C I N T R A F O R

Special Paper

18

EASTERN WASHINGTON TIMBER SUPPLY ANALYSIS

Principal Authors:

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Research Support:

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January 1995

CENTER FOR INTERNATIONAL TRADE IN FOREST PRODUCTS
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CINTRAFOR SPECIAL PAPER 18

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ACKNOWLEDGEMENTS

A study of this scope and complexity could not be completed without the assistance and cooperation of many individuals and groups. Financial support was limited given the difficulty of the project, but the Washington State Department of Natural Resources (DNR), the University of Washington College of Forest Resources and Center for International Trade in Forest Resources (CINTRAFOR) provided funding. Steve Archie, former administrator for the College, paved the way for arranging the financial support and the assistantships for graduate students. Dr. Ralph Alig, study manager for the Westside study, provided initial assistance in the early formulation and frequent assistance in understanding consistency issues with the Westside study. CINTRAFOR staff analyst John Dirks wrote the forest industry employment impact section and helped edit and review the entire document. Graduate students Joao Batista, Guy Robertson, Yujaio Wang, and Jeff Moffett all contributed immensely to the computational support for the analysis. Scot Zens, a graduate student and co-author, carried the major load in providing simulations and went beyond the call of duty in resolving problems. David J. Anderson also provided assistance in the early stages of the study.

Without the Forest Inventory and Analysis project at the Forest Service's Pacific Northwest Research Station there would be no study, since it provided the basic survey plot data for modeling the Eastside forests. To characterize management plans in the future, key contacts were made with representatives of the forest industry, Native American tribes, Washington State Department of Natural Resources and nonindustrial owners. Bob Gustafson, of the Washington Forest Protection Association, provided important assistance in making industry contacts and reviewing the preliminary approach planned for the study. Nels Hanson, of the Washington Farm Forestry Association, provided a number of contacts for nonindustrial owners; Jim Cathcard, of the US Bureau of Indian Affairs (BIA), put us in contact with Native American forest managers in each region; and Charles Chambers, of the DNR, provided information and contacts for state lands. The Washington Employment Security Division helped us obtain employment data for the forest sector on the Eastside.

When we ran into technical difficulties in obtaining consistent projections for plot samples, Mike McGreevey, of Boise Cascade Corporation, provided enormous assistance in helping us structure a system to project every survey plot forward in time with a select set of management alternatives.

High on the scale of importance was Dean David Thorud's persistent encouragement as we worked our way through significant technical problems and his continuing support for adjustments to a constrained budget.

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EXECUTIVE SUMMARY

The Washington State Legislature commissioned a study of future timber supplies for the state during the 1990 session. The analysis for Western Washington was completed and documented in the publication titled "Future Prospects for Western Washington Timber Supply." The Western Washington ("Westside") study benefited from an enhanced inventory of state and private forests involving a doubling of inventory plot measurements by the Forest Inventory and Analysis (FIA) Unit of the US Forest Service. After completion of the Westside survey, a more limited survey of Eastern Washington ("Eastside") was undertaken which provides the primary data for this report on Eastern Washington's potential timber supply.

Eastside forests are more varied in structure than those of the Westside, yet the number of inventory plot measurements per acre of forest is substantially lower. Hence, the objectives of the Eastside study are more limited. The study attempts to identify the potential range of future timber harvests in Eastern Washington, highlighting those aspects of policy, resource base, and owner behavior most significantly impacting the harvest over time.

The issues of forest age and health are fundamentally different than for the Westside. Most Eastside forests are managed as uneven-aged, so the age class distribution is less important. Nevertheless, there are significant forest health issues that can be affected by management decision.

Commercial timberland covers 7.4 million acres of Eastern Washington, 28% of the land area. About 25% of these acres are reserved from timber utilization by statute or administrative regulation, mostly on federal lands. Consequently, 5.6 million acres are "available" for timber production, with just over 4 million acres on non-federal lands.

The dominant species are ponderosa pine and Douglas-fir or western larch, making up a majority of the timber on over 75% of the non-federal land. The distribution of site class by owner is generally well balanced across owners and regions.

Eastside forests are characterized by substantial differences in stand structures. Each FIA survey plot was grown over time under a number of simulated management alternatives which were estimated from a survey of the owner groups' intentions. Harvest schedules were simulated under a number of different conditions, including variations in the amount of decline in the harvest that would be acceptable from decade to decade, alternative management intensities, and regulatory or land-availability constraints.

There are many reasons to avoid interpreting these results as a precise portrayal of future harvests: accuracy of the basic FIA data, the uncertainty in yield projections, the realism of future management assumptions, the absence of natural disturbances, instability in future markets, and changing forest policies. However, the evidence suggests a potential range of harvests for state, private, and Native American lands relative to the recently-revised management plans for federal forests. The importance of management practices and policies that will affect these practices, including forest health options, is also apparent. The Eastside results do, however, fall short of the Westside study in predictive power because of less certain inventory data and much greater variation in stand conditions.

Historic harvest rates show wide year-to-year variation around a 1,100 million board foot trend. The historic harvest rate in Eastern Washington over the last 30 years has fluctuated as much as 25%, around a fairly stable trend. There is some evidence that changing supply conditions as well as the business cycle affect the harvest rate, especially at the timbershed level. The large variations in harvest rates from peak to trough provide evidence that the region is likely a marginal supplier that is impacted by competitiveness with other regions. When market conditions are weak, production declines more than in other supply regions.

Potential future harvest levels over the next 100 years differ according to a large number of factors. Under initial condition assumptions, based on FIA inventory data, simulated growth and yield projections, and estimates from land management plans for the national forests, harvest levels range from 1,207 million board feet (MMBF) per year (average for the first decade, 1991-2000) when harvests from one decade to the next can not vary by more than 5%, to 1,897 MMBF when there are no harvest flow constraints. Compared to the 1985-92 base period, these are increases of 0.2 to 57% for the first decade. Extending the harvest period to the next 100 years, the average harvest is 1,173 MMBF under the ±5% constraints to 1,234 MMBF with no constraints, a -2.5 to +2.5% range over the base period harvest. Initial conditions also assume no new regulations on state and private lands. While these potential harvest levels suggest that historic rates of harvest can be sustained, actual harvest levels will probably fall short of this potential, as they have in past years.

This potential harvest level and similarity to the historical trend also hide large uncertainties relative to market conditions, owner behavior, forest health conditions, natural disturbance, policy changes, and environmental constraints. At the regional level, projections show an increasing harvest potential for the Inland Empire timbershed but a decline in harvest potential for the Central area.

By ownership, the greatest annual harvest decline is expected in the national forests, where a decrease of about 229 MMBF per year is expected relative to the 1985-92 base period. Under the ±5% harvest flow constraints, projections also show that forest industry harvest levels are likely to decline by about 120 MMBF per year in the first decade (1991-2000) relative to the 1985-92 base period. However, this decline can be offset in the short term if harvest flow constraints are relaxed to allow an accelerated harvest of mature inventories with the attendant decline in harvest in later decades. The DNR could potentially increase harvest levels by 70 MMBF during the first decade, and both Native American and nonindustrial owners could each increase harvest by about 140 MMBF to offset the federal and forest industry declines under the ±5% harvest flow constraints. Over history, substantial changes in harvest levels of the different owner groups have produced a rather stable trend for the total Eastside region. The estimated potential harvest levels suggest the same could be possible in the future for non-federal lands.

The impact of environmental constraints is uncertain. The open question is whether the same environmental factors that are contributing to a dramatic decline in federal harvest will have a substantial impact on the non-federal harvest as well. A harvest sensitivity analysis for the non-federal forests suggests a wide range of outcomes is possible. When questioned on the likely impact of forest practice changes, private owners expressed concern that there could be a 15-20% reduction in productive acres through mandated reserves such as streamside buffers and other habitat requirements, leading to a 10-12% decline in annual harvest volume under the ±5% harvest flow constraints. This impact would be immediate, since it would reduce the available harvestable inventory. Sensitivity analysis with no constraints on decade-to-decade harvest level changes shows that non-federal owners have as much as 7.0 billion board feet of marketable or essentially mature inventory which could be liquidated over a 10-20 year period and potentially offset the immediate impact of increased harvest constraints.

Excess mature inventory could be used to offset constraints in the near term. Using flow constraints to model harvest intentions is at best only an approximation of some owners' rationale for smoothing out harvest levels over time. The favorable economics of harvesting timber as soon as it is mature generally cause substantial year-to-year changes for these owners. Inventories do not steadily move toward maturity because they are impacted by prior natural disasters, changing market patterns, and purchase decisions. With no consideration for stabilizing (unconstrained) harvests, some owners would be expected to liquidate their mature inventory quickly. Early liquidation also promotes management of the stand at an earlier date, thereby increasing land productivity. Such an unconstrained harvest simulation produces a 6% increase in harvest over the long term relative to the 5% harvest flow constraint, while also gaining the economic value of several billion board feet of mature inventory in the first two decades. To a considerable degree the tendency for some owner groups to liquidate mature inventory explains some of the variations in harvest levels between one owner group and another over the historic period. Inventory on forest industry land was most likely harvested as soon as it was mature and economical to harvest, subject to the need to stabilize the flow of wood to mills. DNR and nonindustrial owners, on the other hand, feel less economic pressure and have maintained more mature inventory. They will benefit more from the decline in federal and forest industry harvest levels in the future.

Harvest levels may be impacted by future timber management changes. Harvest levels are also sensitive to management assumptions. In comparison to the initial conditions with ±5% harvest flow constraints, increasing management to the highest levels on non-federal land with no harvest flow constraints increases the harvest level over the next 100 years by 135 MMBF per year. Harvests in the first decade are large and well above sustainable levels but can be partially restored in 80 years. In effect, the liquidation of the mature inventory, in conjunction with increased management of harvested acres, produces nearly the highest long-term harvest, but at the expense of a 30% reduction in harvest for a few decades beyond the first. These sensitivity alternatives suggest one possible response to the increased environmental constraints on private harvest would, therefore, be to accelerate the liquidation of mature inventory, thus postponing the impact of the constraints. Assuming no more than a 5% departure from even-flow harvest levels, a 20% acreage boost to the next higher management level in conjunction with 15% decrease in the productive area results in a 6% reduction in harvest over a 10-decade period but with almost no loss in harvest at the end of the period. On the other hand, if environmental constraints interfere with the motivation to increase management by increasing the cost of management, there could be a reduction in management, compounding the impact of reduced land availability.

Forest health issues increase the motivation for earlier harvests and investment. Attention to forest health issues may increase the near term harvest and increase the long-term harvest at the expense of lower harvest levels over the intermediate decades.

Forest health issues include problems of imbalances of forest structures or processes, such as excesses of dense or multi-canopy stands susceptible to insect attacks, mistletoe, fungi, and fire. Past management and natural cycles have led to many forest stands in Eastern Washington being attacked or susceptible to attack by bark beetles (over-crowded stands), mistletoes and defoliating insects (multiple canopy stands), and root or stem rots (over-crowded or previously injured trees). These conditions not only reduce volume through rotting wood or killing trees, they also lead to increased forest fires.

Active management for forest health could lead to thinning or harvest of "unhealthy" stands and active management of other stands to avoid the unhealthy conditions. These activities would lead to increased harvest in the short term, less harvest in the intermediate term, and higher harvest in the long term as the earlier-harvested stands become available for harvest again.

Another scenario would be for the unhealthy stands to burn in wildfires (a highly likely scenario for many areas). Such fires occurred in 1994 will probably occur again in the next three decades. Sporadic salvage harvesting could occur for about three years after the fire, creating "pulses" of wood from the burned areas. If the fires are large enough, they will create the same pattern of harvest as more intensive management with high harvest levels in the next few decades, low harvest levels in the intermediate decades, and high harvest levels in the long term as the burned stands again become harvestable, assuming the post-harvest stands are managed (regenerated or thinned, as necessary).

If neither fires nor harvesting occur to a large degree in unhealthy stands, the result will be a decline in harvest levels at all times, since there will be a reduction in volume produced by the unhealthy stands.

The standing inventory volume may remain stable, but the mean diameter will decline. Under initial condition assumptions, the standing inventory volume remains stable over time. If the mature inventory is harvested early, stand inventory volume declines. Sensitivity analysis shows that the highest levels of management and most rapid levels of inventory reduction reduce the standing inventory by over 30% by 2090.

The average diameter of trees harvested decreases with the reduction in mature inventory from approximately 20 inches to 14 inches over 90 years; hence, the relatively stable inventory is made up of a larger number of smaller trees. Alternatives that result in a more rapid liquidation of mature inventory and intensive management lead to a more rapid reduction in the diameter to about 13 inches. The reduced average diameter at harvest may not mean reduced wood quality if the harvest tree size is made more uniform. Presently, many stands contain a few large trees and many small trees as a result of past selective harvesting. Other stands are over-crowded and contain many very small stems, resulting largely from past stand-replacement fires.

The increasing share of grand fir in the late decades is evidence of generally undesirable shade tolerant, fire intolerant, and disease susceptibility trends under almost all alternatives. These scenarios suggest that even selective cutting that emphasizes leaving preferred trees for the next growth cycle may not be sufficient to contain health degeneration in the absence of occasional fires.

Employment will be impacted by harvest levels. Historically there has been a reasonably stable relationship between harvest level and employment. The forest sector directly employes about 7,000 workers in the region. Labor productivity gains have not been steady and have been impacted both by the severity of business cycles and, even more substantially, by the price of the resource. More labor is used when resource prices are high, than when prices are low, so higher values can be obtained from the resource. A decline in federal and forest industry harvests may be at least partially offset by increases from other owners; but if they are not, the annual harvest could decline by about 348 MMBF per year, leading to an employment decline of over 2,000 jobs in the forest sector. If prices remain high, they will induce a substantial offset to employment losses from reduced harvest. Employment could also be higher with high management levels or lower with policies that inhibit management.

Summary: Non-federal harvests may be stable, but only through a market- and policy-sensitive shift in share. The potential harvest level on non-federal lands appears to be relatively stable in the aggregate but requires a shift from forest industry harvests to other owners and from the Central Cascades to the Inland Empire timbershed. Forest practice constraints may cause a 10-12% reduction in the harvest on non-federal lands, but the existence of significant mature inventory could reduce the impact of this over several decades. There is also a chance that increased management activities could offset some of this impact over the longer term.

Environmental constraints, management practices, market conditions, forest health, natural disturbance and policy are all likely to be important determinants of future harvest levels. The decline in federal harvests and constraints from changes in forest practices on private harvests, accompanied by the decline in industry harvest based on declining mature inventory, may be more certain than increased harvests from DNR and Native American lands or increased harvests from managing lands more intensively. With declining harvests resulting in high prices, increased harvests from nonindustrial lands are more likely, potentially offsetting the industry decline. An overall decline in harvest of about 100-200 MMBF, or 9-18% of the historical average, is likely, even without additional constraints from changing forest practices. Part of this decline could be deferred by several decades by accelerating the removal of existing mature inventory.

I. INTRODUCTION

Origin of the Study

The 1990 Washington State Legislature commissioned the College of Forest Resources, University of Washington, to conduct a study of future timber supplies in the state. The analysis for Western Washington, comprising the 19 counties west of the Cascade crest, was completed in 1992 and published as "Future Prospects for Western Washington Timber Supply."[1] The present report completes examination of the state's timber resources by analyzing the 20 counties east of the Cascade crest.

As documented in the 1992 report, the objectives for the Westside study were to: (a) identify the potential range of future timber harvests in Western Washington under a variety of assumptions about owner behavior, policy, and the resource base, and (2) translate harvest and inventory projections into prospective impacts on two key economic and environmental quality measures: employment and the suitability of habitat for an array of wildlife species. The Westside study benefitted from an enhanced inventory of state and private forests involving a doubling of inventory plot measurements by the Forest Inventory and Analysis (FIA) Unit of the US Forest Service. It was envisioned that this would allow timber inventory aggregations to be made at the county level, although this was later found to be unattainable. Largely because Eastside forests are more varied in structure, it was determined that an enhanced survey would not readily lead to statistically significant data at the county level. Thus, the FIA survey of Eastside forests (conducted one year after the Westside survey) included only 560 plots compared to 2,020 plots for the Westside. As a consequence of more inherent variation and fewer survey plots, the results of this study possess larger sampling errors and less precision than did the Westside results.

To support the Eastside study, supplemental funding was obtained from the Washington State Department of Natural Resources (DNR) with additional contributions from the College of Forest Resources and the Center for International Trade in Forest Products (CINTRAFOR). In lieu of a broad steering group, several forest industry, Native American, Bureau of Indian Affairs (BIA), and DNR experts advised the authors on specific technical issues.

Study Objectives

Partly for the above reasons, the objectives of the Eastside study are more limited than those established for the Westside study. The broad objective is to identify the range of potential future timber harvests in Eastern Washington, highlighting those aspects of owner behavior, policies, and the resource base most influencing the harvest over time. While an analysis of suitable habitat was part of the Westside report, neither the funding made available nor the existence of adequate base data allowed measures of wildlife habitat to be a part of the Eastside

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[1]Available as Institute of Forest Resources Contribution Number 74, College of Forest Resources, University of Washington, Seattle WA.

study. Employment impacts associated with alternative harvest projections are presented. Since the data sources are not sufficient to consider county-level projections, only an aggregate measure of the impact on direct forest sector employment is provided, without a thorough analysis of downstream or indirect economic impacts.

Issues of age class structure and forest health are fundamentally different on the Eastside. Most Eastside forests are not managed under even-aged management systems, so the age distribution of the standing inventory is of little interest. However, due to the existence of significant forest health issues, a secondary objective of the study was to characterize how harvest plans and management alternatives may impact the future health of Eastside forests. Key questions the study attempts to answer are:

* What is the potential range of future timber harvests for state, forest industry, Native American, and nonindustrial timberlands in relation to the proposed timber harvest levels for federal forests?
* How sensitive are future timber harvests to changes in assumed management practices and land allocation decisions?
* How might forest health issues impact harvest levels?
* How do the Eastside results compare to the Westside results given the differences in data quality, composition and structure of the forests, the inherent variation in growing conditions, and the differences in site productivity between the two regions?

Methodological Issues

The primary methodological issues which required attention early in the study were: (1) selection of a model for predicting the future growth and yield of existing and regenerated timber stands under a variety of management prescriptions, (2) development of a model for scheduling timber harvests (by decade) over a 100 year projection period, (3) specification of the types of timber harvest flow constraints to use in the timber harvest scheduling model, and (4) resolution of procedures for grouping FIA plots by ownership, timbershed, and forest type (or plant association).

The PROGNOSIS growth and yield model was selected for projecting all FIA plots over the 100 year projection period. Comparisons of model projections with actual plot measurements indicated that model behavior and performance was acceptable. Given the large proportion of lands managed as uneven-aged in Eastern Washington, and the non-age-based harvest decisions common in the region, use of the ATLAS scheduling model for harvest simulations (used in the Westside study) was abandoned. Instead a more flexible linear programming approach was adopted. The objective of the LP model was to seek the maximum timber harvest possible over the 100 year projection period consistent with the inherent productivity of the land base, the defined management prescriptions, and the assumed timber harvest flow constraints. Four different types of flow constraints were used: (a) unconstrained, wherein the estimated timber harvest from one decade to the next may increase or decrease by any amount; (b) even-flow, wherein the estimated timber harvest from one decade to the next must be constant; (c) ±5%, wherein the estimated timber harvest from one decade to the next may increase or decrease by a maximum of 5%; and (d) ±25%, wherein the estimated timber harvest from one decade to the next may increase or decrease by a maximum of 25%. No attempts were made under any of the flow constraints to link the harvest in the first decade of the 100 year projection period to historical levels of timber harvest.

The Eastside was split into two timbersheds (Inland Empire and Central Cascades) and harvest projections were made for four ownership classes (DNR, forest industry, nonindustrial (including other public[2]), and Native American). A fifth owner class (US Forest Service) was not modeled. Instead, projected timber harvests were taken from available forest plans and other documents for national forests on the Eastside. Taken together, the five owner classes constitute the total Eastside timberland base.

Due to the degree of heterogeneity of stand structures in Eastside forests, and the dependence of growth and yield predictions upon stand structure, aggregating the 560 FIA plots into a reduced number of categories and growing them over time proved not to be a feasible strategy. We found that growth predictions made from the aggregated plots were significantly different than aggregated predictions made from individual plots. With forest industry assistance, an automated routine was developed to use the PROGNOSIS growth model on each individual survey plot. Based upon stand structural characteristics and species composition, each sample plot was classified as even or uneven-aged and assigned to one of five forest type or plant association categories. Using PROGNOSIS, each FIA plot was projected separately using the appropriate management prescriptions. The eight management prescriptions defined for the study represent: (a) no management; (b) four levels of management intensification under even-aged management; and (c) three levels of management intensification under uneven-aged management. These management prescriptions were obtained from interviews with representatives from each of the land owner groups. Common definitions of management prescriptions were applied across all ownerships, timbersheds, and forest types (or plant associations).

The proportion of acres within an ownership, timbershed, and forest type (or plant association) to be assigned to the eight management prescriptions was based upon input from the four owner groups. The assignment of plots to each management prescription and the resulting timber harvest flows was an output of the linear programming model. Based upon these initial conditions, a series of linear programming runs was made for each of the ownership/timbershed combinations under each of the four timber harvest flow variants. For each of these runs, we present results showing: (a) timber harvest flows over the 100 year projection period, (b) quadratic mean diameter of harvested timber, (c) species composition of the harvest, and (d) level of the residual inventory. We also report the total harvest over the 100 year projection

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[2]This ownership category consists of all public timberland other than DNR and US Forest Service and accounts for less than 5% of the nonindustrial land base.

period as well as the average annual harvest for the first two and the last two decades in the ten decade period.

In order to enumerate the range of timber harvests given alternative management scenarios, a sensitivity analysis of harvest levels to a number of factors was conducted. These factors included the level of investment in forest management as reflected by changes in management intensification, land base reductions, and specific combinations of the two. Each sensitivity analysis investigated changes in: (a) timber harvest flows over the 100 year projection period, (b) quadratic mean diameter of harvested timber, (c) species composition of the harvest, and (d) level of the residual inventory. As for the base runs, we also report the total harvest over the 100 year projection period as well as the average annual harvest for the first two and the last two decades in the ten decade period.

Inherent Uncertainties

All projections are subject to a range of uncertainty. This is not the result of sloppy analysis but is the direct consequence of the inherent variation found in the Eastside forests. Large variation coupled with a relatively light sampling intensity leads to wide bands of uncertainty about sample-based estimates. For example, in conducting this study, we relied entirely on the 560 FIA survey plots to characterize the current condition of Eastside forests as of 1990. In comparison, the Westside study relied on 2,020 sample plots. In terms of sampling intensity, the Eastside sampling rate was about one in 7,200 acres compared to about one in 3,700 acres for the Westside. When this lighter sampling intensity is coupled with the wider inherent variation in stand conditions, the error surrounding future estimates is increased. In addition, growth and yield simulations are much less robust and subject to larger errors for the Eastside forests as compared to those west of the Cascade crest. And, natural disturbances including major fires and disease play a larger role. Lastly, the range of best silvicultural practices available to owners of Eastside forests is greater owing to the larger variation in species composition and structural characteristics of the stands. And, many owners may choose to deviate significantly from their basic management strategy to manage for fire and disease protection.

In comparing these projections to historical reports of harvest by owner groups additional uncertainties may become important. The measurement of volume for forest products is difficult as it depends upon both arbitrary merchantability standards as well as scaling conventions. We use the Scribner 16-foot log board foot scale because it is most prevalent in harvest reports. There is also the potential for harvests to come from land not identified in the survey as "available" for production. If this volume is significant the simulations could understate potential harvest. There may also be under-reporting of harvest volumes historically.

Even if the simulations accurately project standing timber inventory, there may be losses of volume to forest residuals in the harvesting process and these losses may be dependent upon stand quality which has been changing over time. Forest health problems represent an important aspect of quality.

A separate management scenario to avoid forest health problems was not modelled. Like other factors, problems with forest health varied with geographic region and ownership. In general, there are more forest health problems where there has been active exclusion of fires (generally true in all forest lands) and less harvesting; these areas are likely to have more insects and diseases, dead or rotten trees, and fires.

The problem is probably more severe on federal lands than private lands, because the federal lands have seen less harvesting but to the degree possible protected from fire. Thus, the stands are overcrowded. DNR lands may have forest health problems similar to federal lands, since relatively less harvesting has occurred there, also.

The impact of insects, diseases, and fires was not modelled in any scenario. Where management is low, there will probably be a general decline in harvested volume per acre as more trees become defective and die. There will be large, catastrophic fires, resulting in some salvage; however, since many stands are susceptible to fire, there may be a large number of fires during a single year of appropriate weather. So much volume may be killed that the harvesting and processing infrastructure may be unable to harvest much of it before it rots.

Taken together these circumstances suggest there may not exist a narrow projection range of likely outcomes as seemed to be the case for the Westside. Consequently, the report can do little more than characterize a range of possible growth and harvest levels consistent with the current forest inventory as defined by the FIA data and, to the degree possible, calibrate these alternatives to observed historical data.

Organization of the Report

This report is organized in four chapters. Chapter II describes the current situation of the forests of the Eastside as of 1990 as defined by the 560 FIA survey plots. This includes a description of the timberland base and the timber inventory as summarized by ownership, timbershed, forest type (or plant association), site class, *etc*. We also present a brief historical review of changes since previous forest inventories. Chapter III describes the methods used when making our projections. Included is a brief discussion of the PROGNOSIS model, the linear programming harvest scheduling model, and a description of the sensitivity analysis. Also included in this chapter is: (a) a description of the management prescriptions, (b) the delineation of plant associations based on stand structural conditions and species composition, and (c) the proportional allocation of acres within a forest type (or plant association) for a given ownership that are to be managed under a specific management prescription. Chapter IV presents the results of the study by ownership group and timbershed. Chapter V provides an analysis of the direct forest sector employment impact. Chapter VI summarizes the major findings and conclusions of the study along with a few observations concerning future opportunities for the Eastside forests.

Overview of Study Approach

Brief definitions of timbersheds, ownerships, and forest types used in the study are provided below. Following this is a brief introduction of the process to produce projections of future conditions.

Timbersheds: The analysis of future timber harvest levels recognizes two sub-regions (or timbersheds) generally known as the Central Cascades and the Inland Empire. These areas are characterized by their geographic location, with the Central Cascades timbershed being made up of Okanogan, Douglas, Chelan, Kittitas, Yakima, and Klickitat counties and the Inland Empire of the remaining counties (see Figure I.1). As a consequence, site class, dominant forest type, and ownership distributions differ between the two timbersheds. Exclusive of the national forests, the Central Cascades area contains about 45% of the available timberland acres, and the Inland Empire 55%.

Ownership: Five ownership classes are recognized: DNR, forest industry, nonindustrial (including other public[3]), Native American, and US Forest Service. Only the first four categories of ownership are included in the model projections. For the national forests, projected timber harvests are taken from available forest plans and other documents for Eastside forests. Forest industry ownership includes timberland owned by companies or individuals operating wood-processing facilities. Nonindustrial ownership includes timberlands owned by companies or individuals that do not operate wood-processing facilities. In addition, this category also includes public timberlands other than national forests or DNR. Native American owners include the Yakima, Colville, and Spokane tribal forests.

Forest Types: Five forest types (Douglas fir/western larch, ponderosa pine, lodgepole pine, true firs and other softwoods, and hardwoods) are recognized. In addition, as an alternative categorization, the forest industry recognizes five plant association types (Douglas fir, ponderosa pine, subalpine fir, grand fir, and hardwoods) in its management planning. The PROGNOSIS model also requires that plant associations be identified and associated with each FIA survey plot. Lastly, based upon structural characteristics and species composition, each survey plot is categorized as either even or uneven-aged.

