planning Area.

Effect on Quality of Life of Project Area Residents

Understanding Quality of Life

Quality of life is characterized by an array of factors, many of which are not directly influenced by Forest Service and BLM management decisions. Factors include an area's economic diversity, scenic beauty, crime rate, levels of income and employment, employment security, environmental risk (pollution, health hazards, natural disaster), voting rates, infrastructure, medical care,

education, and commercial services. The relative importance of these factors differs for each individual depending on his or her personal values, occupation, economic status, and other factors. Quality of life refers to the satisfaction people feel for the place they live and for the place they occupy as part of it. There is no one comprehensive way to measure how the alternatives affect the quality of life of project area residents. As with most change, some people would receive a disproportionate share of the benefits while others would bear a disproportionate share of the costs. Accordingly, some may feel their quality of life would improve while others may feel a decline. In order to address how residents of the project area may perceive their quality-of-life change as

a result of the proposed alternatives, a few very generalized viewpoints are used for illustration. Viewpoints are offered for two categories of project area residents and two categories of project area counties. As with any generalization, exceptions are easy to find, but these viewpoints reflect the major concerns raised in the scoping process and the issues frequently voiced at public meetings held throughout the project area.

Different Viewpoints on Quality of Life

Individuals

Population growth and demographic change is the most powerful source of change in the project area. Neither population nor demographics is influenced by alternatives (or by federal land management in general). These changes are, however, quite important in shaping public preferences on how public lands should be managed. Population growth, especially from in-migration, causes shifts in economic, political, and social power.

Rural Residents with Traditional Lifestyles

Population growth and demographic change can be troubling to people whose sense of place, social status, or economic well-being is grounded in traditional occupations and lifestyles. This is relevant to public land uses because the economic opportunities and traditional lifestyles for this group are often closely tied to nearby federal lands and to resource industries. People and communities hoping to preserve these traditional lifestyles look to federal land managers to make land use choices that support the lifestyles they value (and that appear threatened by new people, new values, and new money). They appreciate and support efforts to improve ecosystem conditions and reduce environmental risk, but often feel they bear most of the social and economic consequences of trading off commodity production for more ecosystem benefits. They generally feel that a less costly trade-off can be found. For these people, the preference order among alternatives might be Alternatives 5, 3, 4, 1, 2, 6, and 7. Alternatives 1, 2, and 5 would have less restrictive standards, inferring more local flexibility. Alternatives 1, 3, 4, and 5

would have relatively higher output levels. Alternative 7 would likely be seen as too restrictive and unpredictable. The preference order presumes that timber harvest and livestock grazing can coexist with improved protection of environmental values, and that local flexibility may be the best way to accomplish this.

Urban and Newer Rural Residents

For others, population growth and demographic change is adding to their quality of life. For most people in the project area, economic prosperity does not depend on the amount of timber or livestock produced from Forest Service- and BLM-administered lands. Most jobs are found in other sectors. Lumber and meat are readily available at reasonable prices regardless of production levels on agency lands. Growth in rural communities provides improved cultural amenities and economic services that enrich their enjoyment of small town living in the highly scenic western landscape. Many people bring with them outside sources of income not directly tied to the land, and often their relationship to the land is different than that of long-time residents. This is relevant to public land uses because these people value the surrounding federal lands more for scenic, recreation, and aesthetic values. They look to federal managers to make land use choices that do not compromise these values. From this perspective, quality of life is best served by a departure from traditional land uses like logging, livestock grazing, and mining. Preferences among the alternatives would likely hinge on reducing the undesirable effects of these uses. Lower production and strict operating standards may be the preferred approach. From this perspective, the order of preference for some people might be Alternatives 6, 2, 4, 3, 5, 7, and 1, based in part on activity levels and in part on a preference for more detailed standards perceived to lessen risk to environmental values. Alternatives 3, 4, 6, and 7 offer more of these detailed standards. Alternatives 2, 6, and 7 would have relatively lower activity levels. Alternatives 1, 4, and 7 would carry an additional element of uncertainty, though each for different reasons: Alternative 4 may appear too aggressive, Alternative 7 may seem too restrictive and risky, and Alternative 1 has an

unreliable implementation history. Trading off commodity production for less environmental risk and greater ecological benefits may seem a good option since few consequences would be experienced.

County Government

Rural and Frontier Counties

Some county commissioners are concerned about their ability to provide social services and support infrastructure when budgets grow tighter, due in part to reductions in revenue-sharing from the federal lands within their counties. Economists share this concern, especially for sparsely populated counties with low economic resiliency. Some counties are experiencing increases in social distress, caused in part by employment losses in the forest products industry. This distress comes at a time when county budgets are least able to cope with the increased need for social services. Whether or not employment losses stem from changes in federal land use, these counties look to federal land managers to make land use choices that help soften the effects of the changes they are experiencing.

To these counties, the most important quality-of-life issue may be providing adequate services to their citizens. While a majority of counties in the project area probably fit this category to some degree, only a small share of the total project area population lives here. Alternative 5 might be most favored by this category because timber and livestock priority areas overlap many of the most economically vulnerable counties. Alternatives 2 and 3 might follow in preference. Alternative 4 is potentially favorable because of high activity levels, but it is uncertain what proportion of these activities will be concentrated around high-risk urban areas versus in the less populated counties. Alternative 6 would be similar to but less favorable than Alternative 4. Alternative 1, as current direction, has proven unreliable and is generally not likely to be favored. Alternative 7 is unlikely to be favored.

Metro and Growth Counties

For metro and growth counties, the challenge is not adapting to job losses but managing rapid growth. These counties are generally

economically diverse and resilient and becoming more so. These counties might look to federal land managers to make land use choices that reduce the risk of wildfire and smoke to their growing population. To these counties, the most important quality-of-life issue might be the safety of their citizens at the wildland-urban interface and the desire to maintain or enhance the amenity values thought important to continued economic prosperity. While a minority of counties are in this category, a large share of the project area population lives here. This category is likely to favor Alternatives 4 and 6 because those alternatives emphasize aggressive risk reduction at the wildland-urban interface and aggressive restoration in general. This assumes people would accept higher short-term risk from prescribed fire, logging, and other restoration activities near populated areas so that long-term risk is reduced. For those not tolerant of higher short-term risk, Alternatives 2 and 3 might be most attractive. Alternative 5 may be relatively less attractive in the timber and livestock priority areas, but attractive elsewhere. Alternative 1 would involve more risk from wildfire and more risk to aesthetic values from traditional management, and may be less favored for this reason. Alternative 7 would likely be least favored because of the high risk of catastrophic natural events.

Some high growth, economically resilient counties might desire to sustain traditional lifestyles and occupations even though these lifestyles and occupations are not important to their economic well-being. These counties might view Alternatives 2 through 6 roughly the same, recognizing that the trade-offs are counter-balancing.

These example scenarios show the differences in how people and governments perceive quality of life and the role of federal lands in supporting it. Most would agree that everybody's quality of life benefits from improved ecosystem conditions and lower environmental risk. Disagreement arises over who bears the costs and if the trade-offs are fair and necessary. People who count their loss of lifestyle or livelihood as the cost of improved ecosystems may feel a decrease in their quality of life. People who do not bear any direct cost for increased ecosystem benefits are likely to feel their quality of life has improved as a result of management that produces these benefits.

Risk and Uncertainty

Long-Term Predictability

The long-term predictability of outcomes is influenced by at least three major factors. First is the likelihood that natural systems will behave as expected. It is thought that ecological systems with more predictable and less extreme disturbance regimes will provide for more predictable human uses. A consequence of managing for more predictable disturbance regimes in the long term is that short-term predictability is likely to suffer. Secondly, a land use strategy that is more responsive to social values (particularly where written into law, as with the Endangered Species Act) has a better chance of being implemented as planned, conferring a higher predictability for human uses. Third, land use strategies that can be implemented at a cost reasonably in line with historical funding levels are more likely to be funded, providing goods and services for human use as projected in the plan.

Short-Term Predictability

In the short term, predictability is mostly a function of how much a new management strategy departs from what is known, especially from knowledge gained through personal and/or documented experience. Given that Alternatives 3 through 7 include fundamentally new management strategies, both in methods and desired outcomes, short-term uncertainty seems greatest for these alternatives. Detailed standards have been included to varying

degrees in Alternatives 3 through 7 in an attempt to solidify processes for achieving desired outcomes. While this may provide some short-term confidence in implementation, there is insufficient experience with this new landscape disturbance approach to confidently predict that outcomes will be exactly as predicted. Alternatives 3, 4, 6, and 7 also entail risk of escaped prescribed fire, unintended smoke pollution, or scenic degradation resulting from active vegetation management, timber harvest, and prescribed fire at the populated wildland-urban interface. Alternative 3 includes additional uncertainty because of inability to predict how the 'local emphasis' would be implemented. Alternative 5 should offer comparably more certainty because 'priority areas' offer more clarity in management priority and include standards that give managers more flexibility to apply local knowledge, perhaps improving the predictability of outcomes. A potential long-term risk from more local flexibility may be inadequate consideration of landscape-scale conditions. Alternative 7 offers comparative certainty in the management of reserve allocations, but much uncertainty about what will happen to these reserves when left to natural disturbance processes. Alternative 1, built on the premise that sustained yield of timber would sustain the underlying forest processes, was designed to offer a high degree of predictability in the supply of timber. With a rejection of this premise, Alternative 1 is no longer thought very predictable. Alternative 2 might offer the most certainty if interim direction provides for legal compliance. The agencies also have some experience with Alternative 2, so predictability is a little higher. This discussion is limited to comparative predictability of outcomes, not their comparative desirability.

Effects of the Alternatives on American Indians

Assumptions

The following major assumptions were made by the Science Integration Team (SIT) during their evaluation of alternatives:

- ◆ Tribal involvement in decision-making will provide necessary cultural information and tribal feedback, and for the success of actions (meaningful consultation, protection of treaty reserved rights) under each alternative.
- ◆ Protection and/or restoration of habitats and ecosystems by the BLM or Forest Service will provide an important part of the biological requirements of healthy and sustainable ethno-habitats (socially and/or traditionally important habitats). The identification, understanding, and protection of ethno-habitats in consultation with affected tribes will provide for the cultural needs of ethno-habitats. Considering both biological and cultural components of ethno-habitats in land use planning and management will help to provide for healthy, sustainable, and useable habitats.
- ◆ The presence of culturally significant species within evaluated habitats will be used as an index of success in meeting responsibilities to protect trust resources, cultural uses, and habitats (ethno-habitats included).

Summary of Key Effects and Conclusions

- ◆ Generally, Alternatives 3, 4, 6, and 7 would provide the best response to agency need for appropriate levels of government-to-government consultation (see Table 4-60). This is expected given that Alternatives 1 and 2 would not address the inconsistencies in tribal consultation between agency administrative units or emphasize a more effective consultation process as found in Alternatives 3 through 7. Also, Alternatives 5 and 7 would limit opportunities for consultation and access to agency policy-making by providing up-front structure to management decisions through identified priority (Alternative 5) or reserve (Alternative 7) areas. Alternatives 4, 6, and 7 appear to be most responsive to federal trust responsibilities and tribal rights and interests, as these alternatives would provide highest levels of habitat consideration for trust resources.
- ◆ Alternative 5 would provide fewer opportunities for collaboration or consultation with tribes (Table 4-60) because it makes decisions for management emphasis for different areas across the project area.
- ◆ Alternatives 3, 4, 6, and 7 would be most responsive to those issues of interest to tribes (Table 4-61). This includes provisions for ethno-habitats and for culturally significant places and resources in management decisions. The collective reasons for this are based on how these alternatives would provide for: (a) a meaningful agency-tribal consultation process; (b) projections of ecological integrity trends; and (c) overall aquatic and terrestrial projections of identified tribal interest species' habitats rated for viability concerns.
- ◆ Tribes share an over-riding concern and interest for healthy functioning ecosystems in the project areas, and for land management that would provide biophysical trends toward their socially desired range of future condition (Table 4-62). Those alternatives that appear most responsive to such federal trust responsibilities and tribal rights and interests are Alternatives 3, 4, 6, and 7 as they would provide the highest levels of consideration for major ecosystem components, such as aquatic integrity; rangeland and forestland regulation processes, patterns, functions and structures; and hydrologic systems.
- ◆ The alternatives differ in the rate and degree at which trends in ecological integrity would occur due to a combination of factors including: (a) differing rates in application of aquatic and riparian habitat protections as found in Alternatives 2 through 7 and especially Alternatives 3, 4, 6, and 7; (b) method of land management activities; and (c) the primary factors contributing to composite ecological integrity and landscape ecology trends (see the Composite Ecological Integrity section). These would benefit most under Alternatives 3, 4, 6, and 7.