Process of Analysis: Based upon the above input parameters and the eight management prescriptions defined earlier, the PROGNOSIS was run to project the growth and yield of each FIA survey plot. These yields were subsequently fed into the linear programming harvest scheduling model. A series of base runs labeled "initial conditions" were conducted to establish reference points for projected timber harvests over the 100 year projection period for each of the modeled ownership/timbershed combinations. Following this, a series of sensitivity analyses explored the effects of altering the assumptions of management intensity allocation and land base reductions (either for forest practices or land conversions). Lastly, a comparison of the base

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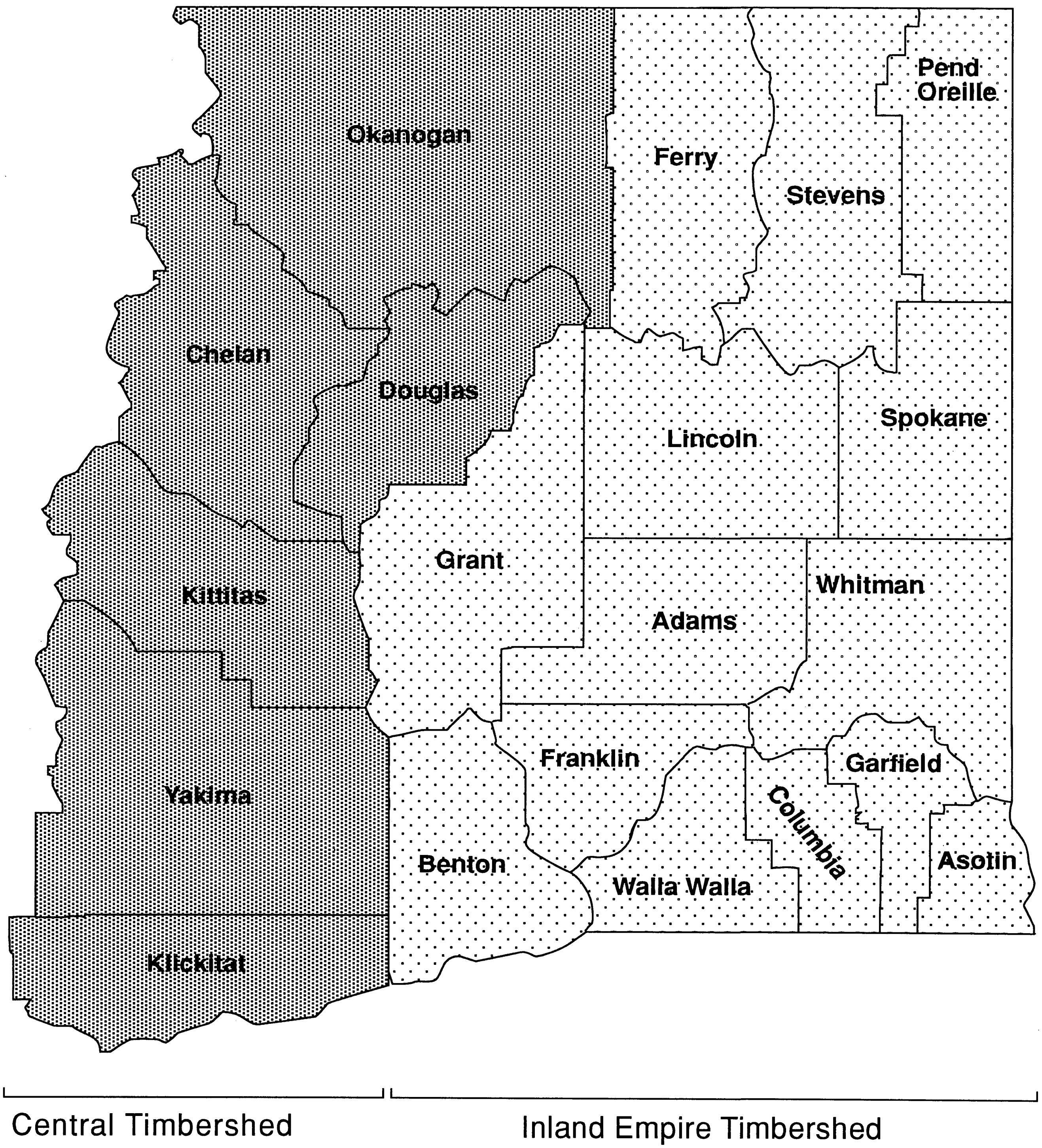
[3]See footnote 2.

Figure I.1 Map of counties making up Central Timbershed and Inland Empire Timbershed



runs and the outputs from the sensitivity analysis are drawn to measure potential effects of assumptions on future timber harvest levels.

Three sensitivity scenarios examined a range of management intensities from the initial conditions case. Low and high management options characterized the impact on all modeled stands for either the lowest or highest intensity of silvicultural management possible. Another scenario boosted 20% of the timberland in the lower levels of management one level of management intensity higher. One sensitivity analysis projected a 15% reduction in the timberland base effective at the start of the 100 year projection period. Given estimates of the amount of land that may be influenced by changing forest practices, productivity standards, and land use designations, it has been suggested that a 15% reduction in the timberland base may be conservative. Combining the 15% land reduction with the 20% boost in management intensity provides a potential measure of the ability of increased management to compensate for a reduced land base if the investment climate permits.

II. CURRENT STATE OF EASTERN WASHINGTON TIMBER RESOURCES[1,2]

Timberland Acreage: All Owners

Eastern Washington consists of the 20 counties which lie east of the crest of the Cascade Mountains. This land area totals 26.6 million acres--of which 9.0 million (34%) are considered to be forest land.[3] Of the total forest land, 7.4 million acres are classified as commercial timberland (both reserved and unreserved).[4] About 25% of this area is reserved from timber utilization by statute or administrative regulation. Only 9% of the reserved land, or 2% of all timberland, is non-federal and reserved. As of this writing, approximately 5.6 million acres of timberland are "available" for timber production in Eastern Washington. The acreages shown in Table II.1 represent land judged to be suitable for timber production as well as that which is "available" and not reserved. The origin of the national forest acreages is shown in Table II.2 and is current as of July 1993.

Of the available timberland shown in Table II.1, the Forest Service manages 28% of the acres, followed by nonindustrial private with 26.5%, Native American with 19.2%, forest industry with 15.8%, and DNR with 10.5%. Also evident in the table is that 51% of the Forest Service timberland acreage has been withdrawn (perhaps only temporarily) from timber production and been placed in reserved status. The history of the available national forest timberland acreage is shown in Table II.3 for the years 1952-1993. The increase in reserved Forest Service acreage reflects changing forest management plans including spotted owl protection (see Table II.2). The size of these reserves may still be fluid, but they represent a more advanced stage of the changed strategy for managing national forests for non-timber uses than was available for the Westside study completed in 1992. Forest practices such as owl protection constraints on DNR and private timberlands are not considered new reserves in the same manner as for the national forests. Instead, a sensitivity analysis of the impact of possible reductions in the timberland base for these ownerships is provided.

Table II.4 shows the trend in available timberland acres in Eastern Washington between 1952-1993. The numbers for 1952-1987 are taken from Alig, *et al.* (1990),[5] while the numbers for 1993 are the authors' estimate. Over the 41 year time period shown, available timberland

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[1]All tables for this chapter are grouped at the end of the chapter.

[2]This chapter is abbreviated because USDA Forest Service Report titled "Timber Resource Statistics for Eastern Washington " (PNW RB-201 Revised January 1995) contains summary information in greater detail.

[3]Forest land is land at least 10% stocked by forest trees of any size including land which formerly had such cover which will be regenerated. The minimum area for classification is one acre.

[4]Timberland is defined as forest land that is capable of producing more than 20 cubic feet per acre per year of industrial wood in natural stands and that is not withdrawn from timber utilization by statute or administrative regulation. For all but the national forests, this includes currently inaccessible and inoperable areas. For national forests, only land suitable for planned timber harvest is included. Reserved timberland is that withdrawn from timber utilization by statute or administrative regulation.

[5]R. Alig, W. G. Hohenstein, B. C. Murray, and R. G. Haight. 1990. *Changes in Area of Timberland in the United States, 1952-2040, By Ownership, Forest Type, Region, and State.* USDA Forest Service, Southeastern Forest Experiment Station, GTR-SE-64, Asheville NC.

acreage has declined by over 2.9 million acres--about 34% or 1.0% per year. This is the result of a combination of factors such as land conversion to other uses and administrative decisions to place timberland into the reserved category.

A similar history of timberland acreage is shown in Table II.5 where the three most recent FIA measurement periods are compared for all modeled owners (excludes the national forests) by timbershed. Acreages in this table follow the definition of ownerships used throughout the remainder of this study. The DNR is split out of the "other public" category and the acres which remain are grouped with the nonindustrial land owners. This table shows that, exclusive of the national forests, there are just over 4 million acres of timberland in Eastern Washington as of the 1990 remeasurement. If we add in the available timberland acres from the national forests, the grand total is almost 5.6 million acres. A summary of the land use distribution for Eastern Washington appears in Figure II.1.

Table II.1 Area of timberland by owner and land class in Eastern Washington.[abc]

Land class	*Thousand acres*		
Timber land	7,367		
Other forest land	1,651		
Nonforest land	17,586		
Total land	26,604		
Timber land	Unreserved	Reserved	% Reserved
USDA Forest Service [def]	1,555[h]	1,637	51.3%
Other public [g]	648	25	3.7%
Forest industry	876	26	2.9%
Native Americans	1,075	72	6.3%
Nonindustrial landowners	1,409	44	3.0%
total	5,563	1,804	24.5%

[a] Totals may be off due to rounding; data subject to sampling error.

[b] Assumed homogeneity of reserved land across land owners in each county.

[c] Timberland units less than 500 acres not included.

[d] Does not Include approximately 197,000 acres of Mount Baker-Snoqualmie National Forest located in Skagit and Whatcom counties and administrated by the Okanogan National Forest.

[e] Does not Include approximately 523,000 acres of the Mt.Baker-Snoqualmie National Forest administered by the Wenatchee National Forest.

[f] National Forest land estimates are from Appendix 2.

[g] Includes the Department of Natural Resources, other state lands managed and reserved.

h Central Washington consists of 709 thousand acres while Inland Empire accounts for the remaining 846 thousand acres.

Table II.2 History of available timberland acres on national forests

(thousand acres)

Owner	Forest Plans	Option 9
Owl Forests		
Wenatchee	576	290
Okanogan	208	85
Total	784	375
Non-owl Forests		
Okanogan	334	334
Colville	616	616
Umatilla	136	136
Panhandle (Kaniksu)	94	94
Total	1,180	1,180
Grand Total	1,964	1,555

(1) From forest plans for the five national forests in Eastern Washington (all dated approximately 1990).

(2) Source of estimate shown in Appendix 2.

Table II.3 Area changes on national forest timberland in Eastern Washington

(thousand acres)

Year	Unreserved National Forest Timberland Area
1952	3,197
1962	3,196
1970	3,103
1977	2,967
1987	2,494
1993	1,555 (estimated)

Estimates for 1993 based on data shown in Appendix 2.

Table II.4 Area changes in available timberland for all owners in Eastern Washington(1)

(in million acres)

Ownership	Year					
	1952	1962	1970	1977	1987	1993(2)
Public	5.54	5.50	5.40	5.20	4.47	3.38
Forest Industry	0.64	0.65	0.75	0.74	0.88	0.88
Nonindustrial	2.39	2.36	2.27	2.19	1.38	1.41
Total	8.57	8.51	8.42	8.13	6.73	5.67

(1) Alig, R., W. G. Hohenstein, B. C. Murray, and R. G. Haight, 1990. "Changes in Area of Timberland in the United States, 1952-2040, by Owner, Forest Type, Region, and State." USDA Forest Service, Southeastern Forest Experiment Station, GTR-SE-64, Ashville, NC.

(2) Authors' Estimates.

Table II.5 Area changes in timberland base by FIA survey by timbershed for all landowners excluding national forest lands.

Timberland acres	1968	1980	1990	1993*
Central timbershed				
DNR	351,616	375,187	366,855	
Forest Industry	479,544	471,208	479,540	
Native Americans	584,809	584,809	584,809	
Nonindustrial landowners	402,108	386,873	386,873	
National Forests				709,000
Inland Empire timbershed				
DNR	186,761	200,042	216,343	
Forest Industry	253,535	403,404	397,045	
Native Americans	489,263	489,263	489,263	
Nonindustrial landowners	1,237,490	1,094,616	1,084,674	
National Forests				846,000
Both timbersheds				
DNR	538,377	575,230	583,198	
Forest Industry	733,079	874,612	876,585	
Native Americans	1,074,073	1,074,073	1,074,073	
Nonindustrial landowners	1,639,598	1,481,490	1,471,548	
National Forests				1,555,000
Eastern Washington Total			4,005,404	5,560,404*

*with 1993 National Forest estimates added to the FIA inventory survey.

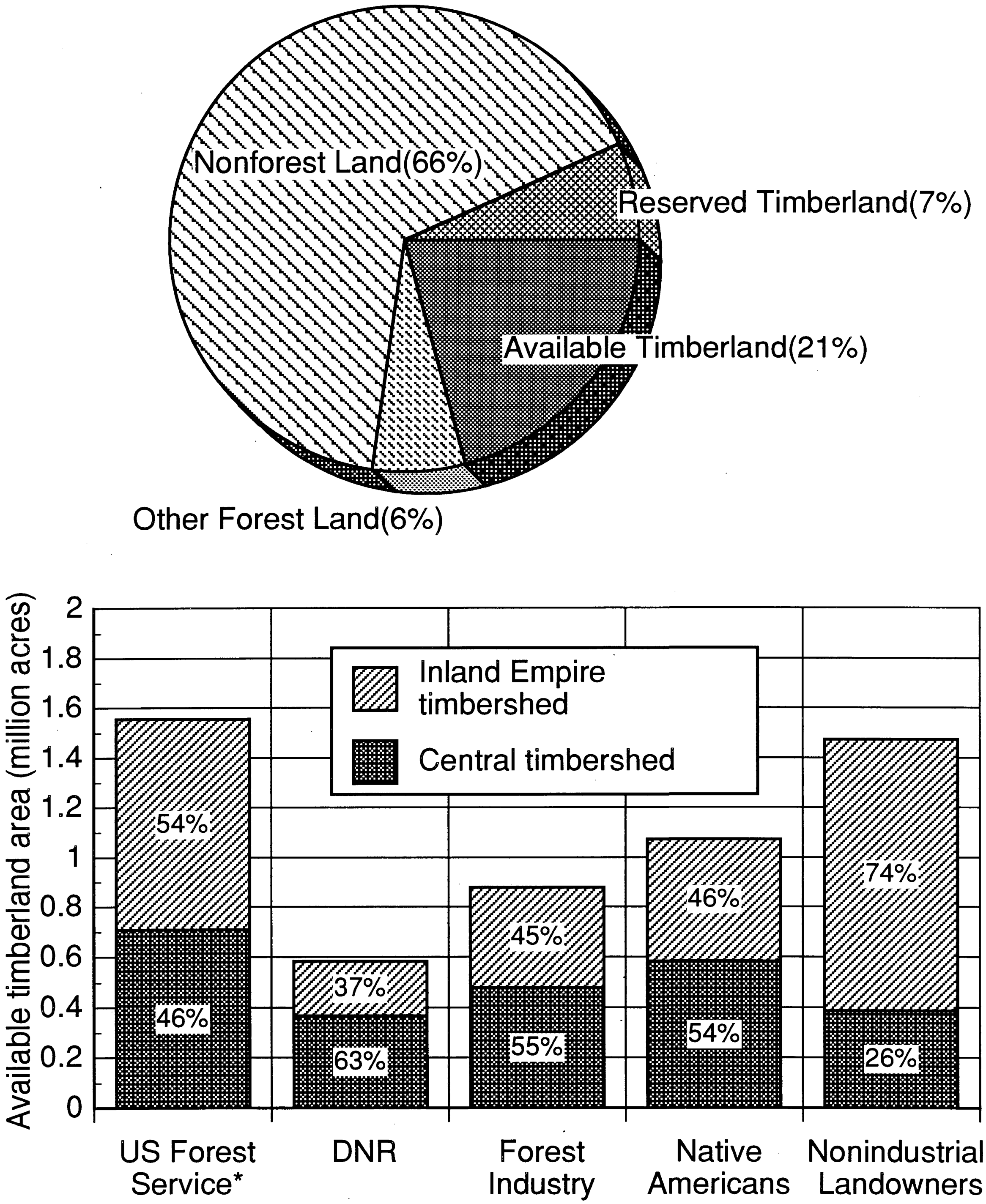


Figure II.1 Land use distribution with available timberland by timbershed and owner

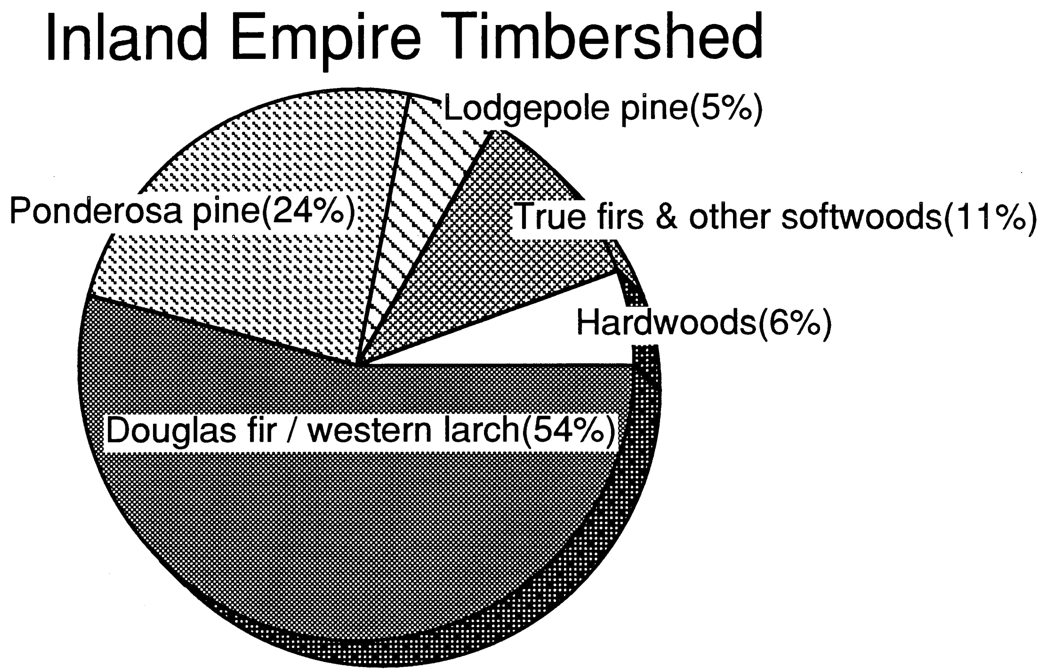
*Author's estimate (see Appendix 2)

Forest Types: Species, Size/Structure Class, Site Class

A summary of the timberland acres by forest type and stand structure class is shown in Table II.6. The Douglas-fir/western larch (46%) and ponderosa pine (33%) forest types constitute almost 80% of the timberland base in Eastern Washington. Over all forest types, the largest concentration of large sawtimber acreages is under control of the DNR and Native American owners, while the largest concentrations of small sawtimber acreages are managed by nonindustrial owners and Native Americans. The nonindustrial and forest industry owners have the largest concentration of sapling/seedling acreages. A summary of the distribution of forest types in Eastern Washington appears in Figure II.2.

Table II.6 Distribution of timberland acres by dominant forest type and size class for all modeled owners (excluding the national forests)

Timberland acres	Douglas fir - western larch	Ponderosa pine	Lodgepole pine	True firs and other softwoods	Hardwoods
DNR					
Sapling / seedling	19,875	16,572	0	0	4,670
Pole timber	34,873	0	27,826	6,641	6,330
Small saw timber	195,636	130,464	13,234	45,533	8,620
Large saw timber	39,561	4,670	0	0	0
Nonstocked	0	0	0	0	28,693
Total	289,945	151,706	41,060	52,174	48,313
Industrial Private					
Sapling / seedling	98,984	23,877	0	36,210	0
Pole timber	62,429	40,342	7,287	8,696	0
Small saw timber	276,124	152,811	11,711	109,189	6,444
Large saw timber	14,077	0	0	14,077	0
Nonstocked	0	0	0	0	14,327
Total	451,614	217,030	18,998	168,172	20,771
Native American					
Sapling / seedling	35,002	40,998	0	0	8,020
Pole timber	55,593	16,568	27,792	11,744	8,284
Small saw timber	313,506	383,515	53,120	63,618	0
Large saw timber	6,571	18,559	0	17,027	0
Nonstocked	0	0	0	0	14,156
Total	410,672	459,640	80,912	92,389	30,460
Nonindustrial					
Sapling / seedling	92,278	49,310	21,695	12,986	7,232
Pole timber	104,482	70,999	46,879	6,493	19,976
Small saw timber	471,506	356,670	57,388	56,672	38,167
Large saw timber	7,232	0	0	8,752	0
Nonstocked	0	0	0	0	42,832
Total	675,498	476,979	125,962	84,903	108,207
Total all owners	1,827,729	1,305,355	266,932	397,638	207,751



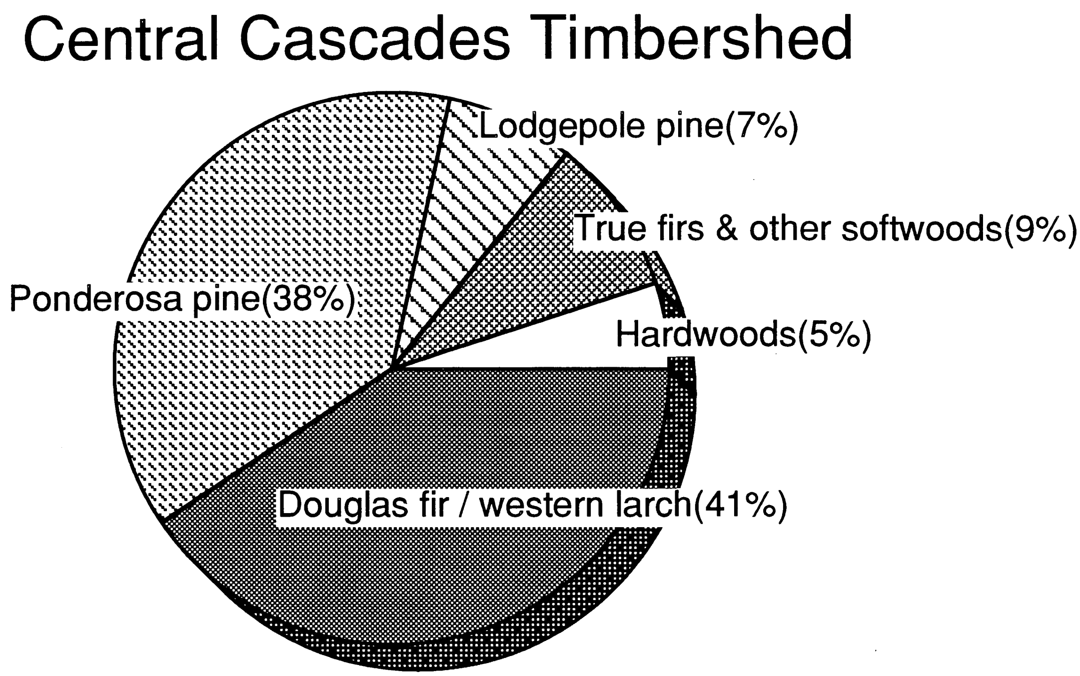


Figure II.2 Forest type distribution by timbershed

The distribution of timberland acres by ownership, timbershed, forest type, and site productivity class is shown in Table II.7. The Native American and DNR are the owners which have the largest percentage of their timberlands in the lowest site class (about 39%). Forest industry and the nonindustrial owners have about 32% of their land in low site. At the other extreme, the DNR has 34.5% of its timberland in the highest site class--the highest percentage of all four owners. The nonindustrial and forest industry have 32.5% in this class, while Native Americans only have 24.5% in high site. A summary of the distribution of site classes by timbershed and owner appears in Figure II.3.

Table II.7 Distribution of timberland acres by site class and dominant forest type for all modeled owners (excluding the national forests).

DNR

Dominant forest type *Timberland acres*	Central timbershed	Inland Empire timbershed	All eastern Washington
High site			
Douglas fir / western larch	49,978	46,486	96,463
Ponderosa pine	33,813	13,545	47,357
Lodgepole pine	0	6,641	6,641
True firs & other softwoods	24,611	6,641	31,251
Hardwoods	19,621	0	19,621
All forest types	128,022	73,312	201,333
Medium site			
Douglas fir / western larch	44,183	43,144	87,327
Ponderosa pine	15,903	13,808	29,710
Lodgepole pine	12,660	6,904	19,564
True firs & other softwoods	14,282	6,641	20,922
Hardwoods	0	0	0
All forest types	87,027	70,497	157,524
Low site			
Douglas fir / western larch	72,424	33,730	106,154
Ponderosa pine	54,190	20,448	74,639
Lodgepole pine	7,951	6,904	14,855
True firs & other softwoods	0	0	0
Hardwoods	17,241	11,453	28,693
All forest types	151,806	72,535	224,341
All sites - all forest types	366,855	216,343	583,198

Native American

Dominant forest type *Timberland acres*	Central timbershed	Inland Empire timbershed	All eastern Washington
High site			
Douglas fir / western larch	32,376	42,136	74,512
Ponderosa pine	47,188	15,851	63,039
Lodgepole pine	39,441	6,571	46,012
True firs & other softwoods	45,797	31,701	77,498
Hardwoods	0	2,148	2,148
All forest types	164,802	98,408	263,209
Medium site			
Douglas fir / western larch	59,141	120,270	179,411
Ponderosa pine	129,712	34,409	164,121
Lodgepole pine	12,479	22,422	34,901
True firs & other softwoods	0	0	0
Hardwoods	5,872	0	5,872
All forest types	207,203	177,101	384,304
Low site			
Douglas fir / western larch	51,210	105,539	156,749
Ponderosa pine	124,264	108,215	232,479
Lodgepole pine	0	0	0
True firs & other softwoods	14,890	0	14,890
Hardwoods	22,440	0	22,440
All forest types	212,804	213,755	426,559
All sites - all forest type	584,809	489,263	1,074,073

Forest Industry

Dominant forest type *Timberland acres*	Central timbershed	Inland Empire timbershed	All eastern Washington
High site			
Douglas fir / western larch	72,089	78,962	151,052
Ponderosa pine	15,823	5,856	21,678
Lodgepole pine	0	5,856	5,856
True firs & other softwoods	29,193	71,059	100,252
Hardwoods	0	0	0
All forest types	117,105	161,732	278,838
Medium site			
Douglas fir / western larch	105,454	78,055	183,509
Ponderosa pine	45,418	26,263	71,681
Lodgepole pine	7,287	0	7,287
True firs & other softwoods	15,553	17,567	33,119
Hardwoods	7,331	13,440	20,771
All forest types	181,043	135,324	316,366
Low site			
Douglas fir / western larch	61,861	55,193	117,054
Ponderosa pine	97,582	26,089	123,671
Lodgepole pine	0	5,856	5,856
True firs & other softwoods	21,950	12,851	34,801
Hardwoods	0	0	0
All forest types	181,392	99,989	281,381
All sites - all forest types	479,540	397,045	876,585

Nonindustrial

Dominant forest type *Timberland acres*	Central timbershed	Inland Empire timbershed	All eastern Washington
High site			
Douglas fir / western larch	68,935	123,260	192,194
Ponderosa pine	8,752	104,782	113,533
Lodgepole pine	0	59,069	59,069
True firs & other softwoods	15,410	63,000	78,410
Hardwoods	19,387	27,860	47,247
All forest types	112,484	377,970	490,453
Medium site			
Douglas fir / western larch	68,703	216,181	284,884
Ponderosa pine	14,580	88,735	103,315
Lodgepole pine	13,944	46,928	60,871
True firs & other softwoods	0	6,493	6,493
Hardwoods	16,674	15,718	32,392
All forest types	113,901	374,055	487,956
Low site			
Douglas fir / western larch	63,965	134,455	198,420
Ponderosa pine	69,167	190,963	260,130
Lodgepole pine	6,021	0	6,021
True firs & other softwoods	0	0	0
Hardwoods	21,336	7,232	28,568
All forest types	160,489	332,650	493,139
All sites - all forest types	386,873	1,084,674	1,471,548

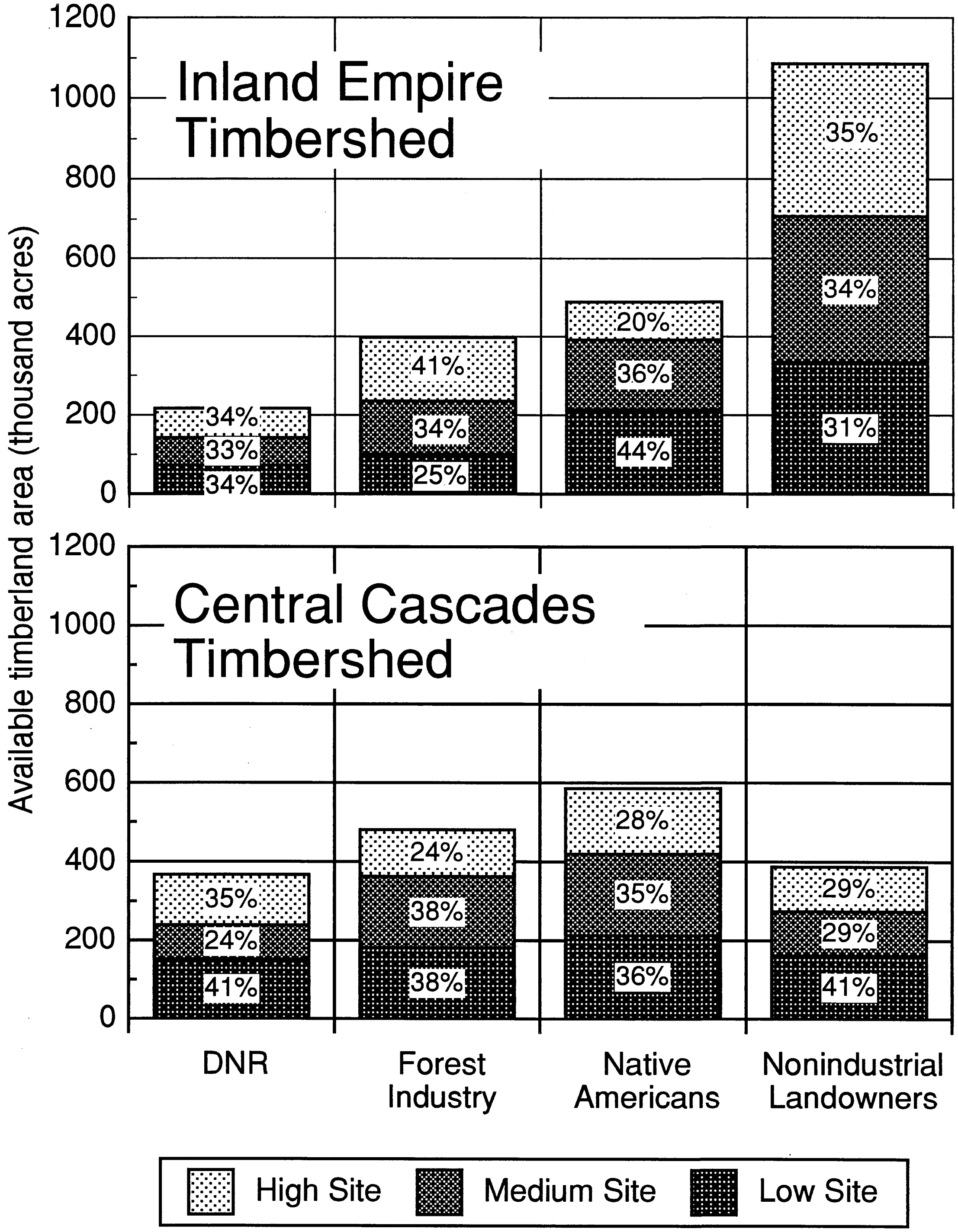


Figure II.3 Site class distribution by timbershed and owner

Table II.8 shows the distribution of timberland acres by stand structural class, and presence of even or uneven-aged management type. This table illustrates the large number of acres which are classified as uneven-aged across all owners and types. Uneven-aged stands are especially prevalent on Native American and DNR lands. On forest industry and nonindustrial owner lands, uneven-aged stands are also the norm, but a somewhat higher percentage of even-aged stands occur relative to the two previous owner classes. A summary of the distribution of management type by timbershed and owner appears in Figure II.4.

Table II.8 Distribution of timberland acres by stand structure composition and dominant forest type for all modeled owners (excluding the national forests)

Stand structure class *Timberland acres*	Douglas fir - western larch	Ponderosa pine	Lodgepole pine	True firs & other softwoods	Hardwoods
DNR					
Even aged - seedling / sapling	8,620	13,291	0	0	0
Even aged - pole timber	8,620	0	6,904	0	0
Even aged - small saw timber	0	8,620	0	0	8,620
Even aged - large saw timber	0	0	0	0	0
Nonstocked	0	0	0	0	28,693
Uneven aged - open canopy - seedling / sapling understory	77,529	15,524	0	23,300	4,670
Uneven aged - closed canopy - seedling / sapling understory	107,097	82,350	19,875	14,282	0
Uneven aged - open canopy - sapling / poletimber understory	41,214	16,572	14,282	7,951	6,330
Uneven aged - closed canopy - sapling / poletimber understory	46,863	15,349	0	6,641	0
Total	289,944	151,706	41,060	52,174	48,314
Industrial Private					
Even aged - seedling / sapling	81,737	45,622	0	46,382	0
Even aged - pole timber	8,696	0	0	8,696	0
Even aged - small saw timber	35,070	13,187	5,856	13,143	0
Even aged - large saw timber	0	0	0	5,856	0
Nonstocked	0	0	0	0	14,327
Uneven aged - open canopy - seedling / sapling understory	137,630	51,806	7,287	57,929	0
Uneven aged - closed canopy - seedling / sapling understory	102,566	77,406	0	28,879	0
Uneven aged - open canopy - sapling / poletimber understory	53,797	21,678	0	0	0
Uneven aged - closed canopy - sapling / poletimber understory	32,118	7,331	5,856	7,287	6,444
Total	451,614	217,030	18,998	168,172	20,771
Native American					
Even aged - seedling / sapling	27,278	17,563	0	0	0
Even aged - pole timber	6,571	0	0	0	0
Even aged - small saw timber	0	25,847	0	18,559	0
Even aged - large saw timber	0	9,279	0	0	0
Nonstocked	0	0	0	0	14,156
Uneven aged - open canopy - seedling / sapling understory	110,681	58,406	61,163	27,792	0
Uneven aged - closed canopy - seedling / sapling understory	113,598	209,498	0	31,182	0
Uneven aged - open canopy - sapling / poletimber understory	81,931	81,375	13,178	0	16,304
Uneven aged - closed canopy - sapling / poletimber understory	70,613	57,672	6,571	14,855	0
Total	410,672	459,640	80,913	92,389	30,460
Nonindustrial					
Even aged - seedling / sapling	52,023	35,936	14,463	0	0
Even aged - pole timber	0	12,986	6,493	0	0
Even aged - small saw timber	45,552	24,865	6,493	11,901	8,752
Even aged - large saw timber	0	0	0	0	0
Nonstocked	0	0	0	0	42,832
Uneven aged - open canopy - seedling / sapling understory	159,020	70,308	12,986	53,523	7,922
Uneven aged - closed canopy - seedling / sapling understory	154,923	180,865	45,612	6,493	12,880
Uneven aged - open canopy - sapling / poletimber understory	175,453	123,666	39,915	12,986	29,327
Uneven aged - closed canopy - sapling / poletimber understory	88,527	28,353	0	0	6,493
Total	675,498	476,979	125,962	84,903	108,206

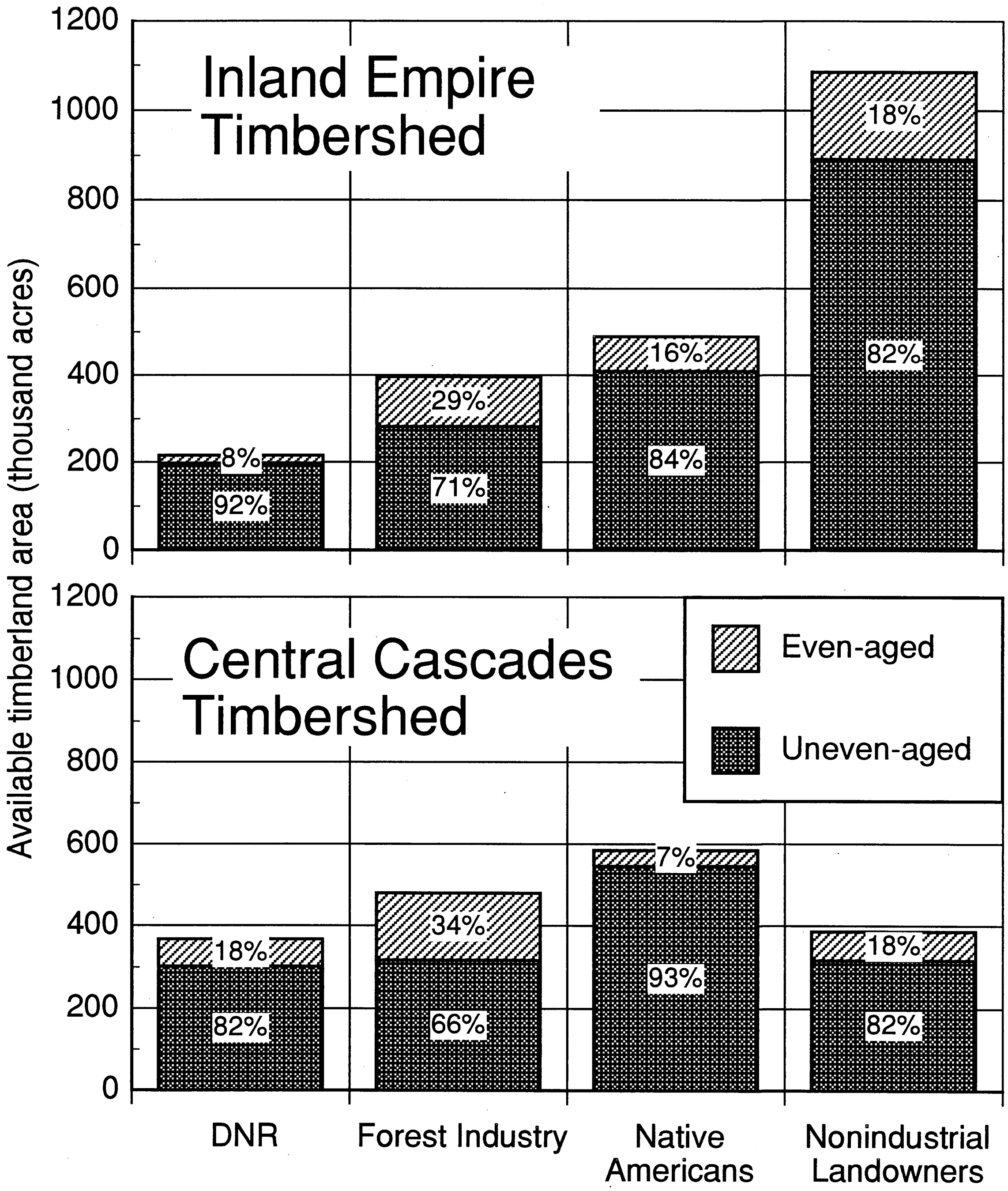


Figure II.4 Management type by timbershed and owner

Historic Annual Timber Harvest

A summary of the annual harvest over the last three decades by timbershed is provided in Figures II.5 and Table II.9 (Larsen, 1994). It shows large cyclic variations that correspond to strong and weak housing demands in the US. The fact that these cycles are larger than the cycles observed in other regions suggest that the Eastside is generally a higher-cost producing region that losses market share in weak markets. The figure also shows a substantial share shift toward the Inland Empire and away from the Central timbershed starting in 1989.

A summary of the harvest by timbershed and owner is provided in Figure II.6. It shows that there have been substantial shifts in owner shares over history. While the most recent decline in federal harvests will likely become the largest, the increasing share by the forest industry and decreasing share by Native American owners are also quite substantial.

Table II.10 summarizes the harvest treatment type (clear-cut or partial cut) from 1980 to 1991 by owner, timbershed, and forest type, using FIA data. Mean density and diameter are also provided where available.

Table II.11 summarizes the harvest method including salvage, firewood and incidental categories by timbershed and forest type.

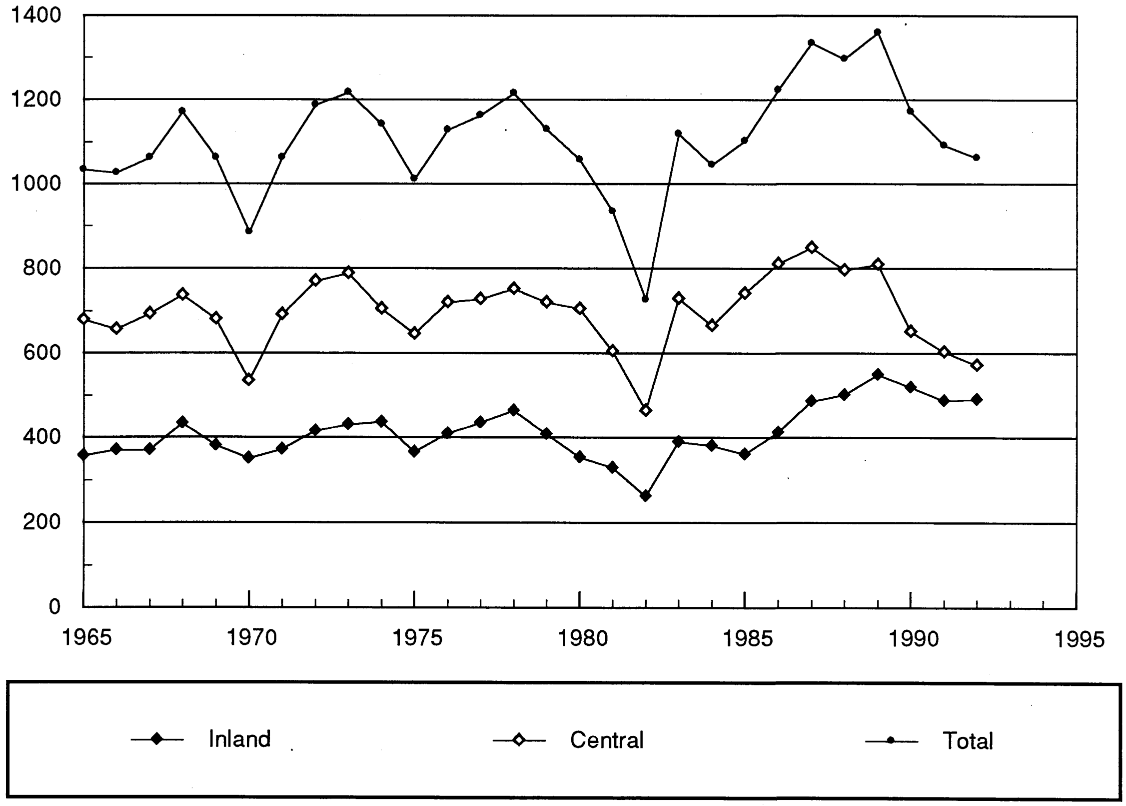


Figure II. 5 Historical harvest (MMBF) for all owners by timbershed.

Table II.9 Historic Annual Harvest Volumes by Owner and Timbershed (MMBF)

Inland	National Forest	DNR	Forest Industry	Native American	Non-industrial	TOTAL	Central	National Forest	DNR	Forest Industry	Native American	Non-industrial	TOTAL
1965	129.1	18.9	28.5	108.6	70.6	355.6	1965	304.0	50.4	105.0	165.2	53.5	678.1
1966	139.8	11.4	44.0	87.9	86.4	369.5	1966	288.4	54.3	94.7	170.2	48.8	656.4
1967	154.4	21.1	24.6	90.2	79.0	369.2	1967	294.4	51.1	99.2	190.6	57.1	692.5
1968	150.7	33.4	37.0	125.0	86.5	432.5	1968	322.0	58.9	97.1	188.3	70.1	736.4
1969	148.5	25.4	51.5	88.7	66.2	380.3	1969	277.9	84.9	101.4	158.0	58.9	681.0
1970	148.9	4.8	53.6	69.7	73.3	350.3	1970	184.0	48.0	93.3	140.2	68.7	534.1
1971	126.9	18.3	63.9	92.1	70.5	371.6	1971	259.1	78.3	119.5	200.9	32.5	690.2
1972	126.2	26.9	52.8	123.7	85.5	415.0	1972	355.6	53.6	64.4	206.3	90.2	770.0
1973	102.6	32.6	30.5	118.4	145.7	429.8	1973	336.6	76.9	123.2	162.9	87.2	786.7
1974	108.3	24.4	81.2	116.4	106.3	436.6	1974	274.5	45.7	145.5	183.7	54.3	703.8
1975	99.3	12.5	75.8	87.2	89.8	364.6	1975	240.6	46.3	137.2	181.0	40.6	645.6
1976	91.3	18.0	97.3	83.9	117.7	408.2	1976	272.6	43.1	141.4	189.7	72.1	718.9
1977	105.8	22.5	73.0	88.0	145.4	434.7	1977	216.1	56.3	136.2	210.5	108.5	727.6
1978	114.5	27.9	83.7	95.5	141.7	463.3	1978	224.9	60.0	160.5	215.8	90.4	751.6
1979	101.4	12.3	70.0	82.0	142.3	408.0	1979	189.9	52.8	145.0	219.2	112.8	719.8
1980	89.8	10.4	85.2	78.2	89.0	352.6	1980	227.0	32.2	143.1	199.7	102.9	704.8
1981	64.3	21.1	80.4	62.7	101.0	329.5	1981	232.8	30.1	158.7	155.6	27.1	604.3
1982	44.4	9.4	95.2	31.0	82.3	262.2	1982	134.4	8.9	208.1	90.4	21.7	463.4
1983	91.0	29.0	101.1	50.0	117.9	389.1	1983	308.3	55.5	231.8	112.4	20.8	728.9
1984	108.7	30.7	107.3	23.6	110.1	380.3	1984	218.9	90.7	218.2	99.3	38.7	665.9
1985	70.6	20.3	103.6	37.3	128.8	360.6	1985	253.5	73.3	276.7	111.1	26.2	740.7
1986	89.9	22.2	130.6	31.3	138.3	412.2	1986	306.7	82.2	246.7	136.9	37.9	810.4
1987	141.2	26.0	126.3	53.1	138.6	485.1	1987	321.1	112.8	223.4	136.3	54.6	848.3
1988	128.5	33.1	134.2	54.3	151.1	501.2	1988	297.8	82.9	230.1	156.3	28.3	795.4
1989	148.7	42.1	138.3	42.0	178.1	549.2	1989	284.8	75.8	255.2	146.2	47.4	809.3
1990	127.9	28.1	164.6	37.0	161.4	519.0	1990	185.3	56.2	241.9	107.7	61.3	652.4
1991	121.0	20.4	186.0	32.5	126.7	486.6	1991	163.3	47.3	201.0	121.8	70.5	603.8
1992	108.0	18.0	201.0	29.0	134.0	490.0	1992	147.0	43.0	211.0	108.0	63.0	572.0

Both	National Forest	DNR	Forest Industry	Native American	Non-industrial	TOTAL
1965	433.1	69.3	133.4	273.7	124.2	1,033.7
1966	428.2	65.7	138.7	258.2	135.1	1,025.9
1967	448.8	72.2	123.8	280.8	136.1	1,061.7
1968	472.7	92.2	134.1	313.3	156.6	1,168.9
1969	426.4	110.3	152.9	246.6	125.2	1,061.4
1970	332.9	52.8	146.9	209.9	142.0	884.5
1971	386.0	96.6	183.3	293.1	103.0	1,061.9
1972	481.8	80.4	117.2	330.0	175.7	1,185.0
1973	439.2	109.6	153.6	281.2	232.9	1,216.5
1974	382.9	70.1	226.8	300.1	160.6	1,140.4
1975	339.9	58.8	213.0	268.2	130.4	1,010.2
1976	363.9	61.1	238.7	273.6	189.8	1,127.1
1977	321.9	78.7	209.3	298.5	253.9	1,162.3
1978	339.4	87.9	244.3	311.3	232.1	1,214.9
1979	291.4	65.0	215.0	301.2	255.1	1,127.7
1980	316.9	42.6	228.3	277.8	191.9	1,057.4
1981	297.1	51.2	239.1	218.3	128.1	933.7
1982	178.8	18.3	303.2	121.4	104.0	725.7
1983	399.4	84.5	332.9	162.4	138.8	1,117.9
1984	327.6	121.4	325.5	122.9	148.7	1,046.2
1985	324.1	93.6	380.3	148.4	155.0	1,101.3
1986	396.6	104.4	377.2	168.2	176.2	1,222.6
1987	462.3	138.8	349.7	189.4	193.1	1,333.3
1988	426.3	116.0	364.4	210.6	179.4	1,296.6
1989	433.5	117.9	393.5	188.2	225.5	1,358.5
1990	313.3	84.3	406.5	144.7	222.7	1,171.4
1991	284.3	67.7	386.9	154.3	197.2	1,090.4
1992	255.0	61.0	412.0	137.0	197.0	1,062.0

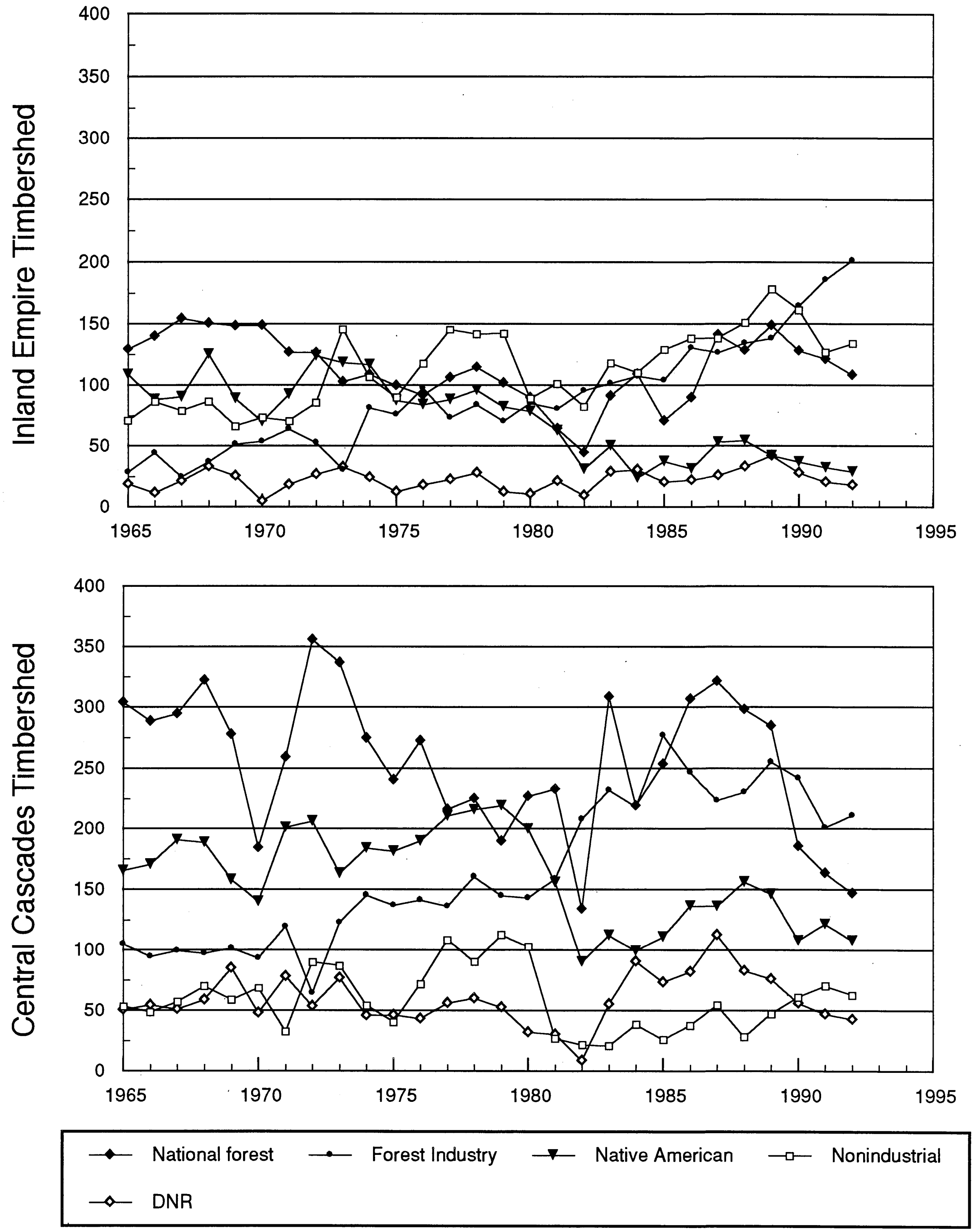


Figure II. 6 Historical harvest (MMBF) by owner for each timbershed.

Table II.10 Distribution of harvest type by timbershed and owner from 1981 - 1991.