- ◆ Many commonalities exist between Indians and non-Indians in areas of social, economic, political, and federal land managing concerns and needs.
- ◆ American Indian peoples, who have long occupied the project area, possess cultures, concerns, and needs that are different from those of the general public.
- ◆ Although tribes have individual identities and relationships with the U.S. Government, there are a number of common interests and concerns which may be affected by the alternatives.
- ◆ Key issues, held by most tribes, could be used by the SIT as criteria to evaluate the effects of the alternatives on the tribes.
- ◆ A panel session specific to tribes was an adequate approach to provide a social evaluation of the alternative effects on American Indian tribes.

Discussion: Those interests used to develop this section (that is, interests that were discussed during the tribal panel and those raised in ICBEMP meetings with tribes) should be understood to be an artificial collapsing of project area-wide tribal issues and concerns. In fact, the tribal panel resisted the process used in their meetings to identify seven criteria for evaluating EIS alternatives. Thus, the very way tribal issues are displayed and currently understood is perhaps best seen as a beginning point for future agency-tribal relations.

- ◆ Federal agencies' legal authority to carry out trust responsibilities to tribes extends beyond strict legal obligations.
- ◆ Assumptions identified in other subject areas concerning ecosystem health are also applicable to the American Indian tribes' evaluation.

The following assumptions were made by the EIS Team:

- ◆ Each tribe represents a sovereign government dependent upon the U.S. Government to protect and promote its individual right to self-determination. American Indian tribes have interests and

legal rights that must be considered by BLM and Forest Service agencies in the project area regardless of whether the tribes are federally recognized through treaties or executive orders. Those tribes that have had their federal recognition terminated in the past and later reinstated often continue reserved treaty rights and/or legal resource interests, such as water rights in old reservation/allotment lands.

- ◆ Each tribe has separate areas of interest (see Appendix 1-2). Each tribe has rights and/or interests in fishing, hunting, gathering, and livestock grazing on off-reservation public lands. Tribal involvement at broad policy levels is just as significant as at site-specific levels in order to protect tribal rights and interests, which are a baseline for examination of federal trust responsibilities to tribes. Pre-existing rights reserved through treaties or executive orders, and rights to self-determination (including social well-being), have varying legal obligations for agencies. Agencies have responsibilities to restore habitats that have been degraded.
- ◆ Both the tribal panel and many comments from tribal representatives suggest there exists an intrinsic set of relationships between the cultural uses, water-land well-being, and social well-being subject areas, without real conceptual boundaries. An assumption was made that much of the ICBEMP's various functional approaches would parallel primary tribal interest and help build toward an evaluation of effects on tribal trust resources, assets, and interests. (This is explained in the Effects on American Indians/Tribes, later in this chapter). Consequently, the four American Indian subject subsections are interrelated and dependent on the findings of the other subject areas, especially Landscape Ecology, Aquatics, and Terrestrial.

Causes of Effects on American Indians/Tribes

The causes of the effects of the alternatives on American Indians and tribes were differentiated between those effects that were the result of

general historical to current trends for all alternatives, and those that would be the result of management actions from one or more of the alternatives. Causes of effects include the following:

- ◆ Significant long-term historical trends away from natural ecosystem processes, loss of habitat integrity and/or connectivity for some species of cultural significance (ethno-habitats included), decreases in fine-scale biodiversity, and increases in broad-scale ecosystem homogeneity (that is, losses in dynamic and resilient ecosystems to the extent that they adversely affect American Indians and their socio-cultural systems).
- ◆ Vacillation in federal Government policies toward tribes from one of assimilation into American society to that of tribal self-determination and acceptance of multiple cultures as a part of society.
- ◆ Encroachment of American society on American Indian/tribal rights and land-based interests. This has affected the cultural integrity of tribes and traditional communities and caused losses in access to culturally significant species, usable and sustainable species levels, healthy habitat conditions, ecosystem health, and place integrity.
- ◆ Lack of acknowledgment of tribes' legal standing and rights, or needed involvement in policy and management activities.
- ◆ Agencies' lack of understanding of American Indian cultures, interests, issues, needs, value systems, or organizational structures.
- ◆ Inconsistent approach to tribal-agency relations and agency units. There has been a history of few or no federal agency policies until recently to address the many federal legal responsibilities and American Indian/tribal interests.
- ◆ No emphasis on a multi-scale management strategy to address tribal rights, interests, or concerns (for example, no multi-scale prioritization of tribes' culturally significant habitats in agency planning and policies).
- ◆ Forest Service and BLM use of timelines required by NEPA to drive dialogue between tribes and agencies in tribal consultation

activities, to the extent of limiting mid- and broad-scale approaches to agency-tribal relations and resolution of fine-scale tribal issues

- ◆ Tribal concerns for the agency decision-makers' accountability and effects of their actions. This is due in part to a lack of cooperative experiences between agencies and tribes where they work toward shared goals, differences in organizational interests and directions, and a general lack of trust between tribes and agencies.
- ◆ Movement of agency personnel for promotion and advancement. This tends to maintain agency-tribal relationships in the early trust-building stages of development, rather than moving the relationship into a long-standing one based on many positive, mutually beneficial experiences.
- ◆ Insufficient funding to allow the tribes to participate in this process to the extent they wished.
- ◆ Disagreement between tribes and federal agencies regarding the nature of the federal trust role on off-reservation public lands.

Methodology: How Effects on American Indians/Tribes were Estimated

Evaluation Methods for Habitat Trends

To examine effects on culturally significant resources and tribal assets, a general listing of known species of tribal interest was created. Because tribes have maintained a proprietary interest in certain resources and places, which may also have cultural (including spiritual) significance to a tribe, disclosure of this information would breach confidentiality. To a degree, this limited the information available to the SIT and their evaluation. However, there was sufficient information to provide a broad-scale analysis of identified species along with a preliminary evaluation of the alternatives' effects on tribal interests.

A set of project area-wide culturally significant species was identified using both anthropological literature and input from a few tribes. From this preliminary effort to identify species, approximately 190 plant species, 70 animal species, and 35 aquatic species (mostly fish) were identified as having historical or current use. This constituted a list of “tribal interest” species. Recognition was made that this species listing is preliminary, drawn from scientific literature for purely analytical purposes, not specific to a particular tribe or tribal area of interest, and not strongly founded in tribal consultation. However, it was considered an adequate effort to begin identifying species’ groupings and habitats for habitat trend analysis to inform tribes in the project area about habitat conditions and general trends. Such information was considered necessary to address habitats of traditional and social importance (ethno-habitats) and species population trends.

The list of culturally significant species was then reviewed to identify core species of importance, for the sole purpose of narrowing the list to a manageable number that could be analyzed. The core list of species of tribal interest was then matched to a list of known species with viability concerns. Aquatic species included 7 salmonids and 18 other narrowly endemic and sensitive fish with viability concerns and of potential tribal interest. A total of 70 terrestrial wildlife species of tribal interest were recognized, of which 9 had associated viability concerns. For plants of tribal interest, 86 species were identified as a core group of species to be considered, and one was found to have a viability concern. These 35 species of identified tribal interest with viability concerns were examined for habitat trends through viability panel assessments (*Terrestrial Ecology* [Marcot et al. 1996] and *Aquatics* [Lee et al. 1996] chapters of the *Assessment of Ecosystem Components* [Quigley and Arbelbide 1996b]).

In addition to assessments of viable populations, all 70 wildlife species of identified tribal interest were examined for general trends in habitat conditions (See Table 2-30 in Chapter 2). Although intended only to provide an indication of habitat trends, some inferences were made as to how responsive alternatives might be over 100 years.

Estimation of Effects on American Indians/Tribes

A social evaluation of the alternatives was conducted by using three social panels: one for representatives of affected American Indian tribes, one for the Eastside EIS, and one for the UCRB EIS. The American Indian tribal panel consisted of representatives from 14 affected tribes representing interest in both EIS areas. (See the *Evaluation of Alternatives* [Quigley et al. 1997] for more information on the panels.)

The methods used to assess effects on American Indian tribes were primarily qualitative and based on selecting key indicator variables and emphasis areas on which tribal issues appear to focus. Those emphasis areas were generally weighted toward healthy ecosystems and usable/accessible ethno-habitats, integrity of culturally important places and provisions for cultural uses, cultural survival, and social needs. These variables were then used to identify SIT evaluation criteria in terms of the following:

- ◆ Landscape ecology conditions that are stable and resilient over time, and/or trends toward the historical range of conditions;
- ◆ Aquatic and terrestrial conditions, habitat trends, and species populations trends where there are viability concerns;
- ◆ Healthy, sustainable, and usable habitats (including ethno-habitats) and culturally significant species populations without viability concerns for tribal needs; and
- ◆ Social-economic conditions or trends that paralleled or addressed components of agency-tribal relations, and social and water-land well-being.

Effects of the Alternatives on American Indians/Tribes

In addition to the information provided in the previous section on Human Uses and Values,

this section describes the effects of the alternatives on the American Indian tribes and communities in the region and their traditional lifeways. Background information for this section has been derived from a long-term and ongoing dialogue with the many affected tribes and Indian communities involved in the Interior Columbia Basin Ecosystem Management Project. Since December 1993, tribal liaison staff of the ICBEMP have initiated many staff-to-staff meetings with all affected tribes and several government-to-government meetings between agency decision-makers and tribal councils. Other sources of information include the *Evaluation of Alternatives* (Quigley et al. 1997), review comments, written submissions provided by tribal representatives, an understanding of the tribal issues described by Hanes (1995), and the seven primary issues taken from tribal panel discussions (Birchfield et al. 1996). Four topic areas based on tribal issues and concerns are used here to describe the alternative effects on American Indians/tribes: (1) agency-tribal relations; (2) cultural uses; (3) water-land well-being; and (4) social well-being.

Agency-Tribal Relations

The basis for federal agency relations with tribes is derived from the U.S. Government's special relationship with American Indian peoples and tribal governments, along with federal common law jurisprudence forms. Federally recognized tribes are sovereigns that have special legal status and relations with the U. S. Government; however, federal agencies are also responsible to both American Indians and tribes through direction provided by all three branches of the federal government. Congress has adopted laws and policies that acknowledge and promote tribal self-determination and the social-well being of tribes and their members. (See the American Indians section in Chapter 2.)

A tribal panel reviewed the alternatives and identified a general distinction between Alternatives 1 and 2 and Alternatives 3 through 7 (see Table 4-60).

Table 4-60 shows a relative ranking of 1, 2, or 3 to indicate a range from most to least, respectively, of how accessible policy and project decision processes would be to tribes,

based on qualitative information and the description of the alternative. This chart provides a qualitative ranking of alternatives based on two primary subject areas of tribal-BLM/Forest Service relations:

- ◆ To provide a *relative ranking for effective consultation*, consideration was given to the relative degree that alternatives would allow for consistency in interagency, region-wide consultation policies and guidelines; and tribal government access to agency decision-making elements.
- ◆ To provide a *relative ranking of effects on resources and lands associated with contemporary Indian interests*, a qualitative assessment was made as to how alternatives: (a) would allow for tribal reserved rights as described in treaties, agreements, or executive orders; (b) would provide water quality and quantity, and access to trust, traditional, or treaty resources and assets; and (c) would implement levels of activities displayed in Tables 3-6 and 3-7 (Chapter 3).

Currently both the BLM and Forest Service have or are developing national policy guidance covering each agency's responsibilities for consultation with federally recognized tribes. Such direction is general and would apply to the respective agencies for all alternatives. The effect of Alternative 1 is that it would promote existing inconsistencies in agency approaches to consultation practiced by the various BLM or Forest Service administrative units. Alternative 2 may provide greater incentives for agency units to establish dialogue with tribes, but it would not provide for consistencies in consultation practices among agencies, agency units, or regional groupings of agency units.