	Timberland (Thousand acres)				Stand density (trees / acre)			QMD of stands (inches)		
	Uncut	Clear-cut	Partial cut	Total	Uncut	Clear-cut	Partial cut	Uncut	Clear-cut	Partial cut
DNR										
Central										
Douglas fir / western larch	117.6	16.7	32.4	166.6	663	194	191	14	23	19
Ponderosa pine	78.5	0	25.5	103.9	471	0	157	12	0	20
Lodgepole pine	20.6	0	0	20.6	616	0	0	10	0	0
True firs & other softwoods	39.2	0	0	38.9	383	0	0	15	0	0
Hardwoods	31.5	0	6.3	36.9	113	0	280	10	0	13
Inland Empire										
Douglas fir / western larch	105.5	13.2	11.2	130.0	1,580	372	356	11	13	13
Ponderosa pine	27.4	0	20.5	47.8	240	0	214	11	0	15
Lodgepole pine	20.5	0	0	20.5	1,932	0	0	7	0	0
True firs & other softwoods	13.3	0	0	13.3	692	0	0	10	0	0
Hardwoods	4.8	0	0	4.8	0	0	0	0	0	0
Total										
Douglas fir / western larch	223.1	29.9	43.5	296.6	1,122	283	274	13	18	16
Ponderosa pine	106.7	0	45.0	151.7	235	0	186	12	0	18
Lodgepole pine	41.1	0	0	41.1	1,274	0	0	8	0	0
True firs & other softwoods	52.2	0	0	52.2	538	0	0	12	0	0
Hardwoods	35.3	0	6.3	41.7	57	0	140	5	0	6
Forest Industry										
Central										
Douglas fir / western larch	154.7	34.9	49.8	239.4	341	479	215	13	19	15
Ponderosa pine	73.6	6.5	78.8	158.8	262	624	205	12	11	15
Lodgepole pine	7.3	0	0	7.3	848	0	0	10	0	0
True firs & other softwoods	44.7	7.3	14.7	66.7	188	549	123	15	13	19
Hardwoods	0	7.3	0	7.3	0	6	0	0	36	0
Inland Empire										
Douglas fir / western larch	123.8	29.1	59.3	212.2	364	451	413	13	13	12
Ponderosa pine	40.8	8.7	8.7	58.2	274	145	133	12	20	13
Lodgepole pine	11.7	0	0	11.7	406	0	0	12	0	0
True firs & other softwoods	68.4	24.4	8.7	101.5	787	609	356	14	15	12
Hardwoods	7.0	0	6.4	13.4	na	0	203	na	0	15
Total										
Douglas fir / western larch	278.5	64.0	109.1	451.6	353	465	314	13	16	13
Ponderosa pine	114.4	15.2	87.5	217.0	268	385	169	12	16	14
Lodgepole pine	19.0	0	0	19.0	627	0	0	11	0	0
True firs & other softwoods	113.1	31.7	23.4	168.2	488	579	240	14	14	15
Hardwoods	7.0	7.3	6.4	20.8	0	3	102	0	18	8
Native American Landowners										
Central										
Douglas fir / western larch	105.4	0	37.3	142.7	280	0	304	13	0	14
Ponderosa pine	188.0	18.3	94.8	301.2	450	234	267	13	14	17
Lodgepole pine	45.3	0	6.6	51.9	566	0	530	13	0	12
True firs & other softwoods	43.2	0	17.5	60.7	278	0	144	15	0	22
Hardwoods	22.4	0	5.9	28.3	930	0	54	5	0	19
Inland Empire										
Douglas fir / western larch	203.0	18.0	47.0	267.9	619	106	673	13	19	13
Ponderosa pine	139.9	9.3	9.3	158.5	868	107	397	15	14	6
Lodgepole pine	29.0	0	0	29.0	438	0	0	11	0	0
True firs & other softwoods	31.7	0	0	31.7	342	0	0	14	0	0
Hardwoods	2.1	0	0	2.2	395	0	0	6	0	0
Total										
Douglas fir / western larch	308.4	18.0	84.3	410.7	450	53	336	13	10	14
Ponderosa pine	327.9	27.6	104.0	459.6	659	171	332	14	14	11
Lodgepole pine	74.3	0	6.6	80.9	502	0	265	12	0	6
True firs & other softwoods	74.9	0	17.5	92.4	310	0	72	14	0	11
Hardwoods	24.6	0	5.9	30.5	663	0	27	5	0	10
Nonindustrial Landowners										
Central										
Douglas fir / western larch	172.7	0	28.9	201.6	569	0	554	11	0	12
Ponderosa pine	43.3	0	49.2	92.5	1,507	0	240	10	0	12
Lodgepole pine	13.9	0	6.0	12.0	601	0	471	11	0	10
True firs & other softwoods	15.4	0	0	15.4	121	0	0	24	0	0
Hardwoods	38.0	3.5	15.9	57.4	242	113	308	12	19	9
Inland Empire										
Douglas fir / western larch	314.7	46.2	113.0	473.9	909	323	282	11	13	12
Ponderosa pine	293.4	28.9	62.1	384.5	568	108	553	11	19	11
Lodgepole pine	72.1	20.2	13.7	106.0	783	1,143	313	9	6	10
True firs & other softwoods	69.5	0	0	69.5	708	0	0	10	0	0
Hardwoods	35.1	8.5	7.2	50.8	1,814	191	26	7	11	22
Total										
Douglas fir / western larch	487.4	46.2	141.9	675.5	739	162	418	11	6	12
Ponderosa pine	336.7	28.9	111.3	477.0	781	54	397	11	9	12
Lodgepole pine	86.0	20.2	19.8	126.0	692	572	392	10	3	10
True firs & other softwoods	84.9	0	0	84.9	415	0	0	17	0	0
Hardwoods	73.1	12.0	23.1	108.2	907	152	167	10	15	16

Table II.11 Timberland acres harvested from 1981 to 1991 in Eastern Washington by harvest method and forest type.

Harvest type	Central timbershed	Inland Empire timbershed	Douglas fir - western larch	Ponderosa pine	Lodgepole pine	True firs & other softwoods	Hardwoods
DNR			0	0	0	0	6,641
Clearcut	0	6,641	0	0	0	0	6,641
Partial harvest	63,132	31,692	43,522	44,971	0	0	6,330
Seed tree or salvage	0	0	0	0	0	0	0
Firewood or local use	7,951	0	7,951	0	0	0	0
Incidental harvest	8,708	6,641	15,349	0	0	0	0
Total	79,791	44,973	66,822	44,971	0	0	12,971
Forest Industry							
Clearcut	55,978	44,796	55,283	6,485	0	31,676	7,331
Partial harvest	143,208	83,184	109,138	87,453	0	23,359	6,444
Seed tree or salvage	0	8,696	0	8,696	0	0	0
Firewood or local use	0	0	0	0	0	0	0
Incidental harvest	0	8,696	8,696	0	0	0	0
Total	199,186	145,373	173,117	102,634	0	55,035	13,775
Native Americans							
Clearcut	0	20,706	11,427	9,279	0	0	0
Partial harvest	162,095	56,271	84,322	104,080	6,607	17,485	5,872
Seed tree or salvage	18,351	0	0	18,351	0	0	0
Firewood or local use	0	0	0	0	0	0	0
Incidental harvest	0	6,571	6,571	0	0	0	0
Total	180,445	83,549	102,320	131,710	6,607	17,485	5,872
Nonindustrial landowners							
Clearcut	3,474	30,181	0	14,463	7,232	0	11,960
Partial harvest	100,026	196,075	141,888	111,322	19,746	0	23,145
Seed tree or salvage	0	0	0	0	0	0	0
Firewood or local use	0	34,681	13,725	14,463	6,493	0	0
Incidental harvest	0	38,957	32,464	0	6,493	0	0
Total	103,500	299,895	188,077	140,248	39,964	0	35,105

Silviculture Treatment Opportunities

Table II.12 summarizes the FIA survey of perceived treatment opportunities that existed in 1980, the area treated over the decade and the opportunity that existed in 1991. The ratio of actual treatment to perceived opportunities is low, even for partial cutting. Treatment opportunities have generally increased over the last decade. With 613 thousand acres classified as ready for commercial thinning or partial cutting and harvest levels of 91 thousand acres per year, there is a 6.7-year supply or backlog of acres ready for harvest. This provides a substantial opportunity to increase harvest in the future but only for a few years. This measure of an opportunity to accelerate harvest is based solely on the FIA survey and is independent of the survey of owners' management plans which in this study will essentially control the projected harvest rates as shown in the next two sections.

Table II.12 Silvicultural treatment opportunities as perceived in 1980, treatments performed 1980-1991, and treatment opportunities perceived in 1991 by owner and by timbershed in Eastern Washington

Silvicultural treatments	Central Timbershed			Inland Empire Timbershed			Total		
	Treatment opportunities in 1980	% area treated 1980-91	Treatment opportunities in 1991	Treatment opportunities in 1980	% area treated 1980-91	Treatment opportunities in 1991	Treatment opportunities in 1980	% area treated 1980-91	Treatment opportunities in 1991
DNR									
Site preparation and planting	43,822	0.0%	49,484	39,331	0.0%	32,164	83,153	0.0%	81,648
Precommercial thinning	6,330	0.0%	0	0	0.0%	0	6,330	0.0%	0
Commercial thinning and partial cutting	30,941	25.7%	22,989	13,545	51.0%	26,826	44,486	33.4%	49,815
Stand conversion	6,330	0.0%	0	0	0.0%	0	6,330	0.0%	0
Total	87,423	9.1%	72,473	52,876	13.1%	58,990	140,299	10.6%	131,463
Forest Industry									
Site preparation and planting	65,448	11.2%	67,367	27,403	0.0%	98,289	92,851	7.9%	165,656
Precommercial thinning	6,485	0.0%	0	5,856	0.0%	14,552	12,340	0.0%	14,552
Commercial thinning and partial cutting	37,641	22.6%	68,083	49,511	17.6%	43,829	87,153	19.7%	111,912
Stand conversion	24,315	0.0%	14,976	23,248	0.0%	12,299	47,563	0.0%	27,275
Total	133,889	11.8%	150,426	106,018	8.2%	168,969	239,907	10.2%	319,395
Native American									
Site preparation and planting	73,191	0.0%	28,312	72,122	0.0%	54,556	145,314	0.0%	82,868
Precommercial thinning	5,872	0.0%	22,440	9,279	0.0%	20,706	15,151	0.0%	43,146
Commercial thinning and partial cutting	79,910	50.1%	134,581	68,390	9.6%	74,962	148,301	31.4%	209,543
Stand conversion	0	0.0%	14,156	9,279	0.0%	0	9,279	0.0%	14,156
Total	158,973	25.2%	199,489	159,070	4.1%	150,224	318,045	14.7%	349,713
Nonindustrial Landowners									
Site preparation and planting	61,679	10.8%	71,811	213,427	0.0%	179,608	275,106	2.4%	251,419
Precommercial thinning	6,658	100.0%	0	37,851	0.0%	54,898	44,509	15.0%	54,898
Commercial thinning and partial cutting	55,850	59.7%	86,565	99,158	32.4%	155,601	155,008	42.2%	242,166
Stand conversion	22,166	0.0%	24,596	48,406	0.0%	30,181	70,571	0.0%	54,777
Total	146,353	31.9%	182,972	398,842	8.1%	420,288	545,194	14.5%	603,260

Sawtimber Inventory Volumes

The net volume of sawtimber inventory in Eastern Washington as reported by the FIA in PNW RB-201 is 73,858 MMBF, inclusive of the national forests. Of this standing inventory, 48% is on the national forests, 27% on private lands other than forest industry but including Native American lands, 12% on forest industry lands, and 13% on other public lands (including DNR). The 38,337 MMBF volume outside national forests was calculated using the Scribner 16 foot log length rule for both softwoods and hardwoods. This volume includes deductions for rot, sweep, crook, and other defects that affect use for lumber and is calculated on live softwood trees of commercial species at least 9.0 inches dbh (diameter at breast height, 4.5 feet above the ground) and live hardwood trees of commercial species at least 11.0 inches dbh. At least 25% of the board foot volume in a sawtimber tree must be free from defect. Softwood trees must contain at least one 12 foot saw log with a top diameter of not less than 7 inches outside bark and hardwood trees must contain at least one 8 foot saw log with a top diameter of not less than 9 inches outside bark. The saw log portion of sawtimber trees is that portion between the stump (12 inches in height) and the top diameter. Noncommercial species include western juniper, Pacific yew, white alder, Pacific dogwood, apple, and willow.

The definition of sawtimber volume used in the yield simulations and timber harvest projections reported in Chapter IV is different from that reported by the FIA. We tabulate sawtimber volumes in all live trees (including noncommercial species) greater than or equal to 5.0 inches dbh to a top diameter of 4 inches outside bark. We do not check to determine if at least one 12 foot softwood saw log with a top diameter of not less than 7 inches outside bark or at least one 8 foot hardwood saw log with a top diameter of not less than 9 inches outside bark are present. We use the 16 foot log length rule consistent with most harvest reports for the Eastside. There do not appear to be significant differences between the volumes reported by the FIA and the volumes in this report when identical definitions are used. However, as a consequence of these differences, it is difficult to make direct comparisons between the sawtimber inventory volumes derived in this report and those produced by FIA.

As reported in Chapter IV, our estimate of the 1990 sawtimber inventory volume is 50,970 MMBF exclusive of the 35,521 MMBF reported in PNW RB-201 for the national forests. Adjusting the national forest inventory upward to reflect our less restrictive definition of sawtimber is required for a consistent comparison. As a rough estimate of that adjustment, we used the ratio of our non-federal inventory to that reported in PNW RB-201 and applied that ratio to their national forest inventory, producing an estimated 47,226 MMBF on the national forests. Adding our non-federal sawtimber value of 50,970 produces an estimated total Eastside inventory of 98,196 MMBF. These adjustments to the national forest inventory may not be accurate but demonstrate the type of adjustment required for consistent comparisons.

National forest timberland (*i. e.*, 2,494 million acres) growing 20 cubic feet or more per acre per year average about 14,240 bd. ft. using the PNW RB-201 definition (or 18,932 bd. ft. using our adjustment), while the remaining, non-federal timberland acres (4,008 million acres) average 12,720 bd. ft. per acre. It should be noted that we have assumed only 62% of this national forest acreage is available for production, given current environmental constraints.

III. TIMBER HARVEST PROJECTIONS ANALYSIS[1]

Harvest Scheduling Method

This study attempts to provide a decade-by-decade projection of the potential timber harvest for Eastern Washington forests. Projections are made for each of four ownership classes (DNR, forest industry, nonindustrial (including other public), and Native American) within two timbersheds (Inland Empire and Central Cascades). A fifth owner class (USDA Forest Service) is not modeled. Instead, projected timber harvests are taken from available forest plans for Eastside forests.

Actual timber harvests for any given year will be a function of the interaction between supply and demand forces operating in the marketplace relative to owner objectives. This study has not attempted to model all of the factors at play in this complex environment. Therefore, specific forecasts of the most likely future time path of harvest for the various owner class/timbershed combinations are not made. Instead, analysis is limited to the supply side of the market. Assumptions concern things such as levels of management intensity and type of silvicultural operations--decisions taken by individual landowners which influence the supply-side. Actual timber harvests will be the result of the interplay between ownership objectives, land use decisions, timber yields and investments, public policies, plus a host of factors affecting the demand-side of the market for timber and the competitiveness of Eastside products.

Baseline projections form the basis for comparisons across a range of timber harvest flow constraints imposed to smooth the flow of timber over the projection period of 100 years. In addition, a series of sensitivity analyses are included to help judge the significance of changes in baseline assumptions. Simulation using the PROGNOSIS Model (Johnson, 1990) was the technique chosen for projecting the growth of forest stands through time. The modeling of timber harvests was done using the LP model developed for this study (see Appendix 1). A timber supply model similar in structure was previously used in California.[2] The model assigns plots to various timber management prescriptions which represent likely strategies for the ownership classes found in Eastern Washington. FIA inventory data as of 1990-1991 represent all ownerships for which timber harvest schedules were developed (*i.e.*, not including the national forests). We considered combining the 560 FIA plots into homogeneous stand types, but rejected this in favor of treating each sample plot as an individual unit. PROGNOSIS was run for each sample plot using a variety of timber management prescriptions to generate yields for the 100-year projection period.

The basic management unit (or decision variable) in the LP model is the number of acres represented by a sample plot assigned to a management prescription. Each sample plot is

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[1] All tables for this chapter are grouped at the end of the chapter.
[2] W. McKillop and B. Krumland, A Simulation/Linear Programming Approach to Timber Supply Modeling. *Western Journal of Applied Forestry 4(3)*:80-84, July 1989.

classified according to its ownership, timbershed, and forest type or plant association characteristics. Five levels of forest type (or plant association) are used in the analysis. Each sample plot is projected separately using appropriate management prescriptions. Eight defined management prescriptions represent: (a) no management; (b) four levels of management intensification under even-aged management; and (c) three levels of management intensification under uneven-aged management. These prescriptions are based on stand structural characteristics and vary in the amount of planting, thinning, and intensity of regeneration harvest. The levels of intensity used for the even and uneven-aged sample plots are qualitatively labeled as low (two varieties for even-aged management), medium, and high.

Management Intensity Prescriptions (MI) and Allocations

Table III.1 summarizes the decision rules for the eight management intensity prescriptions used in the study. For the even-aged management alternatives, the lowest level relies on natural regeneration; the next level replants harvested stands at 250 stems per acre; and the highest level thins young trees once to 175 stems per acre. For uneven-aged management, the lowest level provides a partial cut of 4 MMBF/acre, leaving 150 stems per acre and only occurs if pre-harvest stand volume exceeds 7 MMBF/acre. The next level of management removes 6 MMBF/acre, leaving 150 stems per acre as dominant or co-dominants but only occurs if pre-harvest stand volume exceeds 9 MMBF/acre. The highest level is similar, except 8 MMBF/acre are removed and the stand is planted to 100-150 stems per acre. This highest management alternative allows a high percentage of removal in the partial cut but requires a greater investment in underplanting. For each sample plot, the PROGNOSIS model is used to project the standing and harvest volumes by decade for each selected management prescription. The proportion of acres within a given ownership, forest type, and timbershed combination assigned to a management prescription was provided by representatives of the modeled ownership groups.

Tables III.2-III.5 summarize, for each owner class, the proportion of timberland allocated to each management intensity prescription for each forest type or plant association. The allocation, provided by representative owners, show somewhat higher levels of management for forest industry owners relative to the DNR, but considerably lower levels of management for Native American owners and even lower for nonindustrial owners. Estimates of the number of acres assigned to each of the possible management prescriptions by owner collapsed across forest type are calculated from this information and provided as a constraint to the LP model.

Harvest Flow Constraints

In making the assignment of acres, the objective of the LP model is to seek the maximum timber harvest possible over the 100-year projection period consistent with the inherent productivity of the land base and the assumed timber harvest flow constraints. Four different types of flow constraints are used: (a) unconstrained, wherein the estimated timber harvest from one decade to the next may increase or decrease by any amount; (b) even-flow, wherein the estimated timber harvest from one decade to the next must not decline; (c) ±5%, wherein the estimated timber harvest from one decade to the next may increase or decrease by a maximum of 5%; and (d)

±25%, wherein the estimated timber harvest from one decade to the next may increase or decrease by a maximum of 25%. No attempts were made under any of the flow constraints to link the harvest in the first decade of the 100 year projection period to historical levels of timber harvest. However, the consequences of making such a linkage can be seen in the results shown later.

Only total harvest volume per decade is controlled in the LP model. At the conclusion of each run, three sets of summary statistics are generated by feeding the LP-based solutions back into the PROGNOSIS yield tables. From this we calculate for those acres that were managed (*i.e.*, management prescription 2-8): (a) level of residual standing inventory, (b) quadratic mean diameter of harvested volume, and (c) harvest volume by species. When traced over the 100-year planning horizon, these provide added information concerning the sustainability of the timber resources in the two timbersheds of Eastern Washington.

The even-flow alternative is the most restrictive of the harvest flow alternatives modeled. It requires that estimated harvest volumes per decade be constant over the 100 year projection period. Thus, the decade containing the most limiting level of timber inventory is the one that determines the level of the harvest for all decades. If sufficient inventory exists in all decades, then it is the growth of the forest which limits the level of harvest. The unconstrained run is the least restrictive of the alternatives modeled. In this case, the estimated timber harvest in a decade is set at the maximum level possible and all merchantable timber available in a decade is included in the harvest. In later decades, as timber grows to merchantable size, it is scheduled for harvest at the earliest opportunity. The ±5% and ±25% runs are probably more realistic than either of the above alternatives as they allow estimated timber harvest levels to fluctuate from one decade to the next, but never more than the specified percentage. In all cases, the demand curve facing the land owner is assumed to be perfectly elastic. Thus, owners are assumed to be able to sell all the timber scheduled at the prevailing price. No economies of scale are assumed to be present.

In order to provide additional flexibility within the LP model, it was necessary to allow for some delays in harvest for some ownerships and timbersheds. Without this added flexibility, it was not possible to obtain a feasible solution under selected timber harvest flow variants. Because the proportion of each owners timberland assigned to the eight management prescriptions was a fixed input, the only way to add options within the LP model was to increase the number of timing choices. Therefore, when the LP model could not find a feasible solution given the original set of management prescriptions, prescriptions were successively added which forced a delayed initial harvest of either 10 or 20 years. In this manner, all harvests under these new prescriptions were taken either 10 or 20 years after the time period originally prescribed. Ownership/timbershed groups requiring the use of delayed harvest prescriptions were: (1) forest industry in the Central Cascades, and (2) nonindustrial owners in both the Inland Empire and Central Cascades areas. In the case of the nonindustrial owners in the Inland Empire, no feasible LP schedule satisfying the even-flow timber harvest constraints was found after addition of the 10 and 20 year delayed harvest alternatives. In the results shown herein, we assume a 20 year delay in all cases where delays are required to obtain a feasible solution. This provides sufficient flexibility for the alternative prescriptions examined in our study.

Readers interested in examining the Eastside LP timber harvest scheduling model in detail may consult Appendix 1 where the model's structure is defined.

Delineation of Forest Types and Plant Associations

Tables III.2-III.5 show the proportional assignment of management prescriptions to the five dominant forest types or climax plant associations by owner category and stand structure. These definitions were reached after careful analysis of the FIA plot data. Dominant forest type was used to help classify FIA plot data for all but the forest industry ownership where climax plant association was used. First order plant associations were determined through a series of decision criteria that matched the density, dominance, and species of trees in both the over- and understory on each plot with the association descriptions given in the literature. An examination of the distribution of FIA plots by forest type, plant association, and stand structure (see Tables III.6-III.8) shows that over 80% of the plots fall in uneven-aged stand types. These tables also show that Douglas-fir and ponderosa pine--whether classified by plant association or forest type --constitute the majority (about 80%) of the plots. Differences in whether forest type or plant association is used to classify the FIA plots do, however, arise for the remaining three type groupings.

The number of timberland acres summarized by stand structure, forest type or plant association class, timbershed, and ownership class are shown in Tables III.9-III.12. These complement those shown in Chapter II but reflect the definition of stand structure used in the timber projections. Given the proportional assignment of management prescriptions to the five dominant forest types or climax plant associations by owner category and stand structure, and the timberland acres presented above, the actual acres allocated to each management intensity are shown in Tables III.13 and III.14. These represent the right-hand sides of the LP model's area constraints which control the level of management intensity for the baseline projections as well as the five sensitivity analysis scenarios discussed below. Thus, these acreage constraints do not require that the proportional assignment of management prescriptions by forest type be followed by the LP model. Rather, they only require that the total number of acres (when summed over all plots) is equal to a fixed (specified) number of acres assigned to each of the eight management prescriptions (*i.e.*, the right-hand side of these constraints). A second set of acreage constraints requires that the total number of acres (when summed over all feasible management prescriptions for a given plot) is equal to the number of acres represented by a given plot. Taken together, these requirements give the LP model the flexibility to assign FIA plots to management prescriptions within forest types when maximizing the total harvest volume over the projection period. However, there is no requirement to maintain the exact proportional allocations shown in Tables III.2-III.5. Lastly, acres can not be converted from one forest type to another during the projection period.

Initial Conditions: Base MI Allocations

The baseline timber harvest schedules which form the basis of comparison for the discussion of results shown in Chapter IV are based on the following assumptions:

1. Use of the FIA plot data for all ownerships for which timber harvest schedules are estimated (*i.e.*, excludes the national forests).

2. Use of the PROGNOSIS Model for predicting all future timber yields for the eight management prescriptions. We did not make any extraordinary reductions for mistletoe or root disease infected stands beyond that incorporated by the model.

3. Use of estimates provided by representatives of each modeled ownership group detailing the proportion of their land base to be managed under each management prescription. These percentages were used to derive the area constraints by ownership and timbershed group. Further, once a plot was assigned to either an even-aged or uneven-aged management prescription, it remained fixed throughout the entire 100-year projection period.

4. No major land use shifts or withdrawals of forest land from production.

5. All policies affecting private and public management continue as they have been over the last several years without the imposition of significant new restrictions. Very recent and projected changes in forest practices regulations are not incorporated into these baseline assumptions. These assumptions, therefore, reflect initial conditions for comparison to alternative conditions. Furthermore, they do not represent a forecast but rather a projection reflecting the baseline assumptions.

Sensitivity Analysis: MI and Land Base

In addition to the initial conditions listed above, a series of sensitivity analyses was made to investigate changes in harvest projections under conditions differing from the initial conditions. Sensitivity analyses were performed on the modeled ownership groups (*i.e.*, excludes the national forests) in a sequential fashion. The major elements receiving attention were: (a) timberland base reduction and (b) changes in management intensity and their associated timber yields. Because the number of possible combinations of these various elements is large, we restricted our attention to the critical elements treated in isolation. Five scenarios were generated to examine sensitivity questions included under items (a) and (b). These were:

1. Timberland base reduction: To test the sensitivity of harvest projections against FIA area assumptions, we reduced the timberland acreage by 15% in the first decade of the 100-year projection period. In the initial condition runs, the acres designated as timberland in 1990 were retained throughout the projection period. In the sensitivity run, the area designated as timberland was reduced once in the first decade and then held constant throughout the remaining decades. While a 15% reduction seems like a dramatic reduction, it is not outside the range of alternative forest practice proposals put forward in recent years. Thus, we were interested in estimating the effect on the projected harvest. A second timberland base reduction scenario was to combine the 15% reduction in acreage with a simultaneous increase in management intensity amounting to a 20% increase in the acreage of timberland from a lower level of management intensity to the next higher level. Both timberland reduction scenarios were applied uniformly across both timbersheds and all modeled ownership groups.

2. Changes in management intensity: To test the sensitivity of harvest projections to assumed levels of management intensity, we investigated three scenarios. One scenario presumes that all acreage is assigned to the management prescription representing the lowest level of intensity (with no change in the number of acres in the no-management category). A second scenario presumes that all acreage is assigned to the management prescription representing the highest level of intensity (or the no-management category). In neither case are acres shifted between even-aged and uneven-aged management or between forest types or plant associations. A third scenario is to increase management intensity by shifting 20% of the timberland acres from a lower level of management intensity to the next higher level.

Table III.1 Definition of timber managemnt intensity prescriptions.

	Silvicultural Regime	Decision Rule	Action
1	No management	none..	do nothing

2	Even aged - minimum - natural regeneration	**Existing**
		if (volume < 12MBF)
		then..
		else..
		Post harvest
		if harvest then........................
		if (volume < 12 MBF) then...
		else..
			
			do nothing
			harvest all
			
			natural regeneration only
			do nothing
			harvest all

3	Even aged - minimum	**Existing**
		if (volume < 12MBF) then....
		else..
		Post harvest
		if harvest then........................
		if (volume < 12 MBF) then....
		else..
			
			do nothing
			harvest all
			
			plant to 250 stems per acre
			do nothing
			harvest all

4	Even aged - medium	**Existing**
		if (volume < 13 MBF) then ...
		if (height < 15 ft) then....
		else..
		else..
		Post harvest
		if harvest then........................
		if (volume < 13 MBF) then ...
		if (height < 15 ft) then....
		else..
		else..
			
			do nothing
			thin once to 150 - 200 (175) stems per acre
			harvest all
			
			plant to 250 stems per acre
			
			do nothing
			thin once to 150 - 200 (175) stems per acre
			harvest all

5	Even aged - maximum	**Existing**
		if (volume < 16 MBF) then ...
		if (height < 15 ft) then....
		else..
		else..
		Post harvest
		if harvest then........................
		if (volume < 16 MBF) then ...
		if (height < 15 ft) then....
		else..
		else..
			
			do nothing
			thin once to 150 - 200 (175) stems per acre
			harvest all
			
			plant to 250 stems per acre
			
			do nothing
			thin once to 150 - 200 (175) stems per acre
			harvest all

6	Uneven aged - minimum	if (volume < 7 MBF) then...... else..	do nothing partial cut to 150 stems per acre; yields 4 MBF / acre
7	Uneven aged - medium	if (volume < 9 MBF) then...... else..	do nothing partial cut to 150 stems per acre; yields 6 MBF / acre - leave all less than 2.5 inches dbh - leave trees are dominants or co-dominants
8	Uneven aged - maximum	if (volume < 9 MBF) then...... else..	do nothing partial cut to 150 stems per acre; yields 8 MBF / acre - leave all less than 2.5 inches dbh - leave trees are dominants or co-dominants - under plant 100 - 150 stems per acre

Table III.2 Allocation of DNR timberland acres by dominant forest type and management intensity prescription.