Under existing BLM and Forest Service regional guidance and land use plans, management actions addressing the federal government-to-government relationship with tribes under Alternatives 1 and 2 have little and varying direction to address federal legal responsibilities toward tribes. Also, these alternatives largely are a reflection of historical and current direction. When dialogue does occur between agencies and tribes, it is typically within the context of agency business and the NEPA process rather than being a government-to-government-driven dialogue process. Agency

Table 4-60. Relative Effects on Agency-Tribal Relations, Project Area.

	Alternative						
	1	2	3	4	5	6	7
Effective Consultation	3	3	1	1	2	1	2
Tribal Rights and Interests	3	3	2	1	3	1	1

1 = most accessible to policy and project decision processes
3 = least accessible to policy and project decision processes

expectations for tribal responses to their inquiries within specified regulatory time frames, which legally apply only to federal agencies, maintain stress on agency-tribe relations.

In addition, under Alternatives 1 and 2, there would continue to be little direct representation of affected tribes' perspectives within agency organizations, since few American Indians with a cultural background or tribal affiliation or background from the project area work for either the Forest Service or BLM.

Alternatives 1 and 2 would not provide for a program approach to agency-tribe relations at administrative unit levels. However, Alternatives 3 through 7 recommend use of tribal liaisons or liaison functions, to help meet the intent of effective consultation. These alternatives also are expected to bring about enhanced agency-tribe relations through effective approaches in communication and an emphasis on a balance of agency policy, program, and project level participation of tribes.

These factors, along with past organizational barriers to shared financial and cooperative work activities, may become increasingly significant as tribal governments continue to take on responsibilities previously performed by the Bureau of Indian Affairs. This may be especially true of the Shoshone-Paiute Tribes of the Duck Valley Reservation, which adopted the provisions of the Self Governance Act of 1975, and the Confederated Salish and Kootenai Tribes of the Flathead Reservation, which adopted the provisions of the expanded Self Governance Act of 1994. (This act authorizes interested tribes to, among other things,

become more involved in public land management activities, such as grazing, forestry, and recreation. Self-governance is essentially an expansion of self-determination policies, extended to all Department of Interior's programs in off-reservation settings.)

Alternatives 3 through 7 provide for effective consultation processes based on an approach to identify, understand, and work toward resolving conflicts through a relationship characterized by ongoing dialogue between agencies and tribes. As time passes and relations are developed based on effective consultation, and as habitat trends, access, and ecosystem conditions are addressed, it is expected that agency-tribal relations will improve. If effective consultation occurs concurrently with NEPA-driven processes and outside such legislative processes as intended under Alternatives 3 through 7, this should cause fewer positioning actions/statements, project appeals, and low risk of vulnerability to federal legal responsibilities.

Alternatives 3 through 7 would also enhance the development of a tribal self-governance program and more effectively support tribal self-determination than Alternatives 1 and 2. This same group of alternatives would direct both agencies to uniformly develop meaningful ongoing relationships with affected tribes and include American Indian communities. Objective TI-O1 and its companion standards direct the BLM and Forest Service to develop dialogue with affected tribes and communities. The only distinctions among alternatives are seen in guidelines, which are suggested techniques developed specific to either the EIS area or to the first two alternatives.

Alternatives 5 and 7 both place limits on opportunities for consultation and access of Indian peoples to agency policy-making, as a result of up-front structure to management decisions through identified priority (Alternative 5) or reserve (Alternative 7) areas. The management priority areas of Alternative 5 were developed with a focus other than tribal interest and concerns for cultural uses and social-economic needs. Alternative 5 additionally places tribes and their collective needs in greater contrast with BLM/Forest Service direction than they have traditionally experienced, giving management priority to different areas across the project area. This could result in greater differences in how tribes perceive the agencies' management, and could create a greater distinction in how tribes attempt to focus their relationships with agency managers and seek issue resolutions. Alternative 7 designates reserves that restrict tribes' involvement in the decisions for and use of those areas in the future.

Cultural Uses

American Indians' cultural uses of the project area typically have a basis in their individual cultural traditions and seasonal subsistence patterns, which sustained bands and their cultural systems through thousands of years. These traditional cultural practices occurred over large areas, and even a given seasonal round would cross through a wide range of landscapes (see Chapter 2). Contemporary cultural practices still involve acquisition or use of potentially hundreds of species and use of many ethno-habitat types by a traditional user over a period of a year. Traditional uses considered here include Indian peoples' sacred values and uses of the landscape and cultural places.

Access is a critical factor to American Indian peoples with regard to a wide variety of issues, including cultural practices such as harvests of resources, values and uses of sacred areas and places, and cultural survival through passing knowledge between generations. The presence of healthy and sustainable populations of culturally significant species in ethno-habitats is not sufficient if access to such familiar habitat areas is precluded by physical barriers, socio-cultural restrictions, or change in land ownership.

Alternative 7 poses some limitations of access within reserves that may restrict the full range of Indian cultural uses despite an agency understanding that reserved rights to habitats and resources must be permitted or addressed through a consultation process with affected tribes and communities (see Table 4-61). Alternative 5, especially in timber production priority areas, may enhance or at least maintain physical access to traditional places. However, effects on the integrity or quality of these same places may be adverse to tribal rights and interests. Alternatives 3 through 7, and especially 4 and 6, may limit access in some areas where roads may be reduced or use restricted. In the case of Alternative 4, this limitation may be beneficial to tribal interests.

Because of the strong connection of cultural uses to water-land well-being, some discussion about hunting, fishing, gathering, trapping and livestock grazing is examined here.

The elements in Table 4-61 were rated relative to each alternative using a 1, 2, or 3 to show a range of most to least able, respectively, to benefit tribal issues and rights to access, places, and ethno-habitat protection. The latter category is weighted toward fishing and hunting because more information is available at the broad scale of analysis concerning associated habitat trends as compared to gathering activities.

Table 4-61 attempts to identify some key elements of American Indian cultural uses as they are relevant to alternatives' directions and management actions; alternative direction for an effective consultation process; constraints on tribal access to both ethno-habitats and other socio-cultural places; and issues similar to those used to address the quality of life topic. (See Table 4-60 and the Human Uses and Values section in this chapter.) The ranking of access for each alternative takes into consideration access to decision-making, as well as changes in road densities, which changes access to resources and places. The protection of places considers access, integrity of setting, and the elements of agency-tribal relations.

The cultural significance of many American Indian places is often based on socio-cultural values and related to multiple cultural systems. Thus, a place may derive its cultural meaning

Table 4-61. Relative Effects on Cultural Uses, Project Area.

	Alternative						
	1	2	3	4	5	6	7
Access	1	2	1	1	1	2	3
Places	3	2	1	1	2	1	1
Ethno-habitats Useability	3	2	2	2	3	1	1

1 = most able to benefit tribal issues and rights to access, places, and ethno-habitat protection
3 = least able to benefit tribal issues and rights to access, places, and ethno-habitat protection

and value from more than one cultural system (religious, economic, political, and/or social), and its significance is often based on more than important past events or a small group experience(s).

The importance of sharing cultural experiences, values, and information between generations, and the significance of these activities for tribal cultural survival, are at the heart of tribal access to culturally significant places and resources. Provisions of road access were considered in Chapter 3 through standards and objectives. Allowance for American Indian elders' access to places (including ethno-habitats) has implications for cultural survival and social well-being of tribes and for tribal sovereignty.

Alternatives 1 and 2 recognize the importance of places to American Indians through implementation of existing laws such as the National Historic Preservation Act and regional policies. Alternatives 3 through 7 would provide similar direction. However direction is designed to be achieved through the consultation process with tribes and to recognize place attachments across unit and agency boundaries. The effect is expected to help bring about greater sensitivity toward and incorporation of tribal rights and interests in agency land management.

Water-Land Well-Being

Water-land well-being refers to tribal perceptions and values of water, water systems, and the land (including natural ecosystems and

their components and processes), and reflects the recognition of their interrelationships (ecosystems). Indian people and their tribal governments are interested in the overall condition and health of the Northwest region's environment as well as in their respective homelands. These concerns are often expressed in terms of a tribe's area of interest, where people have traditionally lived and practiced land-based lifeways.

The continued importance of these lifeway patterns is reflected in gathering activities, religious practices, and place attachments specific to sites, landforms, and environment/habitat types. All aspects of ecosystems including water, soils, habitats, species groupings, landscape conditions, and air are viewed as interconnected through the collective socio-cultural values of each individual tribe. The tribal panel expressed greater concern for a "water-land" subject area, in comparison to such issues as economic opportunity.

There is some difficulty in describing effects on tribes and/or Indian communities, stemming from federal agencies' actions on ecosystems and on culturally significant species and habitats. It requires understanding differences between the desired range of future condition (DRFC) in the context of tribal needs and rights, and the historical range of variability as a baseline for understanding trends in habitat conditions. The agencies have an imprecise understanding of how tribal governments might characterize appropriate desired range of future condition considering the ecosystem's current capabilities. However, the distance between the desired condition for some alternatives and the natural range of variability is thought to be

greater than those desired by some tribal governments, especially in the area of overall ecological integrity and aquatic ecosystem values.

Water

The concerns and issues involving water are broad and related to a host of tribal rights, social-economic needs, cultural uses, and property interests. Tribal governments are especially concerned about water quality and quantity, hydrologic functions, aquatic ecosystems' integrity, and soil integrity. This section addresses the first two aspects of tribes' water concerns.

Water quantity issues were not directly addressed by the Science Integration Team due to the fine-scale nature of the issues. Thus, many of the specific outcomes of interest to Indian people concerning lakes, streams, rivers, riparian areas, and wetlands and their relationships to systems and processes that support habitats and species will need to be addressed through discussions at the site-specific analysis and multiple-scale management levels. Alternatives 4 and 6 would offer more flexibility within riparian and wetland habitats than Alternative 7, by permitting restoration, conservation, and those production activities that would not be expected to degrade habitat conditions. However, these alternatives would place risks on riparian and wetland habitats while providing more provisions to improve degraded habitat conditions. Alternative 7 would benefit water-dependent habitats largely through restrictions of human actions in aquatic systems.

Although the Science Integration Team was unable to address water quality directly, a potential indicator of project area-wide water quality is suggested by cold water fish habitat trends and the varying overall protection for aquatic resources provided by each alternative. The SIT's evaluation of cold water fish suggest Alternatives 1 and 5 followed by Alternative 2 would have a decrease in aquatic habitat trends. Alternatives 3, 4, 6, and 7 are predicted to have a slight increase in the same trends and are thus expected to help respond to the water quality and aquatic system concerns of American Indians/tribes. (See the Aquatics section of this chapter.)

Hydrologic Functions

Tribal concerns that agencies contribute to healthy functioning hydrologic systems would be best addressed in Alternatives 3, 4, 6, and 7, and poorly addressed in Alternatives 1 and 2. Slope provisions in Alternatives 4 and 6 (Zones 1, 2a, and 2b) would provide additional protection not found in Alternatives 3 and 7. Alternative 7, however, was designed to include the greatest watershed, riparian, and aquatic protection and includes most of the major components of the five-step coarse screening process advocated by some mid-Columbia River tribes and the Columbia River Tribal Fish Commission. Aquatic priority areas in Alternative 5 are expected to benefit higher elevation forested riparian habitats. However, timber priority areas, which would use less protective standards, are not anticipated to show the same level of benefits.

Relative values for tribes would be a combination of the most protective measures found in Alternatives 4, 6, and 7. Most affected tribes would likely want to use an intergovernmental strategy to reduce the downward trends in aquatic systems and their functions from historical conditions and to seek ways to benefit culturally significant aquatic species. Effective consultation and cooperative relationships with all northwest federal regulatory agencies and federal and state land managing agencies would be a necessary element. (See the Physical and Aquatics sections of this chapter for more detailed discussions.)

Soil

The relative ranking of alternatives for soil protection, maintenance, and restoration suggests how tribes would be affected. (If soil integrity is high, ecosystems benefit, which positively affects tribes.) Overall, Alternatives 3, 4, and 6 would most likely restore, maintain, and protect soil productivity and function. Alternatives 5 and 7 could restore and protect soil productivity. Alternatives 1 and 2 would not meet soil productivity and function goals and objectives. See the Soils portion of the Physical section of this chapter for more details.