	Proportion of land allocated to MI by dominant forest type	Douglas fir - western larch type	Ponderosa pine type	Lodgepole pine type	True firs & other softwoods	Hardwood type
1	No management	0.15	0.10	0.10	0.10	0.00
2	Even aged - minimum - NR	0.39	0.00	0.80	0.11	1.00
3	Even aged - minimum	0.31	0.90	0.00	0.06	0.00
4	Even aged - medium	0.16	0.00	0.10	0.17	0.00
5	Even aged - maximum	0.00	0.00	0.00	0.56	0.00
	Subtotal - even aged by forest type classification	100%	100%	100%	100%	100%
1	No management	0.15	0.10	0.10	0.10	0.00
6	Uneven aged - minimum	0.43	0.90	0.90	0.00	1.00
7	Uneven aged - medium	0.43	0.00	0.00	0.90	0.00
8	Uneven aged - maximum	0.00	0.00	0.00	0.00	0.00
	Subtotal - uneven aged by forest type classification	100%	100%	100%	100%	100%

Table III.3 Allocation of forest industry acres by plant association and management intensity prescription.

	Proportion of land allocated to MI by plant association	Douglas fir type	Ponderosa pine type	Subalpine fir type	Grand fir type	Hardwood type
1	No management	0.00	0.00	0.00	0.00	0.00
2	Even aged - minimum - NR	0.40	0.50	0.33	0.25	0.80
3	Even aged - minimum	0.35	0.50	0.33	0.25	0.20
4	Even aged - medium	0.15	0.00	0.17	0.25	0.00
5	Even aged - maximum	0.10	0.00	0.17	0.25	0.00
	Subtotal - even aged by plant association classification	100%	100%	100%	100%	100%
1	No management	0.05	0.20	0.07	0.03	0.00
6	Uneven aged - minimum	0.76	0.70	0.52	0.51	0.80
7	Uneven aged - medium	0.13	0.10	0.37	0.34	0.20
8	Uneven aged - maximum	0.06	0.00	0.04	0.12	0.00
	Subtotal - uneven aged by plant association classification	100%	100%	100%	100%	100%

Table III.4 Allocation of Native American timberland acres by dominant forest type and management intensity prescription.

	Proportion of land allocated to MI by dominant forest type	Douglas fir - western larch type	Ponderosa pine type	Lodgepole pine type	True firs & other softwoods	Hardwood type
1	No management	0.07	0.07	0.07	0.07	0.07
2	Even aged - minimum - NR	0.47	0.47	0.94	0.56	0.56
3	Even aged - minimum	0.47	0.47	0.00	0.19	0.19
4	Even aged - medium	0.00	0.00	0.00	0.19	0.19
5	Even aged - maximum	0.00	0.00	0.00	0.00	0.00
	Subtotal - even aged by forest type classification	100%	100%	100%	100%	100%
1	No management	0.07	0.07	0.07	0.07	0.07
6	Uneven aged - minimum	0.75	0.62	0.94	0.66	0.56
7	Uneven aged - medium	0.19	0.31	0.00	0.28	0.37
8	Uneven aged - maximum	0.00	0.00	0.00	0.00	0.00
	Subtotal - uneven aged by forest type classification	100%	100%	100%	100%	100%

Table III.5 Allocation of nonindustrial timberland acres by dominant forest type and management intensity prescription.

	Proportion of land allocated to MI by dominant forest type	Douglas fir - western larch type	Ponderosa pine type	Lodgepole pine type	True firs & other softwoods	Hardwood type
1	No management	0.00	0.00	0.00	0.00	0.00
2	Even aged - minimum - NR	0.80	0.80	0.80	0.90	0.90
3	Even aged - minimum	0.15	0.15	0.20	0.10	0.10
4	Even aged - medium	0.05	0.05	0.00	0.00	0.00
5	Even aged - maximum	0.00	0.00	0.00	0.00	0.00
	Subtotal - even aged by forest type classification	100%	100%	100%	100%	100%
1	No management	0.00	0.00	0.00	0.00	0.00
6	Uneven aged - minimum	1.00	1.00	1.00	1.00	1.00
7	Uneven aged - medium	0.00	0.00	0.00	0.00	0.00
8	Uneven aged - maximum	0.00	0.00	0.00	0.00	0.00
	Subtotal - uneven aged by forest type classification	100%	100%	100%	100%	100%

Table III.6 Distribution of FIA plots by dominant forest type and stand structure class for all modeled owners.

	Douglas-fir / western larch	Ponderosa pine	Lodgepole pine	Other softwoods	Hardwoods	Total
Evenaged						
Seedlings, saplings & pole timber						
no. plots	27	17	4	7	,14	69
% total acres	4.7%	3.1%	0.8%	1.3%	2.4%	12.3%
Saw timber						
no. plots	11	10	2	7	2	32
% total acres	2.0%	1.8%	0.4%	1.3%	0.4%	5.9%
Uneven aged						
Seedlings, saplings & pole timber under saw timber						
no. plots	134	101	21	35	4	295
% total acres	24.0%	18.0%	3.7%	6.2%	0.8%	52.7%
Saplings & pole timber under saw timber						
no. plots	86	49	12	7	10	164
% total acres	15.3%	8.7%	2.1%	1.2%	1.8%	29.1%
Total						
no. plots	258	177	39	56	30	560
% total acres	46.0%	31.6%	7.0%	10.0%	5.4%	100.0%

Table III.7 Distribution of FIA plots and acres by plant association and stand structure class for all modeled owners.

	Douglas-fir	Ponderosa pine	Subalpine fir	Grand fir	Hardwoods	Total
Evenaged						
Seedlings, saplings & pole timber						
no. plots	32	20	3	8	6	69
% total acres	5.7%	3.6%	0.5%	1.4%	1.1%	12.3%
Saw timber						
no. plots	12	10	3	7	0	32
% total acres	2.1%	1.8%	0.5%	1.3%	0.0%	5.9%
Uneven aged						
Seedlings, saplings & pole timber under saw timber						
no. plots	135	98	24	34	4	295
% total acres	24.1%	17.5%	4.3%	6.1%	0.7%	52.7%
Saplings & pole timber under saw timber						
no. plots	86	48	17	6	4	164
% total acres	15.9%	8.6%	3.0%	1.1%	0.7%	29.1%
Total						
no. plots	268	176	47	55	14	560
% total acres	47.9%	31.4%	8.4%	9.8%	2.5%	100.0%

Table III.8 Acreage correspondance between dominant forest type classes and plant association classes.

	Douglas-fir / Western larch	Ponderosa pine	Lodgepole pine	True firs / other softwoods	Hardwoods	Total
Grand fir						
n	13	3	4	33	2	55
acres	89,869	21,364	29,015	235,092	12,289	387,631
Subalpine fir						
n	4	2	21	17	3	47
acres	28,447	12,478	140,971	120,652	25,294	327,844
Hardwood						
n	1	3	1	9	14	28
acres	6,606	8,620	19,889	7,331	63,020	98,861
Ponderosa pine						
n	15	155	1	5	176	352
acres	108,183	1,143,064	6,606	32,438	36,825	1,294,679
Douglas-fir						
n	226	16	10	5	11	268
acres	1,601,227	119,826	70,450	34,561	70,322	1,896,388
Total						
n	258	177	39	56	30	560
acres	1,827,728	1,305,354	266,933	397,637	207,751	4,005,404

Table III.9. Distribution of DNR timberland by dominant forest type and timbershed.

	Dominant forest type classification	Central timbershed	Inland Empire timbershed	All eastern Washington
		Timberland acres		
Even - aged	Douglas-fir / Western larch	17,241	0	17,241
	Ponderosa pine	21,911	0	21,911
	Lodgepole pine	0	6,904	6,904
	True firs & other softwoods	0	0	0
	Hardwoods	25,861	11,453	37,314
	All forest types	65,013	18,356	83,370
Uneven - aged	Douglas-fir / Western larch	149,344	123,360	272,704
	Ponderosa pine	81,994	47,801	129,795
	Lodgepole pine	20,612	13,545	34,156
	True firs & other softwoods	38,892	13,282	52,174
	Hardwoods	11,001	0	11,001
	All forest types	301,842	197,987	499,829
Total	All forest types	366,855	216,343	583,198

Table III.10. Distribution of forest industry timberland by plant association and by timbershed.

	First order plant association classification	Central timbershed	Inland Empire timbershed	All eastern Washington
		Timberland acres		
Even - aged	Douglas fir	52,522	59,348	111,870
	Ponderosa pine	60,656	5,856	66,512
	Subalpine fir	14,619	0	14,619
	Grand fir	27,588	43,656	71,243
	Hardwoods	7,331	6,996	14,327
	All forest types	162,716	115,855	278,571
Uneven - aged	Douglas fir	158,535	170,283	328,818
	Ponderosa pine	99,013	43,656	142,669
	Subalpine fir	21,906	11,711	33,617
	Grand fir	37,371	55,540	92,912
	Hardwoods	0	0	0
	All forest types	316,824	281,190	598,015
Total	All forest types	479,540	397,046	876,585

Table III.11 Distribution of Native American timberland by dominant forest type and by timbershed.

	Dominant species forest type classification	Central timbershed	Inland Empire timbershed	All eastern Washington
		Timberland acres		
Even - aged	Douglas fir - western larch	5,872	33,849	39,721
	Ponderosa pine	33,136	27,838	60,974
	Lodgepole pine	0	0	0
	True firs & other softwoods	0	18,559	18,559
	Hardwoods	0	0	0
	All forest types	39,008	80,246	119,253
Uneven - aged	Douglas fir - western larch	156,148	207,250	363,398
	Ponderosa pine	254,607	155,768	410,375
	Lodgepole pine	54,921	26,286	81,206
	True firs & other softwoods	71,842	19,714	91,556
	Hardwoods	8,284	0	8,284
	All forest types	545,802	409,018	954,819
Total	All forest types	584,809	489,263	1,074,073

Table III.12 Distribution of nonindustrial timberland by dominant forest type and by timbershed.

	Dominant species forest type classification	Central timbershed	Inland Empire timbershed	All eastern Washington
		Timberland acres		
Even - aged	Douglas fir - western larch	50,370	47,206	97,575
	Ponderosa pine	0	73,787	73,787
	Lodgepole pine	0	27,449	27,449
	True firs & other softwoods	0	11,901	11,901
	Hardwoods	20,148	31,436	51,584
	All forest types	70,518	191,778	262,296
Uneven - aged	Douglas fir - western larch	151,233	426,690	577,923
	Ponderosa pine	92,499	310,693	403,192
	Lodgepole pine	19,965	78,548	98,513
	True firs & other softwoods	15,410	57,592	73,002
	Hardwoods	37,250	19,373	56,623
	All forest types	316,356	892,896	1,209,252
Total	All forest types	386,873	1,084,674	1,471,548

Table III.13 LP area constraints to the allocation of management intensities to the DNR and forest industry timber land base.

Managment Intensity *Thousand acres*	Base	Low	High	20% boost	-15% land base	-15% land base + 20% boost
Department of Natural Resources						
Central timbershed						
No management	41	41	41	41	90	90
Even aged - minimum - NR	33	60	0	26	28	22
Even aged - minimum	25	0	0	27	21	23
Even aged - medium	3	0	0	7	2	6
Even aged - maximum	0	0	60	1	0	0
Uneven aged - minimum	167	265	0	133	142	113
Uneven aged - medium	98	0	0	112	84	95
Uneven aged - maximum	0	0	265	20	0	17
Total	367	367	367	367	367	367
Inland Empire timbershed						
No management	27	27	27	27	55	55
Even aged - minimum - NR	17	18	0	14	14	12
Even aged - minimum	0	0	0	3	0	3
Even aged - medium	1	0	0	1	1	0
Even aged - maximum	0	0	18	0	0	0
Uneven aged - minimum	108	172	0	86	91	73
Uneven aged - medium	64	0	0	73	55	62
Uneven aged - maximum	0	0	172	13	0	11
Total	216	216	216	216	216	216
Both timbersheds						
No management	68	68	68	68	145	145
Even aged - minimum - NR	49	78	0	40	42	34
Even aged - minimum	25	0	0	30	21	25
Even aged - medium	3	0	0	8	3	7
Even aged - maximum	0	0	78	1	0	1
Uneven aged - minimum	274	437	0	220	233	187
Uneven aged - medium	163	0	0	185	138	157
Uneven aged - maximum	0	0	437	33	0	28
Total	583	583	583	583	583	583
Forest Industry						
Central timbershed						
No management	47	47	47	47	112	112
Even aged - minimum - NR	69	163	0	55	59	47
Even aged - minimum	62	0	0	63	53	54
Even aged - medium	17	0	0	26	15	22
Even aged - maximum	15	0	163	18	12	15
Uneven aged - minimum	206	270	0	165	176	140
Uneven aged - medium	48	0	0	80	41	68
Uneven aged - maximum	15	0	270	25	13	21
Total	480	480	480	480	480	480
Inland Empire timbershed						
No management	25	25	25	25	81	81
Even aged - minimum - NR	43	116	0	35	37	29
Even aged - minimum	36	0	0	37	31	32
Even aged - medium	20	0	0	23	17	20
Even aged - maximum	17	0	116	21	14	18
Uneven aged - minimum	190	256	0	152	162	129
Uneven aged - medium	48	0	0	77	41	65
Uneven aged - maximum	18	0	256	27	15	23
Total	397	397	397	397	397	397
Both timbersheds						
No management	72	72	72	72	193	193
Even aged - minimum - NR	112	279	0	90	95	76
Even aged - minimum	98	0	0	101	83	86
Even aged - medium	37	0	0	49	31	42
Even aged - maximum	31	0	279	39	27	33
Uneven aged - minimum	397	526	0	317	337	270
Uneven aged - medium	96	0	0	156	82	133
Uneven aged - maximum	33	0	526	52	28	44
Total	877	877	877	877	877	877

Table III.14 LP area constraints to the allocation of management intensities to the Native American and nonindustrial landowner timber land base.

Managment Intensity *Thousand acres*	Base	Low	High	20% boost	-15% land base	-15% land base + 20% boost
Native American Landowners						
Central timbershed						
No management	38	38	38	38	120	120
Even aged - minimum - NR	22	44	0	18	17	15
Even aged - minimum	22	0	0	22	17	17
Even aged - medium	0	0	0	4	0	3
Even aged - maximum	0	0	44	0	0	0
Uneven aged - minimum	465	465	0	372	392	314
Uneven aged - medium	0	0	0	93	0	79
Uneven aged - maximum	0	0	465	0	0	0
Total	547	547	547	547	547	547
Inland Empire timbershed						
No management	32	32	32	32	100	100
Even aged - minimum - NR	52	83	0	41	43	34
Even aged - minimum	31	0	0	34	24	29
Even aged - medium	0	0	0	5	0	5
Even aged - maximum	0	0	83	0	0	0
Uneven aged - minimum	342	342	0	275	290	230
Uneven aged - medium	0	0	0	70	0	60
Uneven aged - maximum	0	0	342	0	0	0
Total	457	457	457	457	457	457
Both timbersheds						
No management	70	70	70	70	220	220
Even aged - minimum - NR	74	127	0	59	60	49
Even aged - minimum	53	0	0	56	41	46
Even aged - medium	0	0	0	9	0	8
Even aged - maximum	0	0	127	0	0	0
Uneven aged - minimum	807	807	0	647	682	544
Uneven aged - medium	0	0	0	163	0	138
Uneven aged - maximum	0	0	807	0	0	0
Total	1004	1004	1004	1004	1004	1004
Nonindustrial Landowners						
Central timbershed						
No management	0	0	0	0	58	58
Even aged - minimum - NR	63	71	0	51	54	43
Even aged - minimum	7	0	0	18	6	16
Even aged - medium	0	0	0	1	0	1
Even aged - maximum	0	0	71	0	0	0
Uneven aged - minimum	316	316	0	253	269	215
Uneven aged - medium	0	0	0	63	0	54
Uneven aged - maximum	0	0	316	0	0	0
Total	387	387	387	387	387	387
Inland Empire timbershed						
No management	0	0	0	0	163	163
Even aged - minimum - NR	173	192	0	138	147	117
Even aged - minimum	19	0	0	50	16	42
Even aged - medium	0	0	0	4	0	3
Even aged - maximum	0	0	192	0	0	0
Uneven aged - minimum	893	893	0	714	759	607
Uneven aged - medium	0	0	0	179	0	152
Uneven aged - maximum	0	0	893	0	0	0
Total	1085	1085	1085	1085	1085	1085
Both timbersheds						
No management	0	0	0	0	221	221
Even aged - minimum - NR	236	262	0	189	201	161
Even aged - minimum	26	0	0	68	22	58
Even aged - medium	0	0	0	5	0	4
Even aged - maximum	0	0	262	0	0	0
Uneven aged - minimum	1209	1209	0	967	1028	822
Uneven aged - medium	0	0	0	242	0	206
Uneven aged - maximum	0	0	1209	0	0	0
Total	1472	1472	1472	1472	1472	1472

IV. HARVEST PROJECTIONS: RESULTS OF THE ANALYSIS[1]

The harvest projections reported below are based on the initial set of conditions with the four harvest flow variants previously described. The base line projections are meant to portray possible levels of harvest based upon these assumptions. Actual harvest levels will be determined by the complex interaction of a series of individual decisions taken in reaction to market and environmental forces. Base line harvest projections are generated for each modeled ownership group (*i.e.*, excludes the national forests) for each timbershed. For each ownership group, results by timbershed are summed to obtain results for that group's Eastside land base. These latter totals are then aggregated across all modeled ownerships to obtain projected totals for the modeled portion of the Eastside. In addition to the harvest projections for the four different harvest flow variants, we also present results showing the quadratic mean diameter of the harvest; the status of the residual inventory; and the species composition of the harvest over the 100-year projection period.

To save space and to allow direct comparison, we have grouped as many results on a single figure as deemed possible. On several figures, we separate the page into three panels labelled A, B, and C. In these cases, Panel A represents results for the initial or baseline conditions. This panel shows historic harvest and projected conditions under even-flow, ±5%, ±25%, and unconstrained variants of timber harvest flow. Panel B represents historic harvest and projected results for three of the sensitivity analyses wherein the 20% boost (in management intensity), 15% land reduction, and 20% boost plus 15% land reduction scenarios are compared with the ±5% harvest flow initial condition results. Lastly, Panel C represents historic harvest and projected results for the other two sensitivity analyses wherein the high and low management scenarios are compared with the ±5% and unconstrained initial condition results (the high and low management scenarios are not constrained by flow constraints).

Neither management specifically to avoid forest health problems nor management which considers the consequences (fires, insects, and rot) of forest health problems was projected. The unconstrained management scenario would be most like a program to avoid or to respond to these problems because management to reduce forest health problems would require accelerated harvesting of unhealthy stands. The result would be high harvest volumes in the short run, low harvests in the intermediate term, and high harvests again as the stands become mature.

Management which responds to fires, insects, and other forest health consequences would result in high harvest volumes in the short run as salvage operations occur. Low harvest levels would occur in the intermediate term. Either high or low levels of harvest would occur in the long run, depending upon whether burned areas were adequately managed. Failure to salvage could result either from a policy decision or because the fires were too large and devastating.

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[1]Figures and tables for this chapter are grouped by owner and topic (harvest, diameter, inventory, species) immediately after the related text.

Table IV.1 Annual harvest volumes for all modeled owners (MMBF)

Inland	evenflow	5%	25%	unconst.	boost	-15%	-15%+boost	low	high
1995		551	691	877	627	510	570	626	1,925
2005		523	540	450	596	475	541	495	271
2015		532	535	609	592	526	539	574	444
2025		542	548	510	562	486	512	526	355
2035		558	587	581	564	510	492	622	460
2045		569	631	569	572	518	513	583	424
2055		578	510	545	581	478	517	580	547
2065		565	599	614	610	519	543	541	592
2075		581	584	531	635	518	568	535	664
2085		598	586	674	667	544	596	623	510
Central									
1995	465	523	644	887	753	444	496	575	2,071
2005	465	511	539	451	489	436	471	456	281
2015	465	490	443	463	488	414	448	453	466
2025	465	483	508	462	474	411	426	478	339
2035	465	470	421	448	482	411	415	438	292
2045	465	450	443	407	423	408	411	454	281
2055	465	460	478	461	463	414	417	495	417
2065	465	466	465	466	493	420	423	438	469
2075	465	473	515	511	513	420	436	437	550
2085	465	481	470	496	555	433	450	551	398
Both									
1995		1,074	1,335	1,764	1,380	954	1,065	1,200	3,996
2005		1,034	1,080	901	1,084	911	1,012	951	552
2015		1,022	978	1,072	1,080	940	987	1,027	910
2025		1,025	1,055	972	1,036	897	938	1,004	694
2035		1,029	1,008	1,029	1,046	922	906	1,060	752
2045		1,020	1,074	976	994	926	924	1,037	706
2055		1,038	988	1,006	1,043	892	934	1,074	964
2065		1,031	1,064	1,080	1,103	939	966	979	1,061
2075		1,053	1,099	1,042	1,148	938	1,004	972	1,214
2085		1,079	1,056	1,170	1,223	977	1,046	1,174	908

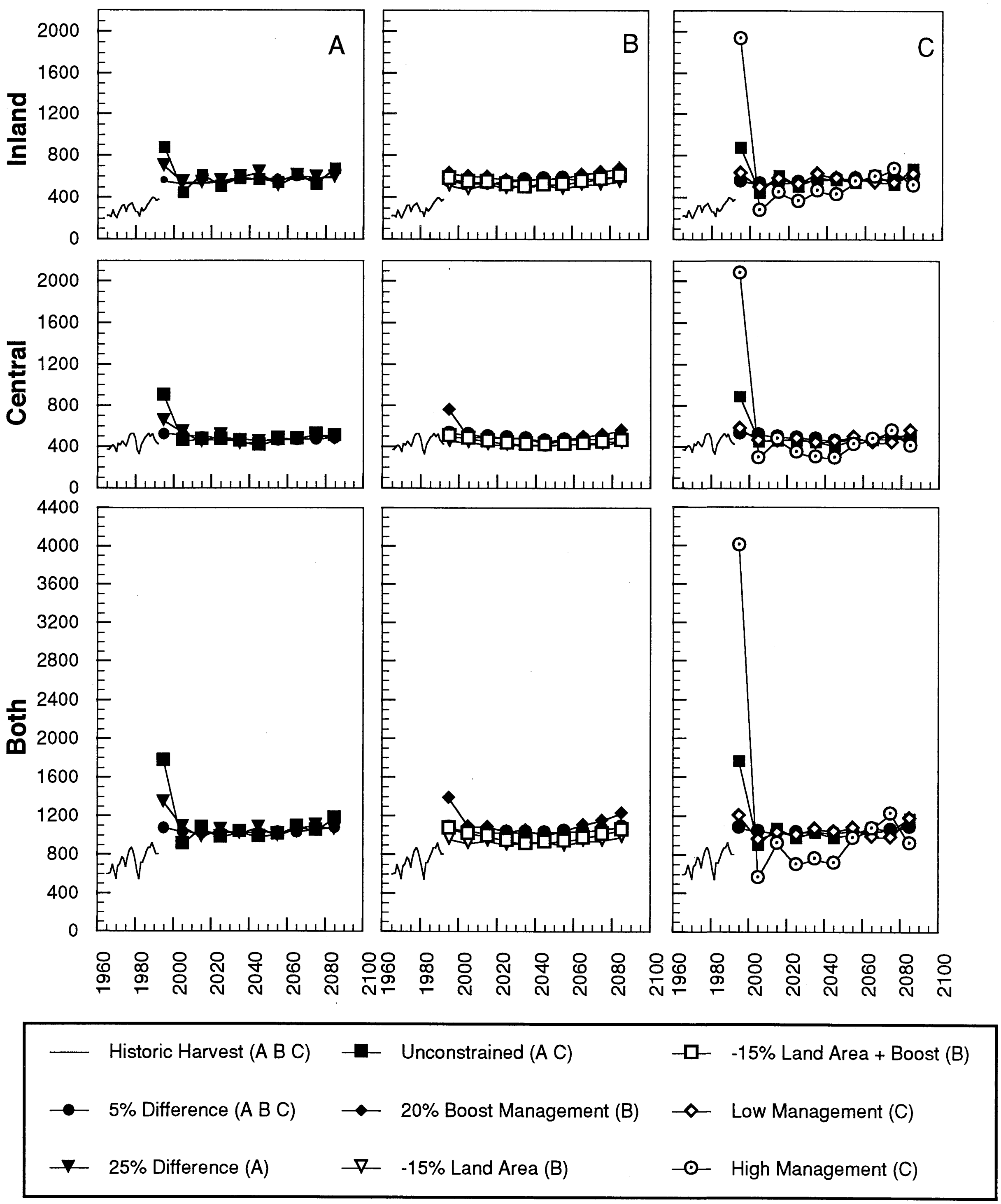


Figure IV.1 Projections of average annual harvest (MMBF) by timbershed for all modeled owners aggregated under four harvest flow variants for initial conditions and for five sensitivity analysis scenarios.

All Modeled Owners (Excludes the National Forests)

Under Initial Conditions--Harvest. The aggregate estimated timber harvest volume over the 100-year projection period is summarized in Table IV.1 and Figure IV.1 Panel A. Shown are the average annual timber harvest volumes in Scribner board feet (16 foot logs) by decade for each timbershed and for the entire Eastside. Results are presented for each of the four timber harvest flow variants examined in this study. Also shown in Figure IV.1 Panel A is the historical timber harvest volume for the period 1965-92. These should be used solely to provide perspective vis a vis the projected harvest volumes recognizing that there may be many factors that preclude comparability between the historical period and the projections. It was not possible to find an even-flow solution in the Inland Empire timbershed for the nonindustrial ownership group. Thus, the projected even-flow harvest volume for this timbershed and for the sum of the two timbersheds is not shown.

One striking feature shown in Figure IV.1 Panel A is that regardless of timber harvest flow constraint variant, there is little variation in projected harvest beyond the second decade when both timbersheds are considered. However, there is considerable variation during the first decade of the analysis. And, as expected, there is more variation in estimated harvest levels in individual timbersheds than when results are aggregated across timbersheds. The second striking feature shown in Figure IV.1 Panel A is that projected timber harvests in the first two decades increase as the degree of harvest flow control decreases. This occurs because excess timber inventory is scheduled for harvest in the early decades of the 100-year projection period if the harvest in a future decade is allowed to decline.

The projected average annual harvest volume per decade for both timbersheds under the ±5% or ±25% harvest flow variants stabilizes at about 1,050 MMBF during the last two decades of the 100-year planning horizon. This harvest volume is above historic harvest levels if both timbersheds are considered. The projection suggests some excess capacity exists to support levels of harvest greater than historic levels. That does not mean owners can be expected to utilize this excess capacity as many factors may inhibit the full utilization of growing capacity. Also, much of this excess would only last for about two decades with no owner constraints on harvest levels. A different conclusion is drawn if the two timbersheds are examined separately. While our projections indicate that harvest levels in the Inland Empire timbershed can be sustained at or above historic levels, timber harvest levels in the Central Cascades timbershed fall below historical levels if the harvests in the first two decades are unconstrained and above the historical trend.