Air

The BLM and Forest Service must consider their management effects on all airsheds, including those associated with tribal lands. Tribal government concerns for clean air, much like those for other communities, are largely centered on emissions from wildfires, which may occur in concentrations that are hazardous to human health for limited time periods. These concerns are largely fine-scale issues and would be unaffected by any of the alternatives in this EIS. In general, tribes are supportive of prescribed burning programs, especially if they would benefit ethno-habitats, and have not taken issue with related smoke emissions. (See relevant discussions in the Physical [Air Quality portion] and Human Uses and Values sections concerning urban interface wildfire information.)

The Flathead and Spokane Reservations, at tribal government requests, have been zoned as Class 1 airsheds (see Chapter 2 for description) and therefore maintain higher standards under the Clean Air Act for management and protection. Both of these tribes' governments monitor their own airsheds and work cooperatively with state Environmental Protection Agency regulatory offices. Federal land managing agencies coordinate with these tribes to help ensure the standards are met.

Habitats and Species Groupings

The tribes' interest in culturally significant species is addressed in terms of species with viability concerns and how habitat trends are affected by alternatives. Three species categories are discussed (aquatic species, and terrestrial animals and plants), based on the SIT's findings. (See the Aquatics, Terrestrial, and Physical sections of this chapter.)

One of the terrestrial goals was to address long-term harvestability for plants and animals, given federal agencies' responsibilities to tribes and needs to implement resource protection strategies for species of identified tribal rights and interests. The overall degree that an alternative provides for the long-term viability of native plants and animals on agency lands was considered the best currently available indicator of the harvestable potential of species with identified tribal interest. The Science Integration Team reported these habitat trends and identified a set of species considered to have viability concerns (see Appendices 1-2 and 4-2).

Aquatic Species

Tribes are greatly concerned over a number of aquatic issues including the disparity between current aquatic systems and the desired range of future condition; extensive losses in aquatic systems' integrity; and viability concerns or problems surrounding a majority of identified species of tribal interest. Many of these same species have played integral roles in the Northwest region's native cultures. The loss of harvestable levels of some species and available/sustainable ethno-habitats for these and many others have affected cultural change in Indian communities through effects to their economies, social well being, cultural integrity, religious practices, socio-cultural values, and quality of life.

Most aquatic species evaluated by the SIT are identified as tribal species. Thus, the trends projected for the alternatives as reported in the Aquatics section of this chapter provide an approximate correlation to how well alternatives would respond to the aquatic concerns of tribes.

All alternatives have goals, objectives, and standards pertaining to the protection of riparian areas and wetlands in expectation that such protection would benefit aquatic systems. The SIT's evaluation of aquatic systems and resources linked the predicted outcomes in fish distributions and status through predictions of management action influences on habitats given the current patterns of fish distribution and road density.

Resident Native Salmonids

Alternatives 1 and 5 would result in a continued decline of resident native species populations due to inadequate protection or restoration of riparian and aquatic ecological processes. Alternatives 6 and 7 would conserve most core population areas and move toward restoration of degraded habitat and improve status of resident native salmonids. Results for Alternatives 2, 3, and 4 vary by species. Refer to the Aquatics section for further information.

Anadromous Fish

Alternatives 3, 4, 6, and 7 are expected to conserve most remaining habitat and move toward restoration of degraded habitats for steelhead, stream-type chinook, and Pacific

lamprey with the greatest potential for improvement under Alternative 6. Alternatives 1 and 5 would benefit some core areas, but overall population declines would continue. It is predicted that none of the alternatives would provide for habitat needs of ocean-type chinook salmon, manage perceived threats, or ensure persistence of the populations. Alternatives 6 and 7 have the most conservative approach to conserving and restoring riparian areas and watersheds, and may have some benefit to ocean-type chinook if actions tend to improve agency-administered land's water quality and quantity. None of the alternatives address the needs and opportunities for restoring habitat conditions on other land ownerships, or provide a comprehensive restoration approach for steelhead, stream-type chinook, or ocean-type chinook.

Narrow Endemic and Sensitive Fish

Under Alternatives 1 and 5, conditions would continue to decline due to high levels and locations of timber and grazing uses and low stream and riparian protection measures. Alternatives 2 and 3 would show relative improvement of habitat conditions due to greater protections and increased watershed and riparian restoration emphasis. Alternatives 4 and 6 would provide a further relative improvement of habitat conditions due to decreased livestock grazing impacts and higher restoration of riparian areas and uplands. Alternative 7 would provide the greatest relative habitat improvements due to greater habitat protection measures and more restrictions on land-disturbing actions.

The most protective measures and positive trends for aquatic integrity are anticipated from Alternatives 4, 6, and 7. Alternative 6 would likely provide the greatest protection and the least risk to aquatic integrity from restoration activities as compared to Alternative 4.

Alternative 7 may achieve similar results to Alternatives 4 and 6, but in the long-term, risks associated with a lack of a restoration emphasis for vegetation and watershed management would lessen its ability to achieve the overall effect of the other two alternatives. Alternative 2 with its relatively high aquatic protection standards, (PACFISH and INFISH) is expected to have positive effects on aquatic integrity, but lacks an integrated ecosystem approach and a restoration emphasis.

Terrestrial Animals and Plants

Animals

The Science Integration Team identified 70 terrestrial vertebrates species of tribal interest including, 35 mammals, 33 birds, and 2 reptiles. For those 17 tribes with government headquarters and/or reservations within the project area, 67 vertebrate species of identified tribal interest were analyzed by comparing historical vegetation cover types and structural stages to the current vegetation condition. These vertebrate species were not listed for a specific tribe; therefore, all species' habitat conditions were analyzed for all 17 tribes regardless of whether or not the species range overlapped a specific tribal area of interest.

Decreasing trends in potentially suitable habitats from historical to current were exhibited for 42 (63 percent) of the vertebrate species. Some species were expected to increase in some tribal areas of interest based on changes in potential suitable habitat, while the same species decreased in other areas based on habitat changes. These trends suggest that impacts have occurred from the historical to the current period on habitat conditions of these selected species'. The *Evaluation of Alternatives* does not provide information on effects to these or many of the species of social interest by alternative.

Only 9 of the 70 terrestrial vertebrates (13 percent) of tribal interest were rated by the terrestrial panels, as the others are not viability concern species. Of these, the Columbian sharp-tailed grouse, California bighorn sheep, and grizzly bear would have the greatest reductions in habitat conditions and population, but would remain unaffected by alternatives since these species are more affected by adverse factors from non-agency management sources. Concerns for bald eagle habitat trends would be reversed under Alternatives 3, 4, and 6. Antelope and sage grouse habitats would respond best under Alternatives 3 through 7. (See the Terrestrial Species section of this chapter for more details.)

Plants

Vegetation has played a large role in the relationship that native peoples have maintained with natural biophysical systems,

landscapes, and cultural places. Native cultures have organized these components according to individual folk biology systems, which have some similarities to scientific categories. Woodlands; cottonwood, aspen and cedar groves; wetland, riparian, and scabland vegetation communities; root fields; and berry patches are included in a mix of plant communities that are culturally significant to tribes. Vascular plants and their habitats continue to be of special significance to people and are valued in their own right. Most of these categories, however, were not addressed by the broad-scale level of analysis done for this project. Some relative trends among alternatives could be assessed for some tribal interest species if their habitats were tied to terrestrial communities and potential vegetation groups.

The SIT identified at least 86 plants as species of tribal interest (*Terrestrial Ecology* [Marcot et al. 1996] chapter of the *Assessment of Ecosystem Components*). Plants of interest were analyzed by comparing historical vegetation cover types to projected vegetation conditions, by alternative (Quigley et al. 1997). Species were analyzed for all tribes in the project area. Only one species from this plant list was examined for viability concerns.

The one plant of tribal interest rated by the panel is from the *Lomatium* genus and thought to be of Warm Springs tribal interest (although not on their core list). This plant was rated as unaffected by all alternatives, and its historical condition was seen as unchanged. The plant's consistent viability panel weighted mean rating of 4.5 through all alternatives is likely due to the difficulty of a broad-scale viability analysis of a habitat type best suited to fine-scale analysis.

Thus, a fine-scale assessment of effects on such plant habitats and tribal interests would need to occur, examining both biological and cultural factors affecting ethno-habitat conditions and trends. This is expected to occur through multi-scale management processes, agency-tribe dialogues, ecosystem analysis, and fine-scale agency directions. A similar approach would be necessary for the recovery issue of broadleaf cover types (aspen and associates) located in dry, moist, and cold forest potential vegetation groups. These are critical for big game and livestock ranges, and are of cultural interest to American Indians/tribes.

Effects of Exotic Plants on Native Plants

The general trend toward invasion of native vegetation communities by exotic plant species is a threat to the distribution of culturally significant species and ethno-habitats significant to American Indian peoples. This is assumed on the basis that most noxious weeds assessed by the SIT for range clusters are anticipated by the EIS Team to affect plant communities of tribal interest. Effects from either federal agency or American Indian reservation lands on each other through spread of exotic weeds is a shared concern, especially where it may degrade culturally significant habitats and a tribe's respective interests (for example, in rangelands, root and berry fields, wildlife and livestock grazing, American Indians/tribal gathering rights and practices, and native species distributions).

In general, the most negative trends are expected in Alternatives 1, 2, 5, and 7 (within reserves). No noxious weed control efforts are proposed in reserves under Alternative 7, and fire disturbances are predicted to increase the spread of weeds. Alternatives 3 and 4 are predicted to be the most effective in preventing the spread of noxious weeds and cheatgrass into dry grasslands, dry shrublands, and cool shrublands. Although not every range cluster would benefit to the same degree through these alternatives' noxious weed control efforts, Range Clusters 5 and 6 would benefit the most. These are the two largest range clusters (have the most acreage of rangelands) where tribal dependence on off-reservation livestock grazing is greatest. (For more noxious weed trend information, see the Rangelands section in this chapter and Tables 4-38 through 4-40.)

Although Alternatives 4 and 6 share an equally great emphasis on noxious weed control through Integrated Weed Management, more acres are scheduled for these control efforts in Alternative 4. Alternative 4 would provide greater risks to tribal interests. These tribal interests relate to adverse consequences of herbicide use in noxious weed control efforts on culturally significant plants and human health.

In general, Alternatives 3 and 4 would regain dry grasslands from medusahead and cheatgrass in Range Clusters 5 and 6. However, dry grasslands would decline in Range Clusters 1 through 4 under all alternatives over the 100-year period as a

result of inadequate noxious weed control. In dry shrublands, noxious weeds would increase in Range Clusters 3 and 4 under all alternatives but they would decline, generally, in the remaining clusters in Alternatives 3, 4, and 6. This is due to a focus on sites that are highly susceptible to cheatgrass and Mediterranean sage and a secondary treatment emphasis for other noxious weeds. The most noticeable increase in dry shrublands would be in Alternative 4. Cool shrublands would decrease in Range Clusters 1 through 3 under all alternatives, except in Range Cluster 2 in Alternative 7. Cool shrublands would increase in Range Clusters 4 through 6 under Alternatives 3 and 4, with other alternatives having varying success in these clusters.

Federal trust responsibility issues exist for all alternatives relative to how each would address exotic species invasions and corresponding effects on treaty reserved rights, exotic weed spread to Indian lands and relevant tribal interests, traditional use practices, and general concerns for ecosystem resiliency/health (such as livestock grazing and gathering of culturally significant plants). In general, it is predicted that divergent trends away from native vegetation types and the magnitude of exotic plant invasions would most adversely affect rangeland productivity and biodiversity in Alternatives 1, 2, and 5, especially in Range Clusters 1, 5, and 6, where most of the rangelands exist in the project area. The adverse effect on rangeland productivity and biodiversity would be expected to affect livestock operations, wildlife, soil, native vegetation health, and ethno-habitats.

While cool shrub vegetation types may be relatively more resistant to exotic plant invasions, there are noxious weed species, for example leafy spurge, that are invasive into cool shrublands and extremely difficult to control. Species such as spotted knapweed and leafy spurge that characteristically dominate communities where they have spread are a threat to native vascular plant communities as well as ethno-habitats.

Cheatgrass monocultures are expected to be the focus of weed control efforts that are directed at cheatgrass. This exotic plant species is known to effectively compete with a number of culturally significant plant species. Where cheatgrass is a component with desirable perennials, burning would be the

only method currently available for control. Herbicides in this situation might be used if native plant species have already been out-competed. Where cheatgrass is controlled and suppressed in range clusters, it is expected that certain plant ethno-habitats, root fields of lomatiums, for example, could benefit, if there are residue plants of desired culturally significant species that would provide a seed source.

It is anticipated that some tribes would have some concerns where reserves are allocated under Alternative 7 and located within their ceded lands, traditional homelands, or areas of interest. For example, the Ft. McDermitt and Duck Valley Reservations have off-reservation interests in traditional plant gathering and livestock grazing, which may lie within reserves. The Ft. McDermitt Tribe, especially, would have a significant portion (approximately 19 percent or 3.08 million acres) of its interest area lands allocated to reserves, and their reservation would be surrounded by a large reserve.

Given the susceptibility of reserves to the spread of exotic plant species and the relative effects on ethno-habitats with Indian gathering and rangeland interests, there could be important short- and long-term effects on certain tribal cultural practices and reservation economies dependent on livestock grazing. The concern may also extend to reservation lands, especially where reserves are proposed along or near reservation lands (such as Fort Bidwell, Fort McDermitt, Duck Valley, and potentially the Fort Hall reservation and one Pit River rancheria). This might also frustrate tribal efforts to maintain cultural integrity and socio-economic self-sufficiency in the long term. The Warm Springs and Umatilla Reservations may be in situations where noxious weed spread from and to adjacent Forest Service- and BLM-administered lands require mutual (agency-tribe) efforts to address short- and long-term controls.

Negative effects on traditional gathering practices are expected to include impacts, to varying degrees, on tribal social cohesion, cultural survival, American Indian religious values/practices, and issues of individual well being. The degree and nature of these impacts would vary by affected area and tribal circumstance. Nonetheless, most tribes would be expected to contribute to and be supportive of cross ownership/interagency strategies to

control exotic species invasions and decision-making/treatment plans, especially if they would avoid adverse impacts to culturally significant plants found on some noxious weed lists, and avoid incidental health concerns from any programs using herbicide treatments.

Landscape Ecology

In general, the discussion of effects on tribes are relative to the following: a) trends toward dynamic and resilient or healthy project area-wide ecosystems; b) effects on reliable and predictable habitats (forest seral stages) for culturally significant wildlife, c) aquatic species and plants; and d) trends toward the historical range of fire disturbances and general desired range of future condition. (See the Terrestrial Species and Landscape Health sections in this chapter for more detailed information.)

In order to suggest how alternatives might affect the interests of Indian people, effects are described in terms of proxy resource use categories of fishing, hunting, gathering, and livestock grazing opportunities across a broad range of landscape types and patterns. In general, big game hunting would benefit by a mix of openings to provide forage and mid-seral forests for cover, and fishing interests would benefit by mid- and late-seral forests, and gathering by a mix of early-, mid- and late-seral stages in natural patterns, depending on the plant species. Also, a trend toward consistency with natural disturbance regimes would likely benefit all four cultural uses categories and allow for sustainable, dynamic and resilient ecosystem conditions.

Alternatives 3 through 7 would meet desired range of future condition and historical range of variability after 100 years on Forest Service- and BLM-administered lands. No alternative would make significant strides toward conditions typical of the historical period for the project area as a whole (all ownerships). Improvements made in Alternatives 3, 4, and 6 towards the historical range of variability are through disturbance levels of about 30 percent per decade on agency lands across the project area.

The alternatives, except Alternative 2, show disturbance of the same percentage of area per decade that approach historical levels (25 to 35 percent per decade across the project area); however, management disturbances do not focus on getting landscape patterns back to

natural patterns that would resemble more natural disturbance regimes. For example, the long-term landscape structures created by alternatives would remain at high risk from uncharacteristic disturbances in landscape positions and patterns. However, Alternatives 4 and 6 would generally resemble natural forest disturbance processes through prescribed fires and/or thinning, and pose less risk of large, high severity wildfires; Alternatives 1, 2, and 7 generally would not.

There may be short-term risks to ecosystem health in Alternatives 4 and 6, where restoration emphasis activities could increase disturbances in a effort to provide long-term ecosystem benefits. An example is aquatic and riparian restoration activities, where removing problem roads may increase sedimentation of streams in the short term, but would benefit the stream and/or riparian area in the long run. Alternative 6 is expected to have a relatively lower risk of short-term adverse effects since it would emphasize adaptive management approaches, going slower with restoration efforts to ensure greater restoration benefits to the landscape. Alternative 7, with its passive management approach, may not as effectively treat problem roads in aquatic zones, thereby increasing the probability of long-term adverse effects to landscape ecosystem components. (See the Effects on Hydrology, Watershed Processes, and Riparian Areas and Wetlands section in this chapter and Chapter 3).

Cultural Uses

Off-reservation interests of American Indians and tribal governments extend to a wide range of environments, resources, species and culturally familiar places, which are influenced or dependant on habitats, habitat connectively, terrestrial community types and resilient ecosystems.

Tribal fishing interests would likely benefit by trends toward those conditions of the historical period and the desired range of future condition in aquatic integrity and natural disturbance regimes. Refer to the Human Uses and Values section for a relative rating of recreational benefits regarding quality fishing. (See the Aquatics and Physical sections in this chapter for further discussion of effects on hydrologic and aquatic systems.)

Restoration of landscape integrity and terrestrial communities near or within desired range of future condition consistent with biophysical environments should contribute to overall aquatic health through interactions with upland conditions and processes. Landscape structures that are consistent with natural disturbance regimes are likely to support watershed-scale disturbances and smaller-scale processes (such as coarse woody debris recruitment to streams, and riparian vegetation for stream shading) important for aquatic health. Alternatives 4 and 6 would provide for restoration and maintenance of ecological processes that are the most consistent with biophysical environments; Alternatives 1 and 2 would not; Alternatives 3 and 5 would be intermediate.

Tribal big game hunting interest within Forest Clusters 4 and 5 could be caught up in a conflict between big game security objectives and ecosystem health objectives to restore natural disturbance regimes. This issue involves human needs for sustainable, dynamic, and resilient conditions consistent with biophysical environments where it lies above the historical range of variability for mid-seral and late-seral multi-story conditions. (See Figures 4-3 through 4-11, which discuss the percent of sub-basins within the historical range of variability, in the Forestlands section of this chapter.)

Tribal gathering interests are related to site-specific ethno-habitats that are often dependent on naturally discrete (fragmented) habitat types. Those that are associated with upper montane meadows, wetlands, and scabflat landform types were not addressed in this chapter because of the scale of the evaluation. However, rangeland standards and their rationales address some of the habitats related to gathering. Overall the habitat trends and management direction would occur at finer scales through the consultation and ecosystems analysis processes (see all the Tribal objectives and standards in Chapter 3 Table 3-5, and guidelines in Appendix 3-2.) Effects on gathering practices are relative to effective consultation practices and ecosystem processes (see Table 4-60 for Agency-Tribal Relations on Consultation, and Table 4-12).

The ability of rangeland landscapes to remain resilient to disturbance regimes in the long term, retain rangeland connectivity, and

generally restore rangeland vegetation types, has potential benefits for tribes with concerns for quality native forage for livestock, wildlife habitat and forage and native vegetation communities. Tribal grazing interests extend across the project area; however, southern tribes such as the Burns Paiute, Shoshone-Bannock of Fort Hall Reservation, Fort McDermitt Paiute, and Duck Valley Tribes may have a relatively greater socio-economic interest than others. Landscape ecology and rangeland information indicate Alternatives 1 and 2 would generally be least effective in providing such changes in areas of the project area. The other alternatives would benefit these rangelands to varying degrees. Overall, Alternatives 4 and 6 would provide the most effective benefits and followed by Alternatives 7 and 5 would likely respond to tribal needs.

Composite Ecological Integrity Trends

A composite ecological integrity estimate for landscape ecology was developed for the project area's 164 sub-basins (4th-field Hydrologic Unit Codes [HUCs]; see Figure 2-1 in Chapter 2) in order to examine how each would respond over the next 100 years under the seven alternatives. Three primary indicators of composite ecological integrity trends were used: (1) forestland and rangeland vegetation; (2) riparian management; and (3) road density changes. These indicators address a number of specific ecological integrity components (aquatic/riparian, terrestrial, landscape, hydrology), their interactions, and the condition and trends for these components.

The current composite integrity of sub-basins were rated as having high, moderate, and low trends compared to historical integrity, and assigned a value of -1 (downward trend), 0 (stable trend), or +1 (upward trend) depending on their conditions for forestland, rangeland, and aquatic ecosystems. The sum of the three indicator variables then resulted in values that varied from -3 to +3 for each sub-basin. A rating of +3 would indicate that all three primary indicators would contribute to positive trends in the overall ecological integrity of a given sub-basin from its current ecological integrity rating. A positive trend rating of +3 within a sub-basin currently in low ecological integrity could remain in low condition although showing improvement through the three primary ecological indicator variables.

These ecological integrity ratings take into consideration the combination of current conditions, future management actions through project alternatives, and unplanned/natural disturbance events (such as fire, flood, insects and disease). (See Composite Ecological Integrity section, later in this chapter.)

Given the emphasis and concerns tribal governments place on ecological conditions in their interest areas lands, a chart is provided (Table 4-62) to illustrate the trends in ecological integrity for interest areas of the 17 affected tribes using the composite ecological integrity information. The preliminary tribal interest area maps developed by the SIT were used to provide composite ecological integrity ratings for each tribe's area, projected over the next 100 years for each alternative. (See Appendix 1-2.)

The implications of Table 4-62 are that all tribes would have declining trends for their areas of interest, contributed by two or three of the primary indicators of ecological integrity, under Alternative 1. Similarly, tribal interest areas would either remain stable or experience decline in ecological integrity under Alternative 5. Alternative 2 would largely provide stable integrity values for most tribal areas. Alternatives 3, 4, 6, and 7 would show some improvements from current conditions for most tribes or remain stable for the most part. Those tribes whose locations are peripheral to the project area boundary could draw some inferences from current and projected trends of neighboring sub-basins with ecological integrity ratings for their areas of interest.

Again, this table does not provide an absolute overall rating of ecological trends from low to high. Rather it shows trends from current conditions in terms of either declining, remaining stable, or improving as an indication of the portion of change contributed by BLM and/or Forest Service actions.

Social Well-Being

The need for federal agencies to consider and promote the social well-being of affected American Indian tribes, communities, and their members has a foundation in both the expressed interests of individual tribes, federal government trustee role, and those legislative

acts Congress adopted to express the federal government's responsibilities to American Indians. Agency effects on air quality, water quality and quantity, tribal cultural integrity, socio-economic conditions, tribal assets, and resource integrity on reservations together form federal government responsibilities (relevant to BLM and Forest Service agencies) to consider the social well-being of tribes.

Many of the trust responsibilities toward tribes are similar to responsibilities to states and counties, where self-determination and self-sufficiency is encouraged and negative effects on economic resiliency and general social well-being are avoided unless for the greater good of society. However, there are some important distinctions, which include the unique nature of tribes' cultural, social, governmental, and economic circumstances and needs. One small example is in the nature of how portions of receipts collected from timber sales are re-distributed back to area counties; tribes do not receive such financial benefits and may rely on other indirect benefits, avenues, and economic opportunities.

Little specific information was acquired by the SIT concerning the socio-economic conditions of Indian communities, or agency effects on their cultural and socio-economic relationships with public lands and resources. However, Bureau of Indian Affairs reporting of reservation employment figures in 1993 in the project area characterize most reservations as having high unemployment relative to other communities.

The preceding discussions on effects of alternatives on tribal cultural uses and water-land concerns directly bear on the social well-being of tribes. This includes off-reservation use of public lands to carry out religious, subsistence, social, economic, and other cultural traditional practices, which relates to cultural survival issues, reservation employment rates, social cohesion, and socio-psychological well-being of tribal membership. Information presented in the previous section discussions (Agency-Tribal Relations, Cultural Uses and Water-Land Well Being) is considered here in providing a relative rating among alternatives for their potential effects on tribal social well-being.

Generally, Alternatives 1 and 2 would be relatively low in their ability to provide benefits to tribal social well-being. Factors include lack

Table 4-62. Ecological Integrity Trends Relative to 17 Tribes' Interest Areas, Project Area.