As a reminder, these projections reflect the maximum possible harvest potential under the initial condition assumptions; they are not predictions of future harvest. While such simulations provide insight on the potential impact of resource constraints and owner behavior, they may not be adequate predictors of behavior. The same set of initial conditions as inputs to simulations in 1980 would almost assuredly have projected harvest levels greater than have been observed over the last ten years. After analyzing simulations for each individual ownership, a more thorough comparison of the assumptions and possible explanations for differences with history and the future will be provided (Chapter VI).

Figure IV.2 shows the cumulative harvest volume over the 100-year projection period under the various harvest flow variants. The largest total harvest under initial conditions is associated with the unconstrained harvest flow constraint, followed by the harvest volumes associated with the ±25% and ±5% variations, respectively. Relative to the total harvest volume under the ±5% harvest flow constraints, the ±25% total harvest is 3.2% higher and the unconstrained total harvest volume is 5.8% higher over the total projection period. More flexible harvest constraints produce higher harvests in the early decades which result in higher growth and, eventually, a higher sustainable harvest. However, the higher harvest in early decades is more sensitive to the magnitude of the constraint than is the longer term sustainable trend over the remainder of the first ten decades.

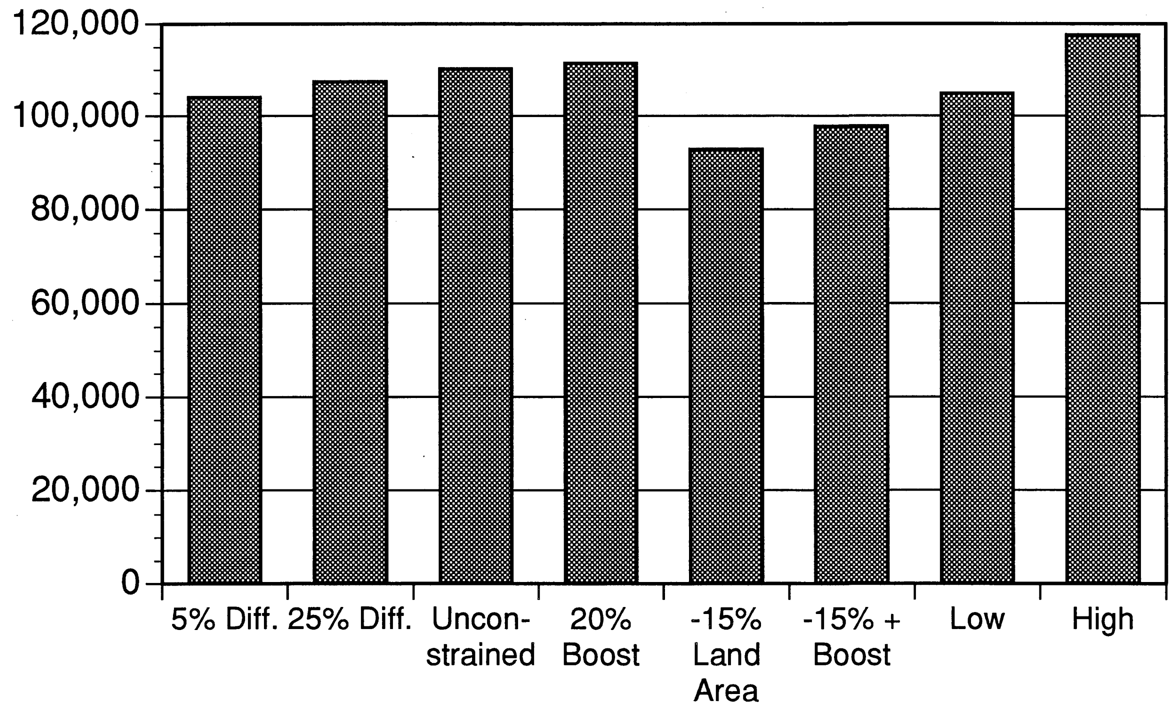


Figure IV.2 Projection of cumulative harvest (MMBF) over 100 years for all modeled owners under four harvest flow variants for initial conditions and for five sensitivity analysis scenarios.

Sensitivity Analysis. Table IV.1 and Figure IV.1 Panels B and C also summarize results for a set of alternatives differing from those assumed in the baseline runs with initial conditions. These additional analyses were conducted for all modeled owners (excludes the national forests) in a sequential manner. The major elements receiving attention were: (a) timberland base reduction and (b) changes in management intensity and their associated timber yields. In all, a total of five scenarios were defined to capture a range of possible acreage and management intensity combinations. In the tables and figures shown, these scenarios are labelled and defined as:

Panel B

1. 20% Boost: Twenty percent of the timberland acreage in a management unit is shifted to the management prescription representing the next higher level of management intensity. A ±5% harvest flow constraint was used except for industrial owners in the Central timbershed, where ±25% was used. There was no constraint between decade 1 and 2 in order to reduce the severity of the area constraints and allow a solution.

2. 15%: The FIA area estimates of timberland (assumed under initial conditions) are reduced by 15% in the first decade and held constant throughout the remaining decades. A ±5% harvest flow constraint was used except for nonindustrial owners in the Inland timbershed, where the ±25% variant was allowed.

3. 15% + Boost: The 15% reduction in timberland acreage (described in number two) is combined with the "boost" scenario (described in number one). A ±5% harvest flow constraint was used.

4. Initial conditions ±5%: These sensitivity alternatives are compared to the initial conditions case with a ±5% harvest flow constraint.

Panel C

5. Low: All timberland acreage in a management unit is assigned to the management prescription representing the lowest possible level of management intensity. In the LP model run for this analysis, the choice is between no management and low management. No harvest flow constraint was enforced.

6. High: All timberland acreage in a management unit is assigned to the management prescription representing the highest possible level of management intensity. In the LP model run for this analysis, the choice is between no management and high management. No harvest flow constraint was enforced.

7 & 8. Initial conditions ±5% and unconstrained: The more extreme sensitivity alternatives in Panel C are compared to initial conditions with a ±5% harvest unconstrained and also no constraint since no constraints were applied to low and high management alternatives.

Results are summarized for the five scenarios in two ways: (1) projected harvest volumes over the ten-decade projection period (Figure IV.2), and (2) projected harvests over the first two and the last two decades of the 100-year projection period compared to an appropriate baseline are summarized in Figure IV.3. The ±5% or unconstrained harvest flow constraints are used in all comparisons.

As the figure shows, there is no penalty by the end of the period for the accelerated harvests that occur in the first 20 years from reduced flow constraints. The 15% set-aside impact cannot be offset by moving only 20% of the acres up to the next higher level of management intensity. The lowest management level does not produce a substantially lower harvest level but the highest management level supports much higher removals in the early decades.

A summary section on sensitivity results compared across owners appears at the end of this chapter after a brief analysis of the projections for each ownership.

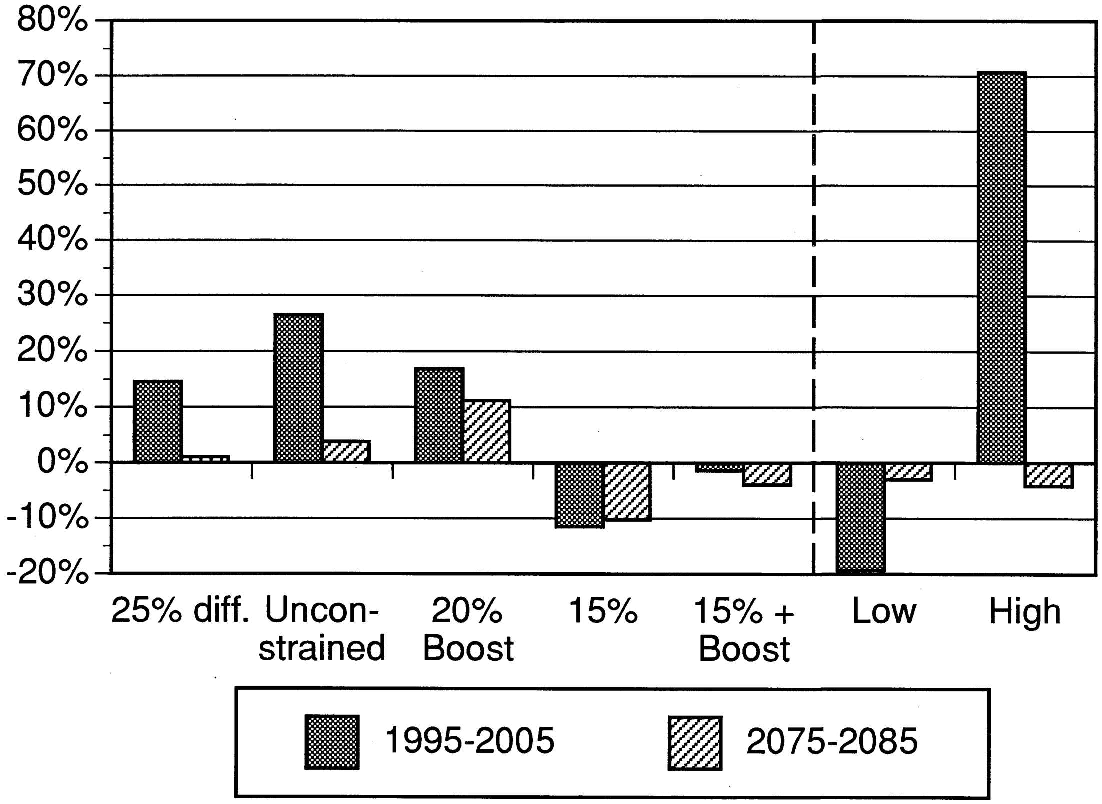


Figure IV.3 Sensitivity of harvest volume for all modeled owners in first two and last two decades to different management scenarios. (First five scenarios display percent difference in harvest volume from 5% harvest flow constraint. Low and High display percent difference from the unconstrained management scenario).

Mean Diameter. Table IV.2 and Figure IV.4 Panel A depict the time path of the quadratic mean diameter of harvested trees for all owners by timbershed and aggregated across the modeled portion of the Eastside. The trends are quite evident: the quadratic mean diameter of harvested trees is projected to decline from an average of around 21 inches during the first decade of the projection period to about 15 inches during the last decade. This trend holds for each timbershed when considered separately as well as for both considered together. The Central Cascades timbershed is projected to produce slightly larger trees than the Inland Empire timbershed for almost the entire projection period. In the Central Cascades area the average size of harvested trees is expected to decrease from around 23 inches in the first decade to around 15 inches in the last decade. In the Inland Empire timbershed, comparable averages are 19 inches to 15 inches, respectively.

Reduced average diameter at harvest does not necessarily mean reduced wood quality because the harvested tree may be more uniform in size. Presently, many stands contain a few large trees and many small trees as a result of past selective harvesting. Other even-aged stands (resulting largely from past stand-replacement fires) are over-crowded and contain many small stems. Future management which reduces the number of small stems in both even-aged and uneven-aged stands can increase the value of the wood even though the maximum size of the harvested trees is smaller. Such managed stands will also contain fewer rotten or otherwise defective trees than stands presently available for harvest.

Table IV.2 Projections of harvested quadratic mean diameter (inches) for all modeled owners

Inland	evenflow	5%	25%	unconst.	boost	-15%	-15%+boost	low	high
1995	.	17.80	17.70	19.90	16.80	17.10	17.90	23.10	13.50
2005	.	19.50	19.00	17.70	17.20	18.90	17.10	19.30	14.90
2015	.	17.10	16.70	16.20	15.60	17.80	16.50	18.50	13.80
2025	.	17.60	17.30	16.80	16.30	16.80	15.80	18.10	10.00
2035	.	15.30	16.00	15.70	14.90	17.10	14.90	17.30	12.80
2045	.	15.70	15.40	15.30	16.20	16.70	16.30	17.30	11.10
2055	.	15.10	14.80	16.20	14.00	15.10	13.60	16.10	12.50
2065	.	14.70	14.80	14.50	13.30	14.40	12.60	15.70	11.90
2075	.	13.50	13.80	13.60	13.90	13.80	13.80	16.80	12.60
2085	.	15.00	14.80	15.20	14.90	14.50	14.80	15.70	12.00
Central									
1995	22.90	23.30	22.70	22.90	17.70	22.10	17.20	24.90	13.00
2005	20.50	20.40	21.20	20.10	17.60	22.60	17.60	23.30	12.20
2015	19.10	19.00	18.20	18.40	17.30	18.90	17.70	21.30	13.90
2025	18.00	18.00	18.30	18.10	17.20	18.20	18.60	18.90	15.30
2035	17.40	17.50	17.90	18.10	16.20	17.80	16.20	18.80	12.20
2045	16.60	16.60	18.00	16.80	16.10	16.90	17.00	18.20	11.90
2055	15.40	16.20	16.00	15.80	14.70	15.20	14.40	16.60	13.90
2065	16.10	16.40	17.20	17.00	14.90	16.30	15.30	18.40	11.80
2075	16.60	15.80	15.80	14.60	13.60	15.20	14.20	17.00	12.20
2085	13.30	13.80	14.50	14.70	12.70	14.50	13.40	14.90	10.80
Both									
1995	.	20.60	20.50	21.50	17.30	19.70	17.50	23.90	13.40
2005	.	20.00	19.80	18.70	17.40	20.90	17.30	21.50	13.00
2015	.	18.00	17.40	17.10	16.10	18.20	16.90	19.90	13.50
2025	.	17.80	17.80	17.50	16.70	17.60	17.10	18.50	13.00
2035	.	16.50	17.00	17.00	15.70	17.50	15.80	18.00	12.60
2045	.	15.90	16.60	15.90	16.10	16.80	16.70	17.80	11.80
2055	.	15.70	15.40	15.80	14.30	15.40	14.10	16.20	13.20
2065	.	15.40	15.90	15.50	14.00	15.20	13.80	16.90	11.90
2075	.	14.60	14.70	14.10	13.80	14.70	14.10	17.10	12.00
2085	.	14.50	14.70	15.00	13.70	14.50	14.00	15.20	10.90

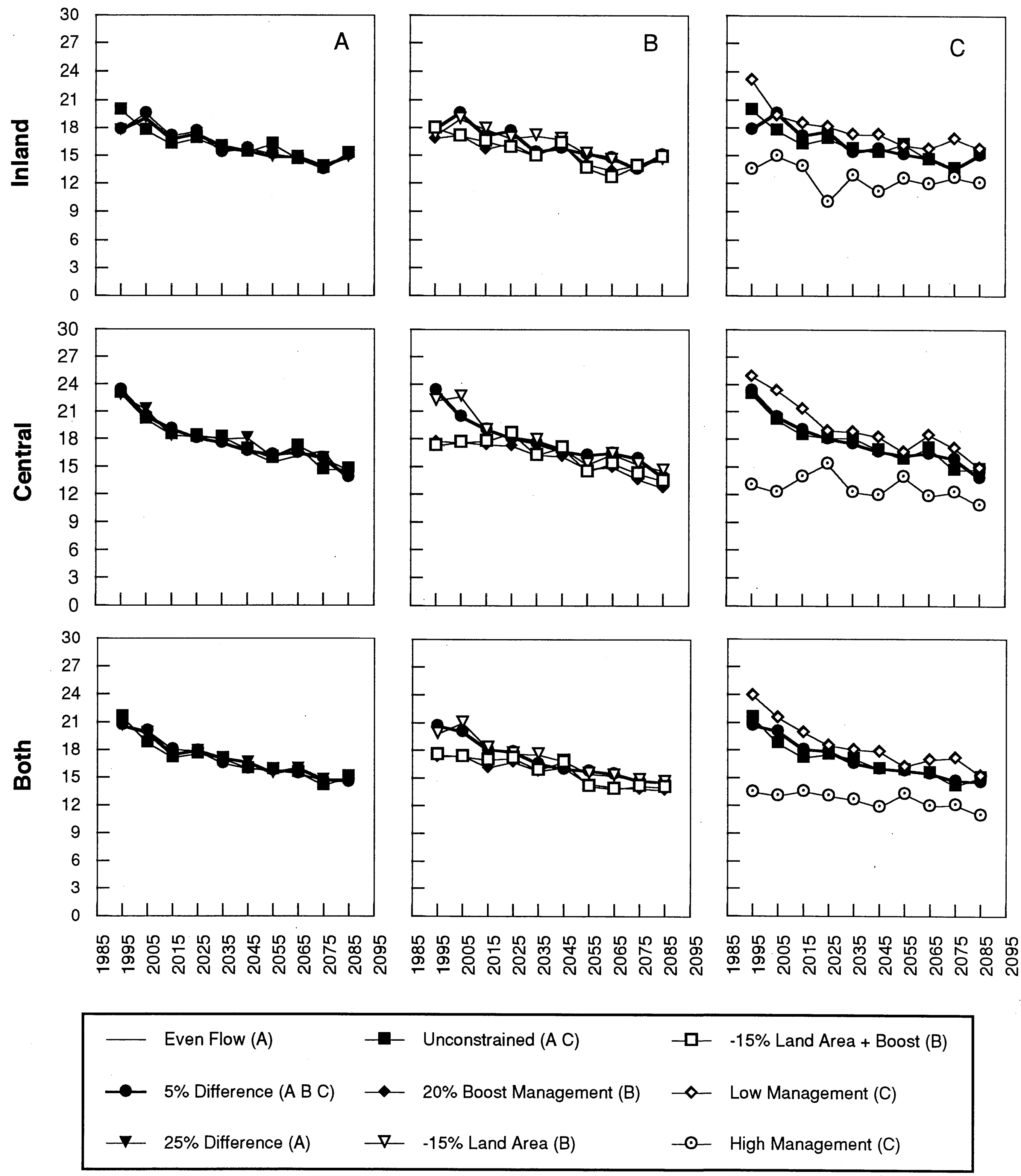


Figure IV.4 Projections of harvested quadratic mean diameter (inches) by timbershed for all modeled owners aggregated under four harvest flow variants for initial conditions and for five sensitivity analysis scenarios.

Inventory. At the start of the first decade of the 100-year projection period, the total modeled Eastside standing inventory was estimated at about 51 billion bd. ft. with 47.3 billion occurring on acres being managed: enough lumber to build over 5 million new houses. At the end of the projection period the standing inventory is expected to increase by 6% to around 50.2 billion bd. ft. for the managed acres (under the ±5% harvest flow variant). The exact percentage change varies with the timber harvest flow variant assumed. These results are depicted in Figure IV.5.

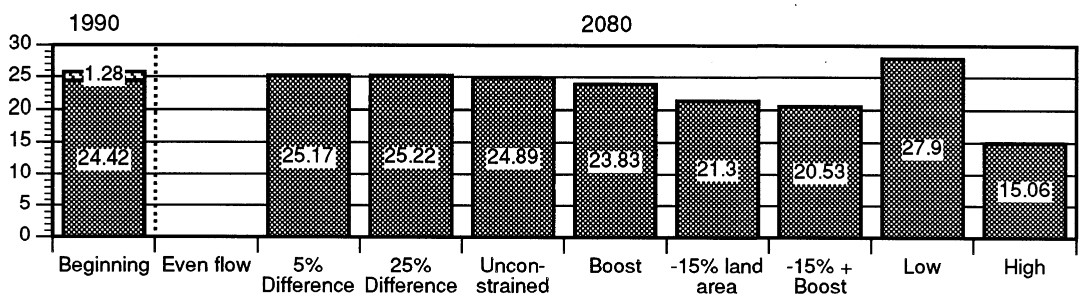
These inventory measures are not directly comparable to FIA measures of inventory because they reflect the merchantability standards adopted for the Prognosis simulations. As noted in Chapter II, they are higher than volumes reflected in Forest Service report PNW RB-201, which shows FIA survey results for Eastern Washington. Possible implications from these differences will be raised at the end of this chapter.

The initial and projected tenth-decade inventory volumes stratified by timbershed show that the ending inventory volumes are about evenly split between the two timbersheds, although the Inland Empire supports the higher inventory level under most alternatives. There is no draw-down in standing inventory while producing a sustainable timber harvest over the projection period (even for the unconstrained case), illustrating that there is excess standing inventory as of 1990 relative to the assumed management prescriptions. Removing that excess inventory does not reduce the sustainable harvest. However, under the high management alternative, the greater removal of inventory in the early decades is not restored after 100 years even though it did not reduce the long-term sustainable harvest. Under high management the inventory is reduced over 40% compared to a 15% increase under the lowest management level.

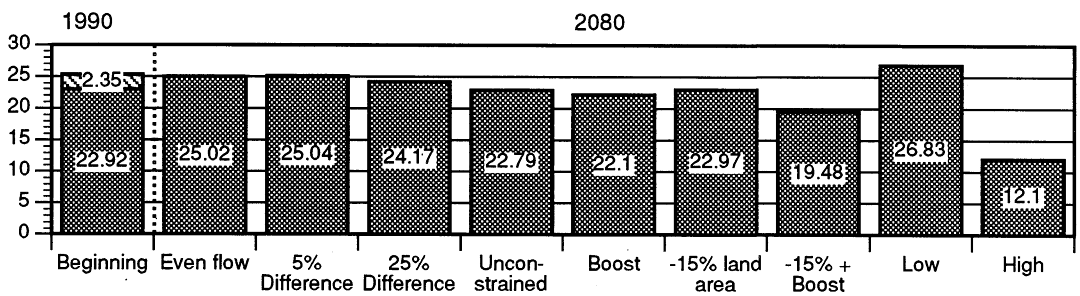
One caveat relative to the timber inventory statistics presented here must be pointed out. In the timber inventory graph (Figure IV.5) for all modeled owners, the bar labelled "Beginning" reflects an estimate of the starting timber inventory as of 1990. The bar is split into two parts. The smaller figure at the top reflects that portion of the initial inventory which resides on those acres assigned to the "no management" prescription as reported in Chapter III. The nine bars to the right of this bar reflect timber inventories at the end of the projection period for the four initial condition variants of harvest flow and the five sensitivity analysis runs. These nine bars only reflect the ending inventory on the managed acres. The ending timber inventory on unmanaged acres is not reflected on these graphs but may be increasing as they were not scheduled for harvest.

Another caveat is that no catastrophic fires are assumed to occur and no volume loss is assumed from insects or diseases other than normal mortality. An alternative assumption is that all losses from fires are successfully salvaged and a part of the projected volumes.

Inland Empire



Central



Both

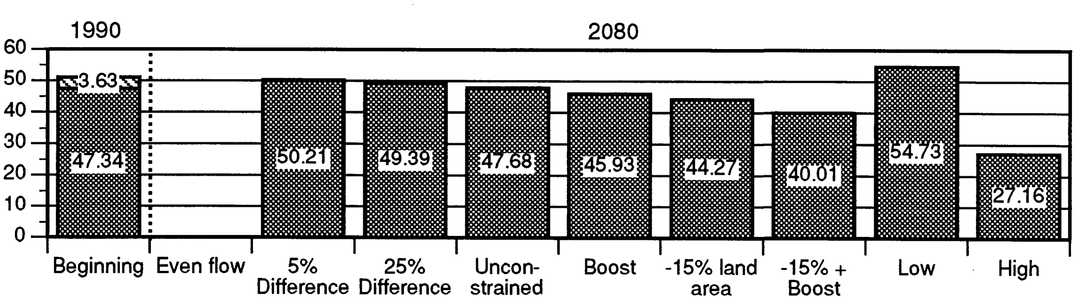


Figure IV.5 Forest inventory (billion bd.ft.) by timbershed in 1990 and 2080 for all modeled owners under four harvest flow variants for initial conditions and for five sensitivity analysis scenarios. Crosshatched area in beginning period indicates inventory on unmanaged acres. Ending period inventories are on managed acres only.

Species Composition of Harvest. The LP timber harvest scheduling model used in this study only controls total harvest volume aggregated over all species. However, by "playing" the LP solution back into the yield tables produced by the PROGNOSIS model, we are able to report the species composition of the projected timber harvest over the 100-year projection period. Tables IV.3-IV.5 and Figure IV.6 depict this information by timbershed and for the modeled portion of the Eastside. Only the most prevalent timber species are summarized individually in these tables. Douglas-fir, ponderosa pine, and grand fir (generally in that order) constitute the largest proportion of the projected harvest over all decades. There is a slight shift towards grand fir in the latter two decades in the Central Cascades timbershed. In general, however, the species mix appears to remain relatively constant when viewed in the aggregate. Tables for projected species under the five sensitivity analysis alternatives are provided in Appendix 6.

Health Implications. Prior to 1990 there was an increase in grand fir above its historical norm because of fire prevention and uneven-aged management. This increase in grand fir can lead to increases in western spruce budworm and *Armelaria* root rot presence and damage. Grand fir is also easily susceptible to stem rot.

Increases in grand fir therefore indicate a greater problem with epidemic levels of insects and diseases and subsequent catastrophic fires from the resulting high fuel loads under all management regimes shown here. The presence of Douglas-fir in uneven-aged management regimes leads to the strong possibility of increased mistletoe disease, which also can lead to increased catastrophic fires. To avoid such unfavorable effects of management, a combination of active management favoring ponderosa pine and western larch on appropriate sites as well as more even-aged management and controlled fires may be appropriate (Everett, 1993; Sampson, *et al.*, 1994). .

The decline in average tree size combined with continued high volumes per acre implies increasing levels of stand density in the future. This crowding also means the stands will be more susceptible to bark beetles (pine stands) and western spruce budworm (Douglas-fir and grand fir stands) in the future.

As a consequence of these increased susceptibilities, more of the timber harvest may be in the form of salvage from wildfires, to the extent that these trees can be harvested. It is very likely that wildfires will aggregate in time during years of supportive weather. These fires may well cover several hundreds of thousands of acres in a single year. A fire of 200,000 acres could burn 2.6 billion board feet if it covered stands of average volume, more than twice the estimated annual harvest. Fires like those of 1994 could be repeated periodically.

Following such fires, an intensive effort would be needed to prevent reburns, do other habitat mitigation, restock some areas, and reduce excessive regeneration in others. The effect of such fires would be reflected in continuing cycles of "boom/bust" as these stands regrow in future years.

Table IV.3 Projections of average annual harvest by species (MMBF) for all modeled owners in both timbersheds under different harvest flow constraints.

SPECIES	Year 1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	±5%									
White Pine	7.52	4.48	2.45	3.05	2.12	4.48	1.26	31.66	34.17	51.32
Western Larch	61.97	55.58	51.24	31.46	46.20	27.41	25.08	25.20	24.15	14.95
Douglas-fir	346.53	356.95	354.33	367.78	393.41	409.13	416.14	413.63	403.25	381.64
Grand fir	137.58	123.62	138.19	156.86	159.35	158.44	170.39	142.45	167.62	187.28
Western Helmock	1.73	0.00	0.85	4.61	4.49	3.86	4.75	3.14	3.41	6.53
Western Redcedar	21.25	13.32	18.51	23.77	39.17	21.87	27.01	22.71	25.46	27.08
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.72	7.31	9.80
Engelman Spruce	21.12	19.43	3.73	3.39	6.75	15.92	9.87	21.87	6.15	11.82
Subapine fir	2.52	3.48	11.08	5.09	4.44	8.85	9.09	22.81	10.80	6.55
Ponderosa Pine	362.01	336.00	330.69	335.64	289.89	273.80	279.87	226.49	253.43	277.16
Other	53.41	74.11	67.84	58.30	53.42	67.78	60.40	76.83	77.83	61.75
	±25%									
White Pine	7.52	4.48	2.45	3.94	3.36	4.32	11.92	18.32	33.29	21.09
Western Larch	108.56	54.31	56.89	45.44	47.25	34.57	28.09	25.60	22.59	12.70
Douglas-fir	430.32	382.42	309.70	375.11	373.07	421.79	422.21	407.47	444.18	406.99
Grand fir	191.92	115.85	128.80	170.32	151.06	166.60	156.79	157.01	202.84	188.83
Western Helmock	1.73	0.00	0.85	4.75	4.49	3.86	4.90	3.16	3.38	6.85
Western Redcedar	27.07	13.95	18.14	24.57	56.42	22.21	29.09	21.96	24.06	27.72
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.33	7.60	6.78
Engelman Spruce	21.11	22.90	3.73	3.39	6.75	9.21	10.15	21.53	6.15	11.81
Subapine fir	2.52	4.01	10.18	5.98	4.44	7.22	9.09	22.81	10.97	6.40
Ponderosa Pine	369.96	342.04	332.49	320.63	265.60	318.63	235.27	265.27	226.55	266.99
Other	61.59	70.58	74.07	55.23	58.82	73.36	54.69	72.88	68.93	62.60
	Unconstrained									
White Pine	8.01	4.48	3.80	2.70	2.80	2.39	10.66	25.21	19.81	60.85
Western Larch	119.72	49.24	57.84	47.86	43.80	32.28	26.49	27.12	20.10	15.71
Douglas-fir	511.22	307.00	351.91	361.44	373.21	403.15	418.31	431.49	416.97	458.64
Grand fir	265.68	104.24	134.43	166.30	152.60	156.21	175.09	171.50	188.26	195.81
Western Helmock	8.35	0.00	0.85	4.47	6.39	2.15	1.72	2.81	4.80	2.96
Western Redcedar	50.29	7.76	21.01	19.41	63.57	20.45	25.74	24.03	22.61	27.85
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.61	2.17	13.08
Engelman Spruce	27.21	18.15	2.88	4.10	5.96	9.20	10.15	21.54	6.15	10.58
Subapine fir	11.08	3.24	10.98	5.05	4.07	5.20	8.99	20.38	9.85	19.88
Ponderosa Pine	414.02	284.71	335.73	290.18	258.59	281.98	232.80	241.90	234.27	282.87
Other	70.08	58.62	85.36	59.46	67.40	75.17	58.54	76.54	76.50	66.07

Table IV.4 Projections of average annual harvest by species (MMBF) for all modeled owners in the Inland Empire Timbershed under different harvest flow constraints.

SPECIES	YEAR 1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	±5%									
White Pine	4.11	4.48	0.18	1.81	0.64	1.64	0.00	18.27	7.59	34.10
Western Larch	44.29	33.73	36.65	25.40	39.28	21.73	23.44	23.29	23.53	13.07
Douglas-fir	160.23	220.37	209.10	221.01	256.48	253.74	249.37	243.70	264.01	246.74
Grand fir	90.10	50.95	38.22	55.27	42.83	44.53	70.54	50.18	56.54	54.63
Western Helmock	1.73	0.00	0.85	4.61	4.49	3.86	4.75	3.14	3.41	6.53
Western Redcedar	21.25	13.32	18.51	23.78	39.18	21.31	25.70	22.71	25.45	27.08
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	6.67	6.21
Engelman Spruce	7.30	4.77	3.73	2.64	6.75	8.38	7.88	12.30	6.14	11.81
Subapine fir	0.91	0.54	6.37	1.51	2.04	3.61	3.21	14.15	4.13	0.92
Ponderosa Pine	178.31	161.29	183.71	179.14	141.87	175.20	171.55	140.10	151.59	173.42
Other	37.59	33.08	34.21	26.57	24.26	34.25	20.61	35.55	29.86	17.81
	±25%									
White Pine	4.11	4.48	0.18	1.81	0.64	3.60	7.90	7.76	7.59	9.37
Western Larch	71.39	40.42	40.72	27.18	31.21	21.20	22.09	23.69	21.96	10.81
Douglas-fir	225.34	226.09	197.35	229.78	252.23	269.58	226.73	255.85	278.19	259.99
Grand fir	127.88	53.49	38.11	59.06	41.69	50.07	55.98	61.00	56.40	71.89
Western Helmock	1.73	0.00	0.85	4.75	4.49	3.86	4.90	3.16	3.38	6.85
Western Redcedar	27.06	13.96	18.14	24.58	56.42	21.64	27.76	21.96	24.06	27.72
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.17	6.76	2.15
Engelman Spruce	7.30	4.77	3.73	2.64	6.75	8.38	7.88	12.30	6.14	11.81
Subapine fir	0.91	0.54	5.47	2.40	2.04	3.61	3.21	14.15	4.13	0.95
Ponderosa Pine	179.17	167.42	189.63	168.91	164.89	210.29	135.59	165.12	149.08	159.85
Other	45.04	28.72	40.39	26.09	26.30	37.65	17.41	32.08	20.81	16.46
	Unconstrained									
White Pine	4.11	4.48	0.18	1.81	0.50	2.39	7.90	7.76	7.44	43.00
Western Larch	78.96	38.32	41.68	28.35	27.77	18.92	20.50	26.17	18.51	14.35
Douglas-fir	278.92	191.05	243.05	223.85	244.87	246.72	230.88	267.40	248.67	288.08
Grand fir	183.51	50.29	41.06	59.94	43.10	49.29	80.45	68.68	51.34	82.48
Western Helmock	8.35	0.00	0.85	4.47	6.39	2.15	1.72	2.81	4.80	2.96
Western Redcedar	50.30	7.76	21.01	19.41	63.57	20.45	25.74	24.03	22.61	27.85
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.22	1.56	7.13
Engelman Spruce	9.91	3.48	2.88	3.35	5.95	8.38	7.88	12.30	6.14	10.58
Subapine fir	0.91	0.54	5.47	2.40	2.04	3.61	3.21	14.15	4.13	0.92
Ponderosa Pine	205.03	132.67	204.79	135.67	152.83	176.59	144.22	151.90	131.32	170.30
Other	50.65	20.95	47.47	30.31	32.79	39.47	21.25	35.74	28.39	19.89

Table IV.5 Projections of average annual harvest by species (MMBF) for all modeled owners in the Central Timbershed under different harvest flow constraints.

SPECIES	YEAR									
	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	Even-Flow									
White Pine	3.42	0.00	2.16	1.35	1.48	2.84	2.61	14.78	19.20	14.93
Western Larch	14.43	19.83	14.27	7.43	10.29	10.43	3.07	7.77	8.59	5.84
Douglas-fir	208.85	156.05	173.30	162.65	166.22	192.35	197.79	192.98	165.52	166.11
Grand fir	42.61	64.58	70.12	89.94	94.93	101.11	92.62	85.40	94.76	130.95
Western Helmock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.47	0.00	0.00	4.38	1.77	2.65	3.24	0.66	1.61	1.38
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.54	0.24	2.70
Engelman Spruce	22.88	20.66	14.42	22.53	10.84	14.67	15.13	14.80	5.12	7.84
Subapine fir	0.77	2.73	5.14	11.04	5.06	8.17	6.68	10.68	13.24	8.00
Ponderosa Pine	157.19	171.79	142.17	130.22	144.84	106.36	120.02	106.95	120.81	87.31
Other	14.98	29.35	43.73	34.64	29.83	26.87	23.76	28.93	35.45	35.41
	±5%									
White Pine	3.42	0.00	2.27	1.24	1.48	2.84	1.26	20.96	26.30	16.29
Western Larch	14.88	22.37	15.43	7.63	8.89	8.98	1.76	6.49	4.28	4.97
Douglas-fir	228.71	176.34	194.05	158.67	154.62	173.12	177.11	187.37	154.92	146.68
Grand fir	47.78	66.90	82.51	91.43	99.44	104.64	93.89	92.21	105.79	137.30
Western Helmock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.93	0.15	0.00	4.79	1.36	2.57	3.18	0.64	1.56	1.33
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.54	0.60	3.74
Engelman Spruce	27.58	25.47	13.23	19.23	10.89	14.67	15.20	15.73	5.18	7.53
Subapine fir	1.61	2.94	4.71	9.92	5.15	8.62	6.38	10.66	13.08	8.10
Ponderosa Pine	179.50	177.21	141.72	150.80	158.15	99.44	123.26	92.97	115.73	108.19
Other	19.20	39.38	35.98	38.00	30.23	35.72	37.86	36.47	44.36	40.95
	±25%									
White Pine	3.42	0.00	2.27	2.12	2.72	0.72	4.02	18.15	25.70	11.72
Western Larch	31.89	14.19	16.59	16.75	15.24	13.61	5.20	6.51	4.48	4.97
Douglas-fir	305.72	204.59	156.48	158.59	139.75	160.52	203.65	169.02	183.21	155.19
Grand fir	67.76	61.05	74.54	102.60	91.87	105.61	93.82	95.90	140.31	117.75
Western Helmock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	9.62	4.39	0.00	7.46	0.00	0.57	1.32	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.18	0.80	4.87
Engelman Spruce	27.40	28.12	12.84	23.84	9.85	7.74	15.00	14.24	4.87	7.88
Subapine fir	1.61	3.47	4.71	11.81	5.15	6.99	6.39	10.25	13.49	7.48
Ponderosa Pine	178.99	183.02	139.49	146.13	122.26	110.78	113.90	111.35	95.87	114.95
Other	17.75	40.27	35.79	36.81	34.22	36.30	34.78	36.79	44.30	41.26
	Unconstrained									
White Pine	3.90	0.00	3.62	0.89	2.30	0.00	2.76	25.03	14.49	18.89
Western Larch	37.78	8.75	16.37	17.30	15.80	12.88	5.04	3.96	5.92	3.96
Douglas-fir	388.89	167.98	136.83	164.37	141.23	156.62	204.31	172.33	182.46	179.52
Grand fir	89.36	53.67	82.97	95.71	95.85	91.88	91.64	93.69	129.52	114.29
Western Helmock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	9.62	4.39	0.00	7.46	0.00	0.00	0.00	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.41	0.61	6.06
Engelman Spruce	47.45	26.98	16.07	19.14	5.60	3.09	20.11	14.11	3.09	3.29
Subapine fir	10.16	2.69	5.50	10.88	4.77	4.98	7.00	7.87	12.37	20.79
Ponderosa Pine	235.38	142.64	129.47	147.51	120.93	107.11	109.91	95.36	126.79	114.53
Other	29.48	37.84	44.00	37.10	32.49	37.52	38.68	36.49	45.25	45.77

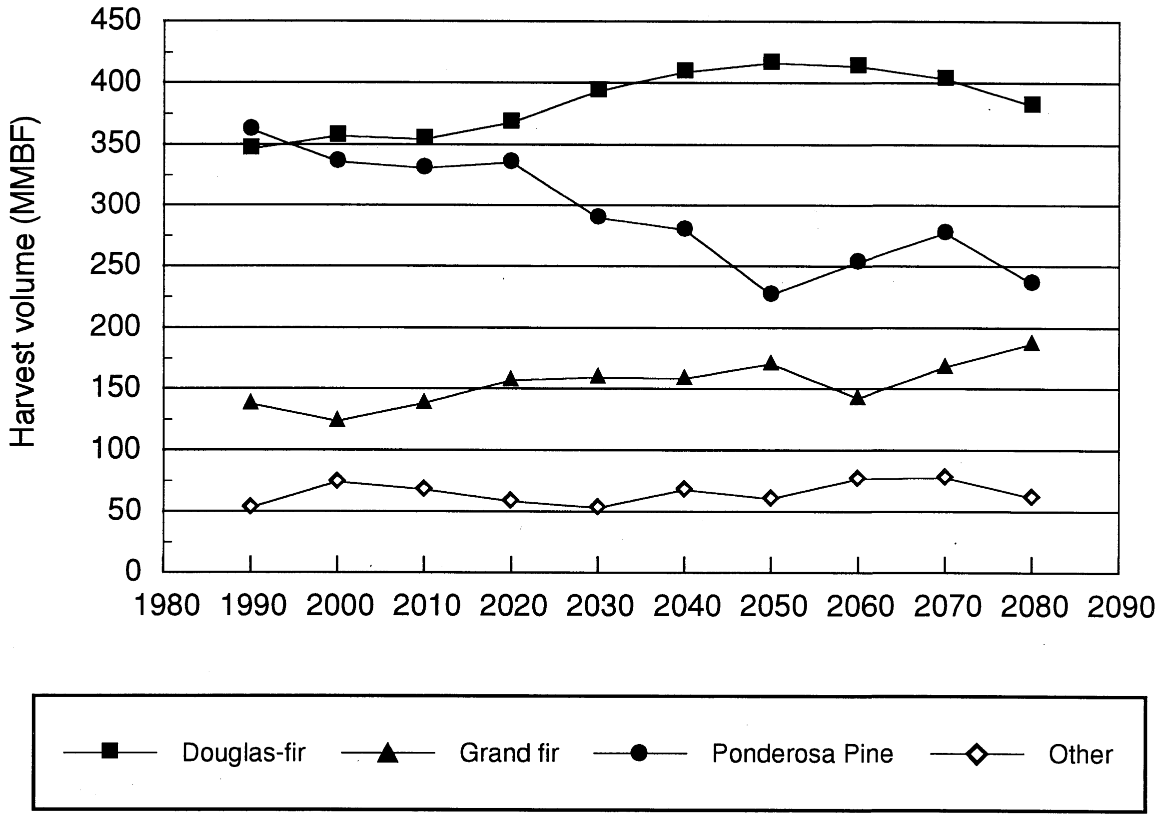


Figure IV.6 Species composition for all ownerships under initial conditions with ± 5% harvest flow constraint

Washington State Department of Natural Resources (DNR)

Under Initial Conditions. The estimated timber harvest volume over the 100-year projection period for the DNR is summarized in Table IV.6 and Figure IV.7. Shown are the average annual timber harvest volumes in Scribner board feet by decade for each timbershed and for the DNR's entire Eastside ownership. Results are presented for each of the four timber harvest flow variants examined in this study. Also shown in Figure IV.7 Panel A is the historical timber harvest volume for the period 1965-92. These should be used solely to provide perspective *vis a vis* the projected harvest volumes.

One striking feature shown in Figure IV.7 is that regardless of timber harvest flow constraint variant, there is little variation in projected harvest beyond the second decade, whether the timbersheds are considered individually or together. However, there is considerable variation during the first decade of the analysis. As expected, there is more variation in estimated harvest levels in individual timbersheds than when both timbersheds are considered. The second striking feature shown in Figure IV.7 is that projected timber harvests in the first two decades increase as the degree of harvest flow control decreases. This occurs because excess timber inventory is scheduled for harvest in the early decades of the 100-year projection period if the harvest in a future decade is allowed to decline. The projected annual harvest volume for both timbersheds under the even-flow harvest flow variant stabilizes at about 146 MMBF. Under ±5% flow constraints, 171 MMBF can be harvested per year in the first decade. These projected harvest volumes are higher than the reported average harvest level during the period 1965-1992 and indicate that some excess capacity exists to support levels of harvest greater than historic levels. The projections also indicate that these increased harvest levels can be sustained at or above historic levels in each of the timbersheds when considered separately. The actual timber harvest on DNR lands will ultimately be dictated by policy, additional measures of inventory, and forest productivity assessments. In the Westside study, significant differences were noted between the FIA survey results and those provided by the DNR. No similar comparison was possible in this study. The above harvest projections based upon the stated assumptions should not be confused with predictions of DNR decisions.

Figure IV.8 shows the cumulative harvest volume over the 100-year projection period under the various harvest flow variants. The largest total harvest is associated with the unconstrained harvest flow constraint, followed by the harvest volumes associated with the ±25%, ±5%, and even-flow variations, respectively. Relative to the total harvest volume under the ±5% harvest flow constraints, the ±25% total harvest is 8.1% higher; the unconstrained total harvest volume is 16.4% higher; and the even-flow harvest is 2.9% lower over the total projection period.

Table IV.6 Annual harvest volumes for DNR (MMBF)

Inland	evenflow	5%	25%	unconst.	boost	-15%	-15%+boost	low	high
1995	52.62	58.33	102.08	157.74	60.24	53.08	53.98	42.51	190.65
2005	52.62	55.41	76.56	53.99	57.22	50.42	51.29	54.99	55.21
2015	52.62	52.64	57.42	64.96	54.36	47.90	48.72	48.48	43.84
2025	52.62	50.01	43.39	48.20	51.64	45.51	46.28	54.18	33.52
2035	52.62	52.12	51.39	48.39	52.46	45.05	46.18	46.18	32.58
2045	52.62	54.73	56.75	56.68	55.08	47.31	48.49	65.44	51.34
2055	52.62	51.99	42.56	39.21	52.33	44.94	46.06	46.59	44.55
2065	52.62	54.59	52.69	58.93	54.94	47.19	48.37	49.81	51.47
2075	52.62	57.03	53.16	42.94	54.58	49.34	49.66	50.92	36.16
2085	52.62	54.93	51.59	54.19	57.31	51.81	52.14	48.50	70.81
Central									
1995	93.85	112.83	171.74	297.18	117.44	101.65	104.47	108.73	354.62
2005	93.85	107.19	128.81	117.42	111.56	96.57	99.24	84.36	112.69
2015	93.85	101.83	96.60	95.12	105.99	91.74	94.28	106.42	82.86
2025	93.85	96.73	113.30	118.35	100.69	87.15	89.57	89.31	64.32
2035	93.85	91.90	93.17	77.14	95.65	82.79	85.09	96.70	58.83
2045	93.85	87.30	71.38	54.30	90.87	78.66	80.84	72.78	68.60
2055	93.85	91.67	89.22	119.50	95.41	82.59	84.88	104.92	54.67
2065	93.85	96.25	98.18	72.10	98.47	86.52	88.89	81.96	134.92
2075	93.85	92.94	97.23	100.36	98.06	82.15	85.15	75.76	69.61
2085	93.85	88.30	83.88	79.16	93.16	78.08	80.90	118.33	83.67
Both									
1995	146.47	171.16	273.82	454.92	177.68	154.73	158.45	151.24	545.27
2005	146.47	162.60	205.36	171.41	168.78	146.99	150.53	139.35	167.90
2015	146.47	154.47	154.02	160.08	160.35	139.64	143.00	154.90	126.70
2025	146.47	146.74	156.69	166.55	152.33	132.66	135.85	143.49	97.84
2035	146.47	144.02	144.56	125.53	148.11	127.84	131.27	142.88	91.41
2045	146.47	142.03	128.12	110.99	145.95	125.97	129.33	138.22	119.94
2055	146.47	143.66	131.78	158.70	147.74	127.53	130.94	151.51	99.22
2065	146.47	150.84	150.87	131.03	153.41	133.71	137.26	131.77	186.39
2075	146.47	149.97	150.39	143.30	152.64	131.49	134.81	126.68	105.77
2085	146.47	143.22	135.47	133.34	150.47	129.89	133.04	166.83	154.48

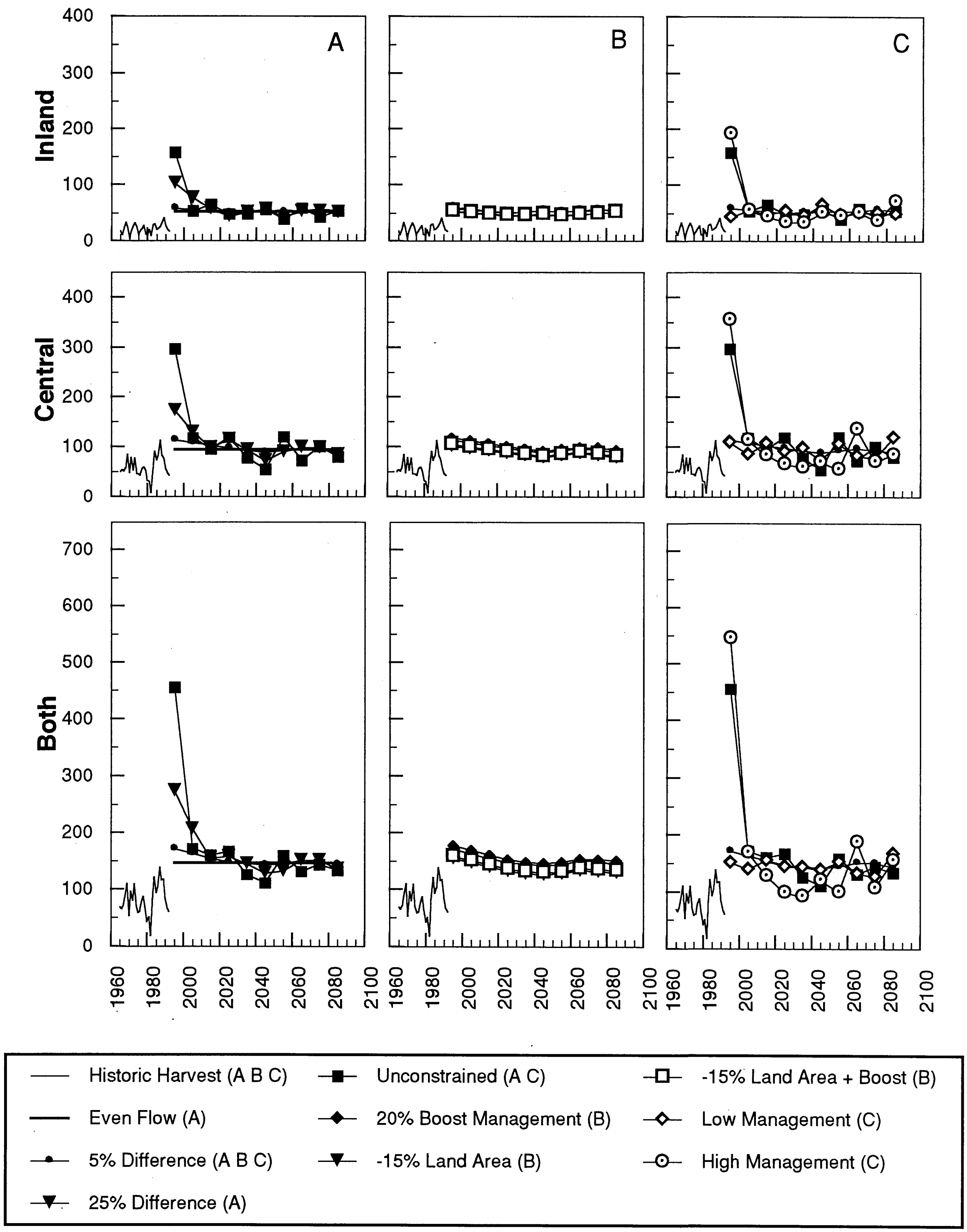


Figure IV.7 Projections of average annual harvest (MMBF) by timbershed for DNR under four harvest flow variants for initial conditions and for five sensitivity analysis scenarios.

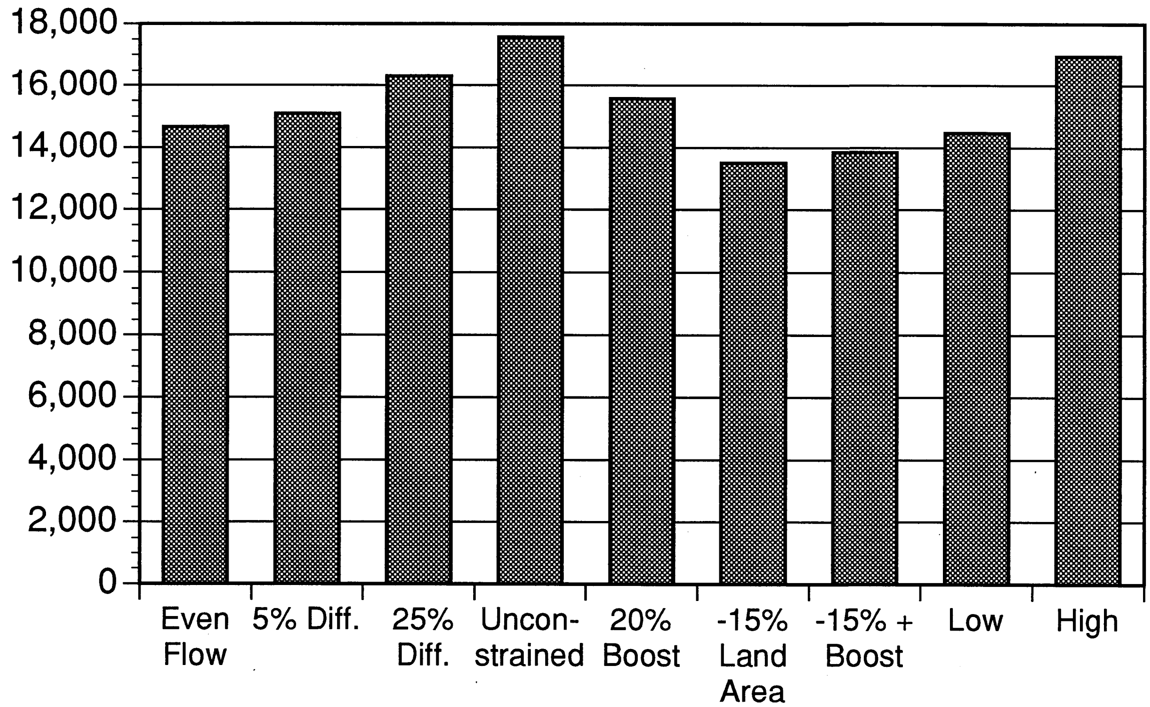


Figure IV. 8 Projection of cumulative harvest (MMBF) over 100 years for DNR under four harvest flow variants for initial conditions and for five sensitivity analysis scenarios.

Average Size of Harvested Timber. Table IV.7 and Figure IV.9 Panel A depict the time path of the quadratic mean diameter of harvested trees for the DNR. The trends show that the quadratic mean diameter of harvested trees is projected to decline from an average of 21-22 inches during the first decade of the projection period to 15-16 inches during the last decade. This trend of decreasing size holds for each timbershed when considered separately as well as in the aggregate. The Inland Empire timbershed is projected to produce smaller trees than the Central Cascades timbershed for almost the entire projection period. In the Inland Empire, the mean size of harvested trees in the first decade of the projection period is between 18-19 inches, while in the last decade the average size is 16-17 inches. Comparable figures for the Central Cascades area are 23-24 and 15-16 inches, respectively.