Reservation Names	Current	Sub-basins (HUCs)	Alternative						
			1	2	3	4	5	6	7
Burns Paiute	Low-Mod	30	-2	0	0	1	-1	1	1
Coeur d'Alene	Low	8	-3	0	0	1	0	1	0
Colville	Low-High	17	-3	0	1	1	0	1	1
Duck Valley	Low-High	36	-2	0	1	0	-2	1	1
Flathead	Low-High	21	-3	-1	1	1	-2	1	1
Fort Bidwell	Low-Mod	13	-2	0	1	1	-2	1	1
Fort Hall	Low-High	53	-2	0	1	1	-1	1	1
Fort McDermitt	Low-Mod	16	-2	0	1	2	-2	1	1
Kalispel	Low	10	-3	-1	0	0	-2	0	0
Klamath	Low-Mod	15	-3	0	0	1	-2	1	1
Kootenai of Idaho	Low-High	11	-3	-1	-1	1	-3	0	1
Nez Perce	Low-High	42	-3	0	1	1	-1	1	1
NW Band Shoshoni	Low-High	10	-3	0	1	1	-2	1	1
Spokane	Low	9	-2	0	1	1	0	1	0
Umatilla	Low-High	33	-3	0	1	1	-2	1	1
Warm Springs	Low-Mod	20	-3	0	0	0	-2	1	1
Yakama	Low-High	13	-2	0	1	1	0	2	1

This table was constructed taking the individual sub-basin ratings within a tribe's area of interest and displaying them for each alternative. The ecological integrity ratings were then summed for each cell and divided by the number of sub-basins within a tribe's area of interest. These numbers were then rounded to the nearest integer to provide an overall value. These ecological integrity trend values range from -3 to +2. (The number of sub-basins for each tribe's area of interest is indicated under the sub-basin column. A sub-basin is equal to a 4th field hydrologic code [HUC].)

of consistent policies for meaningful consultation process in regional and land-use plans or return to desired range of future condition trends; protection of culturally significant fish and wildlife species with viability concerns and their habitats; recognition or management of places; providing for access rights; and addressing interests or rights to healthy, sustainable, or useable ethno-habitats. Alternative 5 also would provide a relatively low response, but is expected to perform better in the area of meaningful consultation and many other previously mentioned areas of tribal interests/rights.

Compared to Alternatives 1, 2, and 5, Alternatives 3 and 7 would respond better,

especially with regard to access to decision-making, aquatic protection and restoration, and in moving trends in viability and landscape ecology toward desired conditions. Overall the alternatives considered most beneficial to social well-being are Alternatives 4 and 6 given aquatic health, riparian protection, more positive trends toward habitat and inferred species population potentials, and access to effective consultation. Alternatives 3 through 7 address access for traditional uses, even in reserves in Alternative 7, and consideration of places through direction for an ongoing consultation process.

The overall rating of alternatives for allowing grazing are of interest to the economic

diversification and resiliency of tribes with interests in Range Clusters 4 and 5. It would appear that Alternatives 1, 2, and 7 would provide a relatively low benefit; Alternatives 3, 5, and 7 a moderate benefit; and Alternatives 4 and 6 the greatest benefit. Relative ratings are based on how alternatives would remain within rangeland ecological capabilities, providing a buffer between ecological capabilities and economic gains as directed by rangeland-use laws such as the Taylor Grazing Act and Federal Land Policy and Management Act.

Composite Ecological Integrity

Examining BLM- and Forest Service-administered lands nearest to tribal lands for composite ecological trends from current conditions may help in understanding some of these agencies' effects on social well-being of tribes and their communities (Table 4-63). Tables 4-63 and 4-64 examine what the composite ecological integrity trends would be with regard to social well-being for sub-basins adjacent to 16 tribes, and/or where a tribe owns lands or has lands held in trust by the Department of Interior.

Ecological integrity ratings in Table 4-63 were taken from sub-basin(s) that include or overlap a tribe's field office, headquarters, and/or a reservation using the same methodology described for Table 4-62. For each alternative where a tribe is located within or adjacent to more than one sub-basin, each associated value was summed, divided by the total of sub-basins, and then rounded to the nearest integer. The column titled "current" describes ecological conditions from historical to current circumstances as depicted in the composite ecological integrity map. (See this chapter's section on the Composite Ecological Integrity.)

Table 4-64 shows the summation of the ratings displayed in Table 4-63 and their ranges under each alternative considering just those sub-basins where project area tribes reside or have a field office. The relative ranking of alternatives was accomplished by adding the individual ratings for each alternative column and dividing it by the total (32 sub-basins). The HUC that is shared between the Colville and Spokane and the Fort Hall Shoshone-Bannock and NW Band of Shoshoni were counted only

once between the tribes in totaling the rating numbers in order to avoid double weighting of those HUC ratings.

The implications suggested by the table's ranking of alternatives is limited to the collective local areas of these 16 tribes. The overall ratings of alternatives suggest Alternatives 3, 4, 6, and 7 would show stable trends, while Alternatives 1, 2, and 5 would show mostly stable or downward trends in their composite ecological integrity. The significance of alternative ratings for agency effects on American Indian communities are most applicable where Forest Service- and BLM-administered lands have direct effects on American Indian communities and where representative sub-basins consider the whole of a community interface area. Thus the composite ecological integrity trends for tribes such as the Kootenai of Idaho and Confederated Tribes of the Umatilla Indian Tribes may not be as significant as for the Duck Valley Indian Community in considering effects on Indian communities.

Tribes may draw inferences from all of the ecological integrity tables concerning aquatic ecosystems and forest and range vegetation structures by tribes. However, the federal government's responsibilities to tribes, and its corresponding need to be equally sensitive to all project area residents, creates a complex set of opportunities for BLM and Forest Service decision-making. General and specific benefits to sub-basin ecosystems and resources would help provide for the interest of tribes, especially as a group of peoples dependant on natural diversity, and natural concentrations of resources.

Table 4-63. Ecological Integrity Trends Relative to 16 Tribes' Local Areas, Project Area.

Reservation Names	Current	Sub-basins (HUCs)	Alternative						
			1	2	3	4	5	6	7
Burns Paiute	Low	1	-3	0	0	0	-2	1	1
Coeur d'Alene	Low	3	-3	-1	-1	0	-2	0	0
Colville	Low	4	-3	0	1	1	-1	1	0
Duck Valley	Moderate	4	-2	0	2	2	-2	0	1
Flathead	Low-Mod	3	-3	-1	0	1	-1	1	0
Fort Hall	Low	3	-2	0	0	1	-2	1	0
Fort McDermitt	Moderate	1	-2	0	2	2	-2	0	1
Kalispel	Low	1	-3	-1	0	0	-3	0	0
Klamath	Low	1	-3	0	0	0	-2	1	1
Kootenai of Idaho	Low	1	-3	-1	0	-3	0	0	1
Nez Perce	Mod-Low	4	-3	-1	1	1	0	2	2
NW Band Shoshoni	Low	1	-2	0	0	1	-2	1	0
Spokane	Low	2	1	0	1	1	0	1	0
Umatilla	Low	1	-3	0	0	0	-2	1	0
Warm Springs	Mod-Low	2	-3	-1	1	1	-2	1	1
Yakama	Mod-Low	3	-3	-1	1	1	1	2	1

This table was constructed taking the ecological integrity ratings from sub-basin(s) that include or overlap with a tribe's field office, headquarters, and/or a reservation using the same methodology described for Table 4-62. For each alternative where a tribe is located within or adjacent to more than one sub-basin, each associated value was summed, divided by the total number of sub-basins (32), and then rounded to the nearest integer. (The column titled "current" describes ecological conditions from historical to current circumstances as depicted in the composite ecological integrity map.)

Table 4-64. Ecological Integrity Trends Summation for 16 Basin Tribes' Local Areas, Project Area.

	Current	Alternative						
		1	2	3	4	5	6	7
Ratings (Mean)	Low	-2.66	-0.4	0.56	0.8	-1.3	0.97	0.72
Ranges	L to M	-2 to -3	0 to 1	2 to -1	2 to 0	1 to -3	3 to 0	3 to 0

This table shows the relative ranking of the alternatives for all project area tribes by adding the individual ratings for each alternative column and dividing by the total 32 4th-field hydrologic unit codes (sub-basins).

Effects of the Alternatives on Ecological Integrity and Social/Economic Resiliency

Unless otherwise noted, information in this section is based on the Evaluation of Alternatives (Quigley et al. 1997) by the Science Integration Team and a more detailed paper describing the integrity work (Sedell et al. on file at the Walla Walla Office of the ICBEMP).

Chapter 1 describes two primary needs underlying the proposed action: (1) restoration and maintenance of long-term ecological health and integrity; and (2) supporting the economic and/or social needs of people, cultures, and communities, and providing sustainable and predictable levels of products and services. These were examined as part of the *Evaluation of Alternatives*. These needs, combined with the goals for alternatives described in Chapter 3, imply the desire to achieve and maintain a higher level of ecological integrity and social/economic resiliency. The evaluation of ecological integrity and social/economic resiliency are part of a more comprehensive evaluation within this chapter. The information in this section needs to be considered with other information in this chapter for a more complete understanding of how the alternatives respond to the Purpose and Need statement in Chapter 1.

An estimate of current composite ecological integrity across the planning area was made for lands administered by the Forest Service or BLM (see Chapter 2). The evaluation in this chapter also includes an estimate of current social/economic resiliency, and risks to ecological integrity and human assets. In addition, trends in ecological integrity, trends in social/economic resiliency, and trends in risk to integrity and human assets were estimated for each alternative for the next 100 years on lands administered by the Forest Service or BLM.

Ecological Integrity

Current

The SIT recognized that there are no direct measures of ecological integrity and that assessing integrity requires comparisons against a set of ecological conditions and against a set of clearly stated management goals and objectives as described in the alternatives. The SIT also recognized that this process is not a strictly scientific endeavor (Wickium and Davis 1995), because to provide meaning, ecological integrity must be grounded in desired outcomes. The initial estimates were based on current understanding and information, and are not presumed to be absolute.

As discussed in Chapter 2, current ecological integrity was based on the analysis of the 164 sub-basins within the project area. Relative integrity ratings (high, moderate, low) were assigned by sub-basin for forestlands, rangelands, forestland and rangeland hydrology, and aquatic systems. The analysis was based on information from the *Scientific Assessment* (Quigley et al. 1996a,b) and understandings of conditions and trends. At present, 26 percent of the BLM- or Forest Service-administered lands is in high, 28 percent is in moderate, and 46 percent is in low ecological integrity. Map 2-49 in Chapter 2 displays this information.

Future Trends

Methodology

Projecting ecological integrity into the future for each alternative was done based on current integrity, future management actions as defined by alternative, and unplanned disturbance events. Projections of future ecological integrity were made as a composite; no attempt was made to project the individual integrity components. Many elements contribute to composite integrity trends. These elements were represented by three primary indicators or “proxies”:

- ◆ Forestland and rangeland vegetation (as integrated indicators of such elements as

disturbance, succession, management activities, exotic weeds, and habitat);

- ◆ Riparian management (as indicators of such elements as aquatic environment, riparian communities, connectivity of riparian and aquatic ecosystems across Forest Service-BLM-administered land, fragmentation, and habitats); and
- ◆ Road density changes (as indicators of such elements as change in erosion, sediment, aquatic conditions, and exotic weed introductions).

The current composite integrity of sub-basins were rated by alternative as having high, moderate, and low trends compared to historical integrity, and assigned a value of -1 (downward trend), 0 (stable trend), or +1 (upward trend) depending on their conditions for forestland, rangeland, and aquatic ecosystems. The sum of the three indicator variables then resulted in values that varied from -3 to +3 for each sub-basin. A rating of +3 would indicate that all three primary indicators would contribute to positive trends in the overall ecological integrity of a given sub-basin from its current ecological integrity rating. The trend estimates are not indicators of overall ecological integrity in terms of low, moderate, or high; an upward trend within a sub-basin in low current ecological integrity may remain in low condition but be improving.

Results

Summing across all the Forest Service- and BLM-administered lands within the planning area shows that the alternatives provide very different outcomes in overall ecological integrity trends (Figure 4-54).

Alternatives 3, 4, 6, and 7 would show mostly upward trends over time. These alternatives have consistent aquatic/riparian conservation strategies coupled with either passive or active restoration/conservation management emphasis. Restoration actions would focus on restoring biophysical processes, functions, structures, and patterns across the landscape. Alternatives 4 and 6 would show the highest upward trends. Alternative 7 would have many upward trends but is also projected to show some downward trends in the reserves and in some unroaded areas. Over time, natural

disturbance events such as fire, insects, and disease would tend to be of higher intensity and more unpredictable, especially within reserves.

Alternatives 1, 2, and 5 are less focused on restoration of ecological processes, functions, structures, and patterns and would have less consistency in managing aquatic/riparian resources. They would also have less emphasis on reducing impacts from roads. Alternatives 1 and 5 would have more management emphasis on production, which can increase risks to aquatic, riparian, and terrestrial resources. Under these alternatives, many sub-basins would become ecologically stable over time, but many would also show downward trends.

Social/Economic Resiliency

Current

County social/economic resiliency of the 100 counties within the project area was rated using a system of high, moderate, or low. This composite rating system combines three factors: population density, economic diversity, and lifestyle diversity. Methodology is discussed in the *Scientific Assessment* (Quigley et al. 1996a,b). Using this system, there were 17 counties that were rated as having high social/economic resiliency, 30 as moderate, and 53 as low. The high to low ratings are not meant to be value ratings; rather the intent was to describe the county's adaptability to changing conditions. Generally, most of the people in the project area (82 percent) live in counties that are moderately or highly adaptable, as measured by the social/economic resiliency. Most of the land area (68 percent), however, is in the low category. Approximately 53 percent of the population in the project area lives in the high social/economic resiliency counties (15 percent of the project area). Conversely, the 45 most sparsely settled counties have 14 percent of the project area's human population. High social/economic resiliency is associated with more densely populated areas ~ a condition not usually found in areas with a high percentage of lands administered by the Forest Service or BLM.

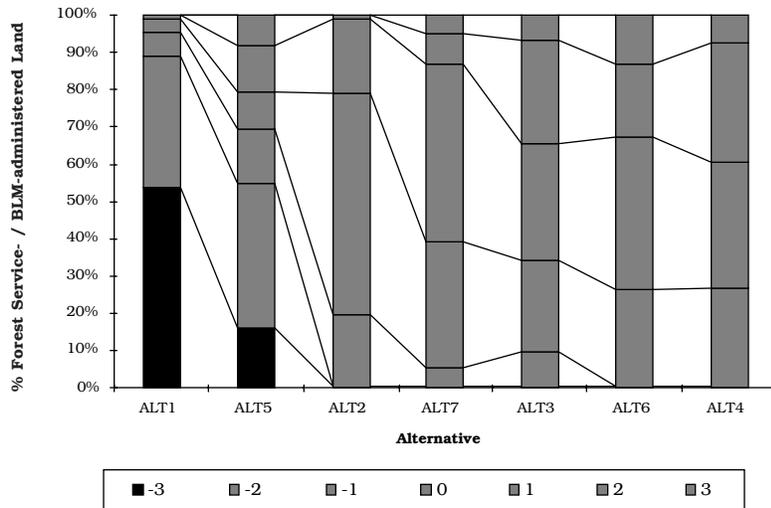


Figure 4-54. Composite Ecological Integrity Trends, Project Area.

Future Trends

Methodology

The effects of Forest Service and BLM resources and management activities on future trends in economic/social resiliency were estimated for each county. Future trends are dependent on current resiliency, future management actions by the Forest Service and BLM, unplanned natural disturbance events (such as floods, fire, and volcanic eruptions), and economic/social changes not necessarily related to Forest Service or BLM policies or management. Recognizing the number of external influences beyond the control of the agencies, this analysis focused on how alternative management strategies might affect resiliency assuming other factors did not change.

As with ecological integrity, there are no direct measures of social and economic resiliency in the literature. This is not strictly a science question. To provide meaning, social/economic resiliency must be grounded to desired outcomes. Population density was assumed to be a good proxy for social/economic resiliency to make some broad projections about future trends because economic resiliency, lifestyle diversity, and population density generally vary with each other. Projecting population density was the most robust and predictable estimate available.

Results

As of 1995, the population of the project area was 3.1 million. Census Bureau projections estimate the counties in the project area will have 6.0 million people by 2045 (*Economics* [Haynes and Horne 1996] chapter of the *Assessment of Ecosystem Components*). This growth rate is higher than the population growth rate for the United States as a whole. Some medium population density counties shift to high density, while some sparsely populated counties become medium density counties. Because of the projected increase in project area population, there will be more and more people in the high density counties. This is particularly true in “recreation” counties, which are projected to attract a disproportionate number of in-migrants (McCool and Haynes 1996). In terms of social/economic resiliency, this means a continued shift toward higher social/economic resiliency, with one exception ~ counties which remain with the lowest population density.

None of the 100 counties are projected to lose population between 1995 and 2045, although a few will have only minor increases. As other areas become more densely populated, these few will be increasingly isolated and have difficulty attracting infrastructure and investments. On the other hand, they will be more apparent as “refuges” for people seeking solitude.

Population increases were not projected to vary by alternative. Thus, changes in social/economic resiliency by alternative were not estimated.

Managing Multiple Risks

Throughout the Evaluation of Alternatives, risks were identified to ecological systems, as well as to society. This can be discussed and displayed in many ways. Two types of risks were evaluated by the Science Integration Team. These were risks to people and their assets from wildlands (such as floods, wildfire, and animal interactions with people), and societal risks to ecological integrity.

Current

Although risks are always present no matter which activities are proposed or where they are located, more risks occur where forestlands are adjacent to non-forestlands. It is typically where natural disturbance processes, such as fire regimes, have been most altered. These lands are also near many communities, which depend on adjacent lands for recreation, livelihoods, and overall quality of life. Fire hazards are typically high. Many of these lands are important wildlife wintering areas or contain habitat diversity or components not found elsewhere. Smoke from wildfire or prescribed fire is often a concern. These areas also tend to have higher road densities affecting habitat, hydrologic processes, and the advancement of exotic weeds.

In areas where populations are expanding the most and wildland ecological integrity is highest, the risks tend to be greatest. Risks are further exacerbated by more limited options for such things as vegetative treatments and prescribed fire. Risks tend to be higher in forested settings than in rangeland settings. Managing these risks will continue to be high priority for the Forest Service and BLM, which will continue the trend of shifting valuable resources and investments from the more general wildland settings to these areas of interface. Considering the risks associated with human and ecological interactions on lands administered by the Forest Service or BLM, nearly 50 percent of the area is rated with a moderate risk and approximately 18 percent has a high or very high risk (see Figure 4-55).

Future Trends

Alternatives 3 through 7 have more emphasis on recognizing these risks than Alternatives 1 and 2. Alternatives 4 and 6 would more actively respond to these multiple risks, especially in placing emphasis on hazard reductions from fire in concert with aesthetics and habitat needs. Alternative 7 would pose greater risks from wildfire, insect, and disease outbreaks in some areas, as natural disturbances may not always be contained within reserves. Alternative 5 places emphasis on these risks, but it would be a more variable response due to different levels of management priority throughout the planning area. Figure 4-56 shows the risks for each alternative.

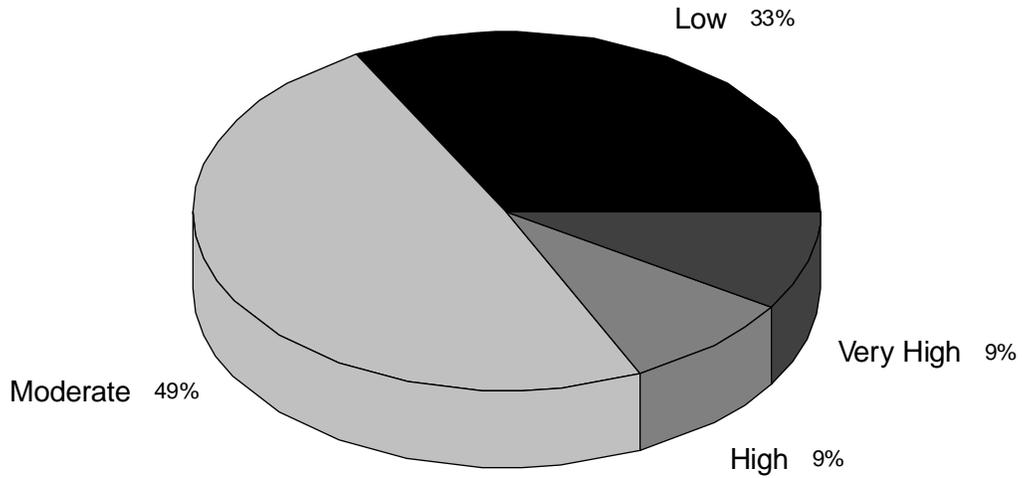


Figure 4-55. Risks Associated with Human and Ecological Interactions, Project Area.

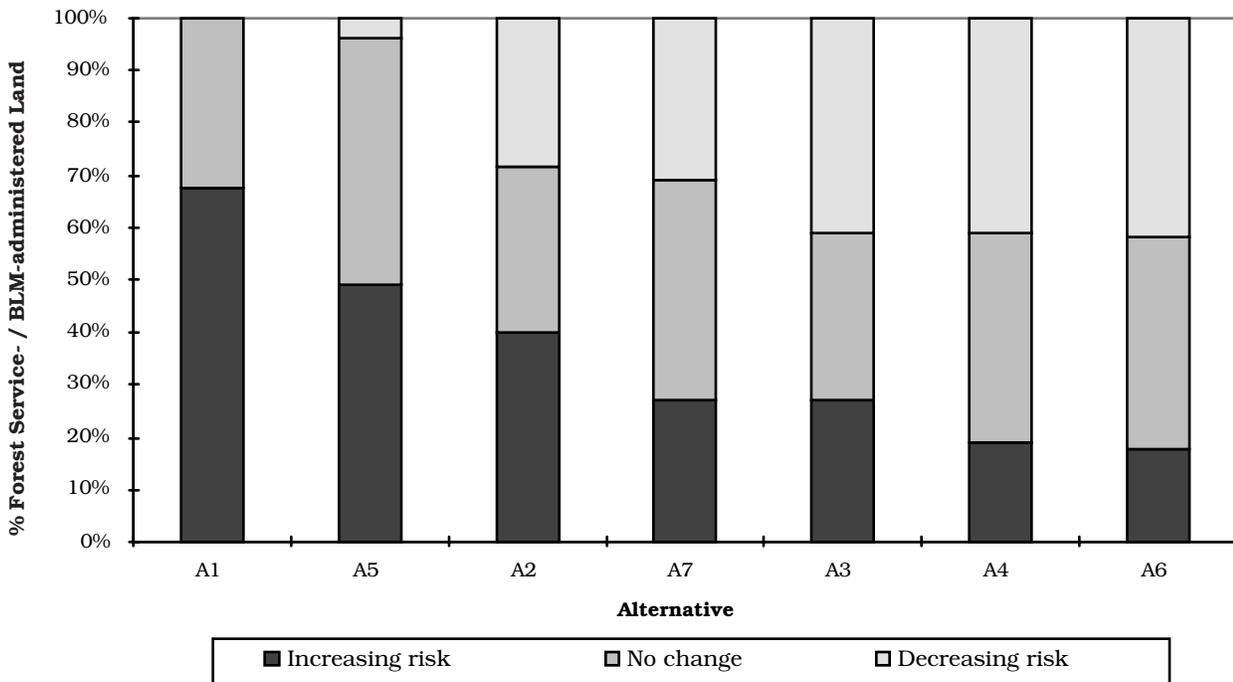


Figure 4-56. Alternatives and Risks, Project Area.

Cost Analysis

Alternatives were compared for their effects on agency budgets. Two steps were developed for understanding the effects: estimates of costs of each alternative, and a sensitivity analysis of each alternative's costs.

The cost estimates shown in Table 4-65 later in this chapter do not comprise the total federal cost to implement an alternative. Costs were estimated only for Forest Service and BLM management activities described in Chapter 3, such as riparian restoration and integrated weed management. These costs vary by alternative and provide one of many ways to compare alternatives. Other costs, such as administrative and research costs were not calculated at the time this chapter was completed. Costs to other federal agencies (for example costs to the National Marine Fisheries Service, U.S. Fish and Wildlife Service, and Environmental Protection Agency for collaboration and consultation required under the Endangered Species Act, Clean Water Act, or Clean Air Act) were not calculated at the time this chapter was completed.

Assumptions

The cost analyses of the alternatives were initiated with an assumption that Alternative 2 should probably reflect current budget levels and agency costs. This assumption allowed for comparison of costs to current budget information for a "baseline" condition. This approach could help determine how the cost estimates developed for each alternative compare to current budget levels.

For the development of cost estimates, it was assumed that average costs for a certain activity would properly reflect the true costs for these activities in the project area. One set of average costs was developed to be applicable for both the Eastside EIS and the Upper Columbia River Basin EIS.

It was also assumed that decisions made in the EISs reflect only a portion of current agency budgets in the region. Many programs currently operated by the Forest Service or BLM will not be affected by decisions from the EISs.

Methodology

Estimates of the probable costs of implementing the alternatives were developed by a team of representatives from the EIS Team and budget office representatives for the Forest Service Pacific Northwest Region and Intermountain Region, and BLM state offices in Idaho and Oregon. Data sources for estimates included information on file in regional, state, and Forest/BLM district offices and national level publications of the agencies. At the time of the development of cost estimates, the team consulted with several field offices to gather information.

For most items the approach for cost estimates was to price each activity or requirement by estimating a cost per unit (such as the cost of pre-commercial thinning per acre), and calculating total costs based on the level of activity proposed for each alternative. Costs were calculated for a ten-year period and then presented as annual costs, with annual costs being one tenth the ten-year costs (inflation factors were not included). The effort to develop implementation costs was to report the relative differences in potential effects on agency budgets, not necessarily to show an overall agency budget based on each alternative. Many Forest Service and BLM management activities are outside the decisions to be made in this EIS.

Cost estimates on a "per acre" basis were developed for the following activities: improved livestock management, rangeland improvements, integrated weed management, prescribed burning, riparian improvement, range monitoring and inventory, commercial timber harvest, pre-commercial thinning, prescribed burning in forests, watershed restoration, forest monitoring/inventory, required Ecosystem Analysis at the Watershed Scale, optional ecosystem analysis, and public involvement. Road closure costs were developed on a per mile basis, and included assumptions for different types of road closures (restricting access versus obliteration to meet watershed objectives).

Cost estimates were intended to err on the side of being higher than may be experienced by some or most of the operating units. For example, timber sale preparation and administration costs (exclusive of National

Environmental Policy Act costs and road building) in Alternatives 3 through 7 were assumed to be 30 percent higher per thousand board feet than for Alternative 1.

The management activity tables in Chapter 3 (Tables 3-6 and 3-7) provide activity levels for watershed restoration on a per acre basis, but cost estimates were not developed on this basis because of the need to first define the level of road closures and other activities (thinning, prescribed burning) which would also contribute to watershed restoration. In addition, Tables 3-6 and 3-7 display several actions under watershed restoration, including: increased road maintenance, improved road condition (surface and/or drainage), reduced road related erosion, obliteration of already closed roads, increased coarse woody debris, riparian plantings, and in-channel restoration.

In an effort to estimate social/economic impacts, it was necessary to develop a package of watershed restoration activities, some assumptions regarding their impact on a watershed, and from that, project an overall cost of watershed restoration by alternative. Aggregating different proposed restoration activities and relating them to the number of acres of watershed restoration was difficult. For example, activities such as road maintenance or in-channel improvement are usually expressed in terms of miles (either improved or decommissioned). To present cost estimates, several assumptions were needed: first the link between specific activities and amount of forestland acreage affected, secondly a suite of watershed restoration activities.

Until these relationships are further defined, an activity- or component-based cost estimate for watershed restoration would be difficult to develop. In the interim, cost estimates for watershed restoration presently consist of an assumption where Alternative 2 equates to the current costs of watershed restoration. Costs for the other alternatives were then varied based on the watershed restoration level of activity for each alternative. Alternative 4 had the highest funding and activity level and Alternative 7 had the lowest.

With only limited information (beyond some objectives and standards) for development of a monitoring program, costs for monitoring were estimated based on acreage of rangeland and

forestland (based on vegetation), and an estimated monitoring cost per acre. This cost per acre was varied by alternative to respond to the theme of the alternative.

Costs were not estimated for: adaptive management, developing a road management strategy at the local level, developing snag and coarse woody debris direction at the local level, consultation costs with Indian tribes, fuels reduction in wildland-urban interface areas (assumed to be covered by timber harvest, thinning and prescribed fire activities), community economic development participation, use of native plant species for post-fire rehabilitation over less expensive and more available non-native sources, recreation site development and improvements, interpretive facilities, current road maintenance, setting priorities within each 4th-field HUC (sub-basin) for vegetation management and restoration activities, and designing all stream crossings to handle a 100-year flood event. Of all these costs, potentially the most significant cost over time would occur with reconstructing stream crossings, but there was no information on the number of stream crossings that needed to be addressed on over 65,000 miles of roads on BLM- and Forest Service-administered lands. Nevertheless, this cost item was partially addressed in road closure and watershed restoration activities.

This section does not include costs of wildfire suppression. Costs estimated from the Landscape Ecology section of the *Evaluation of Alternatives* (Quigley et al. 1997) were reported in the section on Human Uses and Values. The 10-year cost estimates for fire suppression underestimate potential suppression costs because the Columbia River Basin Successional Model (CRBSUM) does not model the growth or spread of wildfires. In addition, wildfire suppression costs are largely affected by emergency suppression funding at the national level, while this section provides cost estimates for the alternatives at the regional or local level. No cost estimates for post-wildfire rehabilitation were developed, as these costs are usually provided by national emergency funds, as well.

A significant additional cost item beyond the activity tables (Tables 3-6 and 3-7) in Chapter 3 was for Integrated Weed Management. Alternatives 3 through 7 provide overall policy level direction, and the levels of "improve

rangeland” activity reflect current understanding of the geographical extent of the noxious weed problem. Application costs and acreage combine to create a very significant annual and 10-year cost.

Based on total annual implementation costs of the alternatives, it appears that Alternatives 3, 4, and 5 would have the greatest relative increase in costs compared to Alternatives 1 and 2 as (the baseline alternatives).

Results

Activities and costs which may or may not be directly or indirectly affected by the EIS are not included in the cost calculation tables. For example, the annual cost estimate for Alternative 2 is substantially less than the total estimated annual budgets for the Forest Service and BLM in the Eastside planning area. Table 4-65 provides an annual estimate of costs for each alternative.

Sensitivity Analysis

Some requirements can be considered additional costs to current agency land management. The costs of an Integrated Weed Management Strategy for rangelands is one such cost. Some costs represent no additional cost, but instead a reprioritizing of existing resources to meet the broad-scale ecosystem objectives of the alternative. The cost for rangeland improvements is one example of this kind of cost. Other additional costs, such as required ecosystem analysis, will partially substitute for agency costs connected with preparation of NEPA documents, providing partial savings.

The performance of the alternatives under different funding levels could be inferred by examination of those cost items which are more dependent on increases in appropriated funds. The EIS Team selected several cost items on which full implementation are highly sensitive, moderate to highly sensitive, moderately sensitive, or have low sensitivity to appropriated funds in order to achieve implementation (see Table 4-66). The highly sensitive items included new programs with significant expenditures, or programs which have experienced chronic under-funding, such as integrated weed management, forestland and rangeland monitoring, additional ecosystem analysis, road closures in rangelands, and public involvement. Moderate to highly sensitive items are those which need a significant increase in budget, but which may be funded by commercial timber sales as well as appropriated funds, include watershed restoration and road closures in forestlands. Items with moderate sensitivity are those where there is an increase in budget but the amount of increase may not be as significant include prescribed burning (on both forestland and rangeland), improved livestock management, and precommercial thinning. Items with low sensitivity are those where funding has traditionally been available or the overall cost is low, and include commercial timber harvest, required watershed analysis, riparian improvements, and rangeland improvements.

A comparison of the alternatives shows that Alternative 1 would have the highest proportion of projected activities in line items which may be least sensitive to appropriations (see table 4-66), followed by Alternatives 2 and 5. At the other end of the spectrum, Alternative 7 would be most sensitive to appropriations and Alternatives 3, 4 and 6 would fall in the middle.

Table 4-65. Costs of Alternatives¹ and Actual Obligations for Fiscal Year 1999, Eastside Planning Area.

Management Actions(s)	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
	(in thousands of dollars)						
Sub-basin Review ²	-	-	560	560	560	1,680	306
Ecosystem Analysis at the Watershed Scale	354	519	3,080	3,080	3,080	6,160	3,080
Road Condition Risk Inventory (Yrs 1-2)	-	-	333	333	333	333	333
Access and Travel Management Plan (Yrs 3-7)	-	-	1,680	1,680	1,680	1,680	1,680
Develop Interagency Monitoring Protocol	-	-	250	250	250	250	250
Monitoring & Inventory	9,753	10,761	11,338	11,906	11,338	11,906	11,338
Integrated Weed Management	500	500	6,640	9,080	5,040	5,600	2,240
Public Involvement	385	290	372	429	419	365	210
Tribal Consultation	-	-	1,620	1,620	1,620	1,620	1,620
Survey & Nominate Cultural Sites	-	-	1,700	1,700	1,700	1,700	1,700
Tribal Native Plant Conservation	-	-	170	170	170	170	170
Improve Livestock Management	63	184	184	309	171	309	114
Range Improvements	168	168	498	681	378	420	168
Prescribed Fire, Range	105	105	185	207	135	210	180
Riparian Restoration	32	32	80	88	80	88	64
Road Closures, Range	123	123	132	358	167	257	336
Commercial Timber Harvest	74,115	47,520	50,673	53,564	64,617	43,729	21,910
Pre-commercial Thinning	7,125	7,500	11,250	13,500	10,875	12,750	4,575
Prescribed Fire, Forest	2,280	2,280	6,750	9,750	6,300	8,850	7,080
Watershed Restorations	1,739	2,808	2,808	5,538	4,469	4,875	1,739
Road Closures, Forest	700	1,923	3,076	3,770	2,184	2,656	2,274
TOTAL	97,442	74,713	103,379	118,573	115,566	105,608	61,367
Restoration Activities subtotal	86,950	63,143	82,276	96,845	94,416	79,744	40,680

¹ The cost estimates shown in this table do not comprise the total federal cost to implement an alternative. Costs were estimated only for Forest Service and BLM management activities described in Chapter 3, such as riparian restoration and integrated weed management. These costs vary by alternative and provide one of many ways to compare alternatives. Other costs were not calculated as of the printing of this chapter, but were subsequently generated and used in selection of the Preferred Alternative. These include, but are not limited to, costs to other Federal agencies (for example costs to the National Marine Fisheries Service, U.S. Fish and Wildlife Service, and Environmental Protection Agency for collaboration and consultation required under the Endangered Species Act, Clean Water Act, or Clean Air Act), administrative costs of the Forest Service and BLM, research costs, and wildfire suppression costs.

² Cost for Alternative 6 is the highest because EM-S1 requires all sub-basin reviews to be completed in one year for that alternative, one-third of sub-basin reviews in one year for Alternatives 3, 4, and 5; and prior to initiating management activities for Alternative 7.

Table 4-66. Relative Cost Sensitivity for the Alternatives, Eastside Planning Area.

	Alternative						
	1	2	3	4	5	6	7
<i>thousands of dollars</i>							
Sensitivity Analysis on Funding Increases							
High	10,938	\$11,934	\$23,179	\$26,470	\$21,661	\$24,295	\$18,694
Moderate to High	2,616	4,991	10,581	14,005	11,350	14,328	8,583
Moderate	9,573	10,089	18,369	23,766	17,481	22,119	11,949
Low	74,315	47,720	51,251	54,333	65,075	44,237	22,142
Total	97,442	74,713	103,379	118,573	115,566	105,608	61,367
<i>percent</i>							
Percent Distribution of Sensitivity							
High	11	16	22	22	19	24	30
Moderate to High	3	7	10	12	10	14	14
Moderate	10	13	18	20	15	21	19
Low	76	64	50	46	56	42	36
Total	100	100	100	100	100	100	100

This table applies to the Eastside planning area.