Table IV.7 Projections of harvested quadratic mean diameter (inches) for DNR

Inland	evenflow	5%	25%	unconst.	boost	-15%	-15%+boost	low	high
1995	18.50	18.70	17.80	17.50	17.10	19.30	17.80	24.70	10.80
2005	17.30	18.30	23.70	18.50	18.70	17.10	18.20	21.20	23.00
2015	17.30	17.60	17.30	17.20	17.50	17.60	17.50	20.00	12.90
2025	18.70	15.30	15.10	15.50	15.80	16.40	13.90	18.60	9.80
2035	15.00	14.60	14.90	14.00	14.90	14.60	14.70	19.20	12.20
2045	17.30	16.70	14.90	15.00	14.50	16.90	15.40	18.10	10.90
2055	13.70	13.80	14.90	17.70	17.10	13.10	13.30	18.20	10.50
2065	17.30	17.00	16.30	15.40	14.20	16.30	14.00	18.60	11.60
2075	15.00	14.50	14.40	13.90	13.70	14.10	14.00	16.70	14.40
2085	16.50	17.10	16.30	17.10	18.00	16.80	18.00	17.20	15.30
Central									
1995	22.80	23.10	23.70	24.00	18.10	23.00	18.30	26.60	16.80
2005	20.60	21.90	21.20	18.80	18.30	20.00	16.50	26.30	14.00
2015	17.80	18.30	17.40	19.50	16.60	17.70	16.70	25.20	15.60
2025	18.10	18.40	18.40	18.40	19.30	19.60	19.10	21.20	26.40
2035	17.10	17.10	17.50	18.10	18.00	17.20	18.30	18.00	16.60
2045	16.20	15.60	17.00	16.40	15.60	15.30	16.10	18.40	13.40
2055	17.70	16.80	16.40	15.40	17.10	16.70	16.70	16.20	15.00
2065	16.80	17.30	17.20	15.90	14.30	17.10	14.40	17.70	13.50
2075	15.40	15.30	15.60	14.50	15.30	15.30	15.30	20.30	10.70
2085	13.50	16.20	15.80	16.90	11.90	14.90	12.00	15.80	10.60
Both									
1995	21.20	21.40	21.50	21.60	17.70	21.60	18.10	25.90	14.60
2005	19.40	20.60	22.10	18.70	18.40	18.90	17.20	24.50	17.30
2015	17.60	18.00	17.40	18.70	16.90	17.70	17.00	23.30	14.60
2025	18.30	17.30	17.20	17.30	18.00	18.40	17.20	20.20	20.30
2035	16.30	16.20	16.50	16.60	16.80	16.20	17.00	18.50	15.00
2045	16.60	16.00	16.20	15.90	15.20	15.90	15.80	18.30	12.50
2055	16.20	15.70	15.90	16.20	17.10	15.40	15.40	17.00	13.30
2065	17.00	17.20	16.90	15.70	14.30	16.80	14.00	18.00	12.80
2075	15.30	15.00	15.20	14.30	14.70	14.90	14.80	19.00	12.00
2085	14.60	16.60	16.00	17.00	14.20	15.60	14.20	16.30	12.30

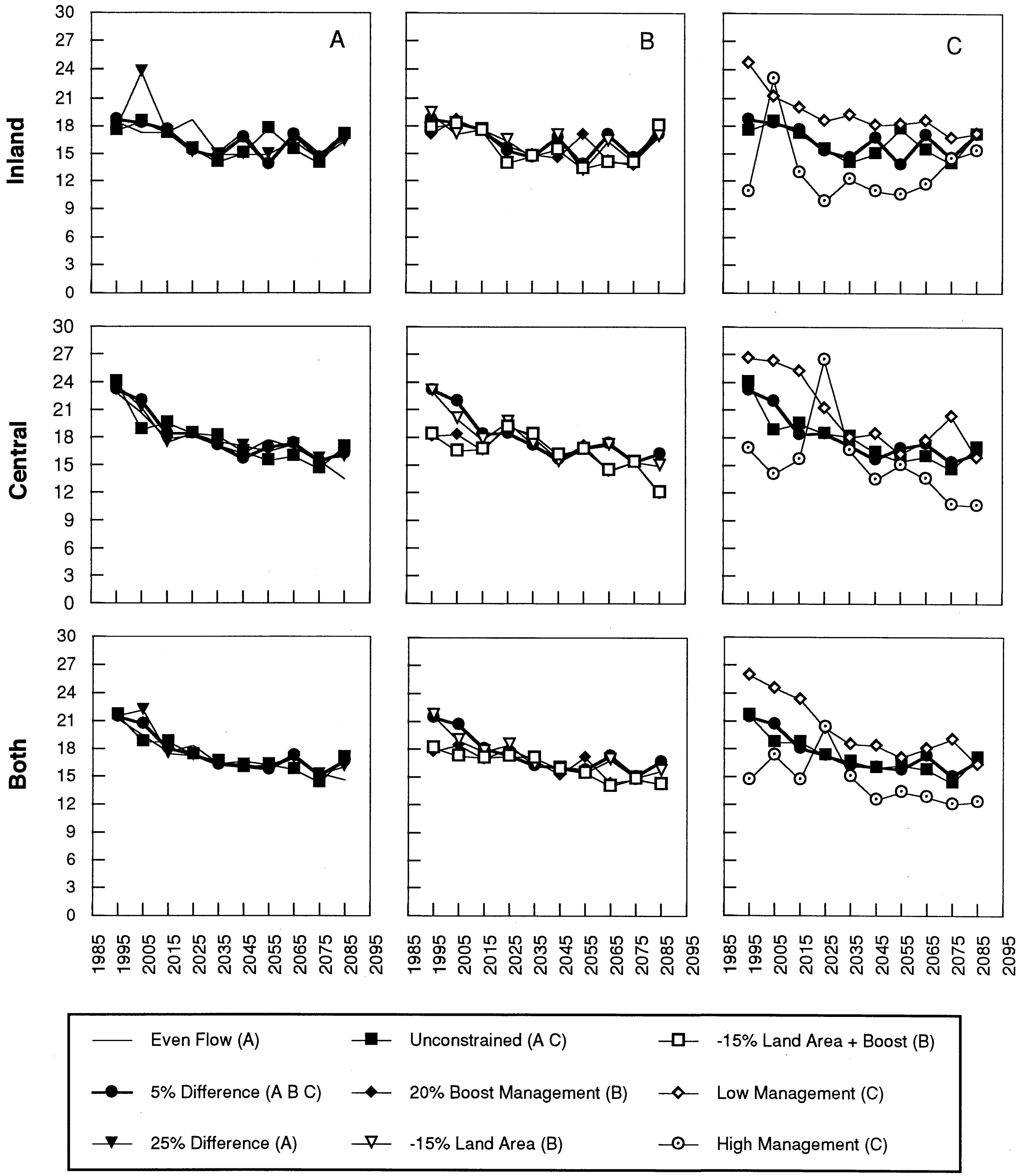
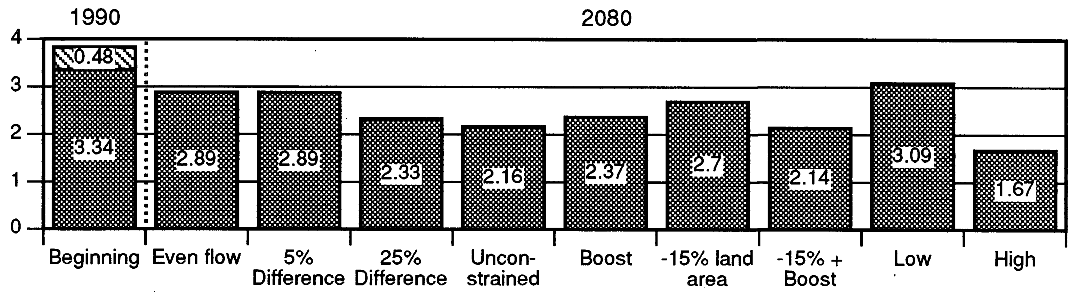


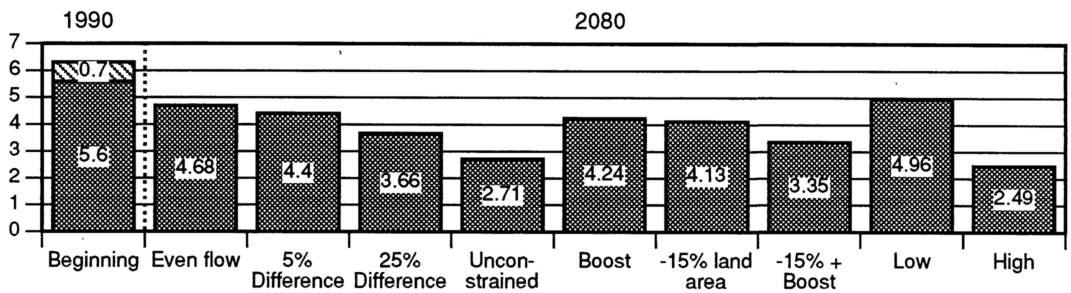
Figure IV.9 Projections of harvested quadratic mean diameter (inches) by timbershed for DNR under four harvest flow variants for initial conditions and for five sensitivity analysis scenarios.

Timber Inventory. At the start of the first decade of the 100-year projection period, the DNR standing inventory was estimated at about 10 billion bd. ft., with just under 9 billion ft. occurring on managed lands. At the end of the projection period the standing inventory on managed acres is expected to be reduced to around 7.3 billion bd. ft., a reduction of approximately 18% (under the ±5% harvest variant). The exact percentage reduction varies with the timber harvest flow variant assumed. These results are depicted in Figure IV.10. The initial and projected tenth-decade inventory volumes stratified by timbershed show that about 60% of the ending inventory volume is contained within the Central Cascades at the beginning and end of the projection period. This draw-down in standing inventory, while producing a sustainable timber harvest over the projection period, shows that there is excess standing inventory as of 1990 based on the FIA survey. The beginning inventory of 17.4 thousand bd. ft. per acre or 37% above the all-owner average is reduced to 14.2 thousand bd. ft. per acre at the end of the period or only 5% above the all-owner average.

Inland Empire



Central



Both

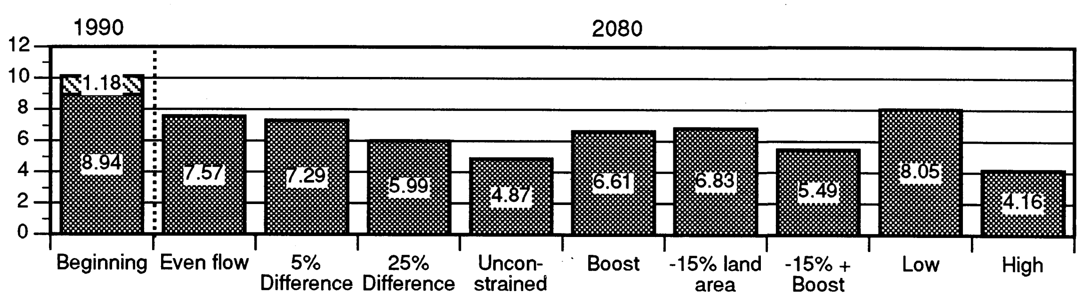


Figure IV.10 Forest inventory (billion bd.ft.) by timbershed in 1990 and 2080 for DNR under four harvest flow variants for initial conditions and for five sensitivity analysis scenarios. Crosshatched area in beginning period indicates inventory on unmanaged acres. Ending period inventories are on managed acres only.

Species Composition of Harvest. Tables IV.8-IV.10 depict species composition of the projected timber harvest over the 100-year projection period by timbershed and for the total DNR Eastside ownership. Only the most prevalent timber species are summarized in these tables. In the Central Cascades timbershed, the DNR harvest is composed primarily of Douglas-fir, ponderosa pine, and Engelmann spruce during the first five decades and Douglas-fir, ponderosa pine, and grand fir during the last five decades of the projection period. In the Inland Empire, the harvest over the entire projection period is composed largely of Douglas-fir and ponderosa pine. However, western larch makes up a significant portion of the DNR harvest in the first decade. For both timbersheds considered together, the harvest is composed primarily of Douglas-fir and ponderosa pine throughout the projection period.

Tables showing the impact of the five sensitivity analysis scenarios for the DNR on species composition are contained in Appendix 6.

Table IV.8 Projections of average annual harvest by species (MMBF) for DNR, in both timbersheds, under different harvest flow constraints.

SPECIES	YEAR									
	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	Even-Flow									
White Pine	1.08	0.89	0.18	0.00	0.00	0.00	0.00	0.88	0.24	0.06
Western Larch	9.52	8.86	10.70	10.90	6.40	7.45	5.75	10.87	6.54	5.13
Douglas-fir	70.01	47.92	74.36	45.49	61.94	65.38	54.40	61.97	57.06	63.78
Grand fir	9.72	7.48	4.54	13.89	5.65	11.46	13.60	18.25	16.59	22.69
Western Hemlock	0.00	0.00	0.00	0.00	1.74	1.21	0.05	0.00	0.00	4.67
Western Redcedar	2.21	6.96	2.42	6.69	5.68	4.42	7.7	3.52	7.70	3.73
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.70
Engelman Spruce	16.84	14.38	13.32	20.23	12.34	7.72	13.18	7.91	5.12	7.84
Subapine fir	0.00	0.00	0.00	6.85	3.15	3.38	0.79	2.77	6.91	2.37
Ponderosa Pine	32.22	55.98	33.51	25.27	38.00	28.17	44.02	32.80	39.43	27.92
Other	4.94	3.98	7.47	16.04	11.57	17.28	6.79	7.26	5.87	5.76
	± 5%									
White Pine	1.08	0.89	0.18	0.00	0.00	0.00	0.00	7.56	0.00	0.31
Western Larch	13.79	7.47	11.21	9.20	6.58	8.10	5.37	10.88	7.32	5.89
Douglas-fir	76.25	70.26	76.23	47.92	57.35	59.42	53.70	62.10	63.14	52.50
Grand fir	12.15	8.46	3.66	14.29	4.70	11.07	12.53	17.18	17.95	25.43
Western Hemlock	0.00	0.00	0.00	0.00	1.74	1.21	0.00	0.00	0.00	4.48
Western Redcedar	2.41	7.19	2.42	7.34	4.86	4.35	6.91	3.50	7.64	3.74
Lodgepole Pine	0	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.15
Engelman Spruce	17.27	14.59	13.60	18.92	12.77	7.72	13.52	8.51	5.18	7.53
Subapine fir	0.00	0.00	0.00	6.34	3.15	3.38	0.79	2.89	6.85	2.47
Ponderosa Pine	40.66	49.76	38.16	27.93	41.49	27.53	42.2	33.69	34.00	30.97
Other	7.61	3.96	9.02	13.83	11.37	19.24	8.56	3.99	6.68	7.98
	± 25%									
White Pine	1.08	0.89	0.18	0.00	0.00	0.00	0.00	7.59	0.00	0.56
Western Larch	38.45	15.00	16.60	7.83	4.58	7.52	3.24	8.91	5.87	4.85
Douglas-fir	147.59	90.74	66.02	44.05	55.19	52.63	51.74	58.14	60.77	45.38
Grand fir	16.02	10.72	6.01	14.55	6.39	12.64	14.44	24.16	15.10	29.29
Western Hemlock	0.00	0.00	0.00	0.14	1.74	1.21	0.15	0.00	0.00	4.80
Western Redcedar	11.88	11.21	2.41	10.01	3.50	2.34	7.52	2.86	6.10	2.62
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.05	0.00	0.24
Engelman Spruce	17.09	13.77	13.21	23.53	11.73	7.50	13.05	7.35	4.87	7.88
Subapine fir	0.00	0.00	0.00	8.23	3.15	3.38	0.80	2.48	7.08	2.03
Ponderosa Pine	31.22	57.49	40.76	31.26	41.14	23.19	32.61	33.98	41.49	30.19
Other	10.45	5.53	8.89	15.59	17.14	17.68	7.98	4.80	7.87	5.74
	Unconstrained									
White Pine	1.08	0.89	0.18	0.00	0.00	0.00	0.00	7.59	2.13	2.39
Western Larch	45.51	6.62	18.25	7.64	4.44	5.35	3.26	7.80	7.53	4.36
Douglas-fir	221.04	89.61	50.03	60.73	47.75	45.35	58.72	51.39	51.89	48.19
Grand fir	22.59	10.33	12.60	13.29	10.25	9.05	18.10	20.71	13.25	27.01
Western Hemlock	2.90	0.00	0.00	0.41	0.00	0.00	0.24	0.15	0.00	0.91
Western Redcedar	23.00	7.85	5.54	7.84	2.05	1.69	5.50	1.54	4.30	2.62
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.04	0.16	0.10	0.04	0.11
Engelman Spruce	33.67	16.07	16.44	19.54	6.68	2.86	18.15	7.22	3.09	3.29
Subapine fir	0.00	0.00	0.00	8.23	3.15	3.38	1.50	2.54	7.08	1.84
Ponderosa Pine	77.28	33.09	43.98	30.95	38.39	24.22	41.99	26.49	43.75	30.14
Other	23.97	7.00	13.10	16.42	12.81	19.00	9.92	4.66	9.06	10.29

Table IV.9 Projections of average annual harvest by species (MMBF) for DNR, in the Inland Empire Timbershed, under different harvest flow constraints.

SPECIES	YEAR 1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	Even-Flow									
White Pine	1.08	0.89	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.03
Western Larch	9.52	6.48	6.65	8.23	3.80	3.29	4.86	6.37	2.65	2.05
Douglas-fir	22.12	16.91	21.28	19.89	25.87	21.39	20.49	28.50	28.34	24.72
Grand fir	3.90	4.65	3.41	3.40	1.45	1.52	2.49	3.34	4.50	4.00
Western Hemlock	0.00	0.00	0.00	0.00	1.74	1.21	0.05	0.00	0.00	4.67
Western Redcedar	1.75	6.96	2.42	2.31	3.91	2.34	5.79	2.86	6.08	2.35
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Engelman Spruce	0.00	0.05	0.37	0.43	1.88	0.44	0.00	0.00	0.00	0.00
Subapine fir	0.00	0.00	0.00	0	0	0.00	0.00	0.00	0.00	0.00
Ponderosa Pine	12.04	16.20	17.72	14.13	10.84	12.80	15.90	7.36	9.17	13.05
Other	2.29	0.47	0.61	4.23	3.13	9.61	2.93	4.17	1.17	0.99
	±5%									
White Pine	1.08	0.89	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.31
Western Larch	13.57	5.26	7.18	6.54	3.78	3.94	4.85	6.31	3.66	2.81
Douglas-fir	22.83	20.15	16.85	22.52	23.71	22.60	22.27	28.81	30.71	25.06
Grand fir	4.46	5.53	2.54	4.21	0.39	0.53	1.42	1.52	6.64	2.18
Western Hemlock	0.00	0.00	0.00	0.00	1.74	1.21	0.00	0.00	0.00	4.48
Western Redcedar	1.48	7.03	2.42	2.55	3.50	2.34	5.06	2.86	6.08	2.41
Lodgepole Pine	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Engelman Spruce	0.00	0.05	0.37	0.43	1.88	0.44	0.00	0.00	0.00	0.00
Subapine fir	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ponderosa Pine	11.94	16.00	21.51	11.65	12.47	13.10	13.89	13.60	7.14	15.45
Other	3.03	0.47	1.61	2.11	4.64	10.54	4.43	1.54	1.89	1.53
	± 25%									
White Pine	1.08	0.89	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.56
Western Larch	38.45	12.53	12.57	5.17	2.25	4.00	2.55	4.31	2.01	1.77
Douglas-fir	36.81	31.26	11.95	16.55	22.72	25.06	19.36	24.12	27.01	19.74
Grand fir	4.90	3.32	3.69	2.97	2.49	3.76	3.39	8.04	2.14	8.49
Western Hemlock	0.00	0.00	0.00	0.14	1.74	1.21	0.15	0.00	0.00	4.80
Western Redcedar	2.25	6.82	2.41	2.55	3.50	2.34	7.52	2.86	6.10	2.62
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.03	0.00	0.00
Engelman Spruce	0.00	0.05	0.37	0.43	1.88	0.44	0.00	0.00	0.00	0.00
Subapine fir	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ponderosa Pine	10.49	19.65	24.54	13.22	7.70	9.34	4.96	11.83	11.81	11.47
Other	8.05	1.99	1.73	2.36	9.10	10.56	4.43	1.54	3.27	1.19
	Unconstrained									
White Pine	1.08	0.89	0.18	0.00	0.00	0.00	0.00	0.00	0.00	1.36
Western Larch	43.22	6.62	14.44	5.67	1.55	2.56	2.73	4.78	3.20	1.76
Douglas-fir	54.42	26.37	12.11	19.70	21.29	25.89	17.64	26.54	21.20	21.80
Grand fir	8.00	1.91	4.56	3.69	2.49	4.28	3.06	13.60	1.57	6.04
Western Hemlock	2.90	0.00	0.00	0.41	0.00	0.00	0.24	0.15	0.00	0.91
Western Redcedar	13.38	3.47	5.54	0.38	2.05	1.69	5.50	1.54	4.30	2.62
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.07	0.00	0.00
Engelman Spruce	0.00	0.03	0.37	1.15	1.08	0.44	0.00	0.00	0.00	0.00
Subapine fir	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ponderosa Pine	18.37	13.05	25.86	14.29	11.33	11.09	7.22	10.18	8.63	17.28
Other	12.73	1.69	1.93	2.91	8.59	10.67	2.47	1.70	3.52	1.25

Table IV.10 Projections of average annual harvest by species (MMBF) for DNR, in the Central Timbershed, under different harvest flow constraints.

SPECIES	YEAR 1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
Even-Flow										
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.88	0.24	0.03
Western Larch	0.00	2.38	4.04	2.67	2.59	4.16	0.90	4.50	3.89	3.08
Douglas-fir	47.89	31.01	53.08	25.60	36.07	43.99	33.92	33.47	28.71	39.06
Grand fir	5.82	2.84	1.13	10.49	4.20	9.94	11.11	14.92	12.09	18.70
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.47	0.00	0.00	4.38	1.77	2.08	1.92	0.66	1.61	1.38
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.70
Engelman Spruce	16.84	14.33	12.95	19.80	10.46	7.29	13.18	7.91	5.12	7.84
Subapine fir	0.00	0.00	0.00	6.85	3.15	3.38	0.79	2.77	6.91	2.37
Ponderosa Pine	20.18	39.78	15.79	11.15	27.17	15.37	28.12	25.44	30.25	14.87
Other	2.65	3.51	6.87	11.81	8.44	7.67	3.86	3.09	4.70	4.77
±5%										
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.56	0.00	0.00
Western Larch	0.22	2.20	4.03	2.67	2.79	4.16	0.52	4.57	3.66	3.08
Douglas-fir	53.42	50.11	59.38	25.40	33.64	36.82	31.44	33.29	32.43	27.44
Grand fir	7.70	2.93	1.13	10.09	4.31	10.54	11.10	15.66	11.32	23.24
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.93	0.15	0.00	4.79	1.36	2.01	1.85	0.64	1.56	1.33
Lodgepole Pine	0	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.15
Engelman Spruce	17.27	14.54	13.23	18.48	10.89	7.29	13.52	8.51	5.18	7.53
Subapine fir	0.00	0.00	0.00	6.34	3.15	3.38	0.79	2.89	6.85	2.47
Ponderosa Pine	28.72	33.76	16.65	16.28	29.02	14.43	28.32	20.09	26.86	15.51
Other	4.58	3.49	7.41	11.72	6.73	8.71	4.13	2.45	4.79	6.45
±25%										
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.59	0.00	0.00
Western Larch	0.00	2.47	4.03	2.67	2.33	3.52	0.69	4.60	3.86	3.08
Douglas-fir	110.78	59.47	54.06	27.50	32.47	27.57	32.38	34.02	33.76	25.64
Grand fir	11.12	7.40	2.32	11.58	3.90	8.88	11.05	16.13	12.96	20.80
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	9.62	4.39	0.00	7.46	0.00	0.00	0.00	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.00	0.24
Engelman Spruce	17.09	13.72	12.84	23.10	9.85	7.06	13.05	7.35	4.87	7.88
Subapine fir	0.00	0.00	0.00	8.23	3.15	3.38	0.80	2.48	7.08	2.03
Ponderosa Pine	20.73	37.84	16.21	18.04	33.43	13.85	27.65	22.15	29.68	18.72
Other	2.40	3.54	7.16	13.23	8.04	7.11	3.55	3.26	4.59	4.55
Unconstrained										
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.59	2.13	1.03
Western Larch	2.29	0.00	3.81	1.97	2.90	2.79	0.53	3.01	4.33	2.60
Douglas-fir	166.63	63.24	37.92	41.03	26.46	19.46	41.09	24.85	30.69	26.39
Grand fir	14.59	8.42	8.04	9.59	7.76	4.76	15.04	7.11	11.68	20.97
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	9.62	4.39	0.00	7.46	0.00	0.00	0.00	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.02	0.04	0.11
Engelman Spruce	33.67	16.04	16.07	18.40	5.60	2.42	18.15	7.22	3.09	3.29
Subapine fir	0.00	0.00	0.00	8.23	3.15	3.38	1.50	2.54	7.08	1.84
Ponderosa Pine	58.91	20.04	18.13	16.65	27.06	13.13	34.77	16.32	35.12	12.87
Other	11.24	5.31	11.17	13.52	4.23	8.33	7.45	2.96	5.54	9.03

Forest Industry

Under Initial Conditions. The estimated timber harvest volume over the 100-year projection period for forest industry is summarized in Table IV.11 and Figure IV.11. Shown are the average annual timber harvest volumes in Scribner board feet by decade for each timbershed and for forest industry's entire Eastside ownership. Results are presented for each of the four timber harvest flow variants examined in this study. Also shown in Figure IV.11 Panel A is the historical timber harvest volume for the period 1965-92. These should be used solely to provide perspective vis a vis the projected harvest volumes.

One striking feature shown in Figure IV.11 Panel A is that there is more variation in projected harvests beyond the second decade than was seen for either the DNR or for all aggregated ownerships modeled in this study. As expected, there is considerable variation between the harvest flow variants during the first two decades of the analysis. There is also more variation in estimated harvest levels in individual timbersheds than when both timbersheds are considered. The second striking feature shown in Figure IV.11 Panel A is that projected timber harvest volumes over the next 100 years are generally at lower levels than historic levels of harvest of 384 MMBF during 1985-92 and are comparable to the 255 MMBF average from 1965-92. As shown in Table IV.11 for both timbersheds, projected levels of harvest vary widely under the four timber harvest flow variants. However, under all scenarios, it appears unlikely that historic levels of harvest can be sustained beyond one more decade. Under ±5% harvest flow constraints, 265 MMBF can be harvested per year in the first decade, a drop of 119 MMBF from the 1985-92 average harvest. When viewed from the perspective of each timbershed separately, the same trends emerge. However, there is considerably more variation in the Central Cascades timbershed than in the Inland Empire.

Figure IV.12 shows the cumulative harvest volume over the 100-year projection period under the various harvest flow variants. The largest total harvest is associated with the unconstrained harvest flow constraint, followed by the harvest volumes associated with the ±25%, the ±5%, and the even-flow variations, respectively. Relative to the total harvest volume under the ±5% harvest flow constraints, the ±25% total harvest is 3.5% higher; the unconstrained total harvest volume is 6.8% higher; and the even-flow harvest is 3.5% lower over the total projection period.

It should be noted that the acceptability of variation from an even-flow timber harvest schedule will differ by ownership. For example, DNR owns no processing facilities and is more likely to accept an even-flow interpretation of sustained yield in the long-term. Since there is an economic penalty for holding mature timber inventories, forest industry is more likely to target stability in timber harvest flows only to the extent that it is supportive of current and planned processing facilities, which have a shorter economic life. While forest industry does have mature standing timber inventories to support high levels of harvest over the next decade, it is a much lower level than for DNR and can only be sustained for one decade.

Table IV.11 Annual harvest volumes for forest industry (MMBF)

Inland	evenflow	5%	25%	unconst.	boost	-15%	-15%+boost	low	high
1995	107.38	126.60	175.43	237.17	121.80	108.28	108.54	101.40	325.98
2005	107.38	116.47	131.57	94.56	115.71	102.87	103.11	97.93	61.97
2015	107.38	110.65	105.78	139.65	109.93	97.72	97.95	103.58	113.79
2025	107.38	105.11	95.25	98.11	104.43	92.84	93.06	93.09	54.91
2035	107.38	99.86	101.40	97.75	99.21	88.20	88.40	107.51	90.71
2045	107.38	101.35	89.90	92.49	99.95	92.61	91.87	101.58	52.16
2055	107.38	106.42	104.38	93.04	104.95	97.24	96.46	122.97	56.92
2065	107.38	111.74	130.47	142.91	110.19	102.10	101.28	89.74	168.13
2075	107.38	113.33	115.54	104.71	115.70	107.20	106.35	79.19	119.86
2085	107.38	112.47	113.56	110.52	121.49	107.41	111.66	110.80	102.99
Central									
1995	116.96	138.22	186.20	269.80	312.14	103.24	106.17	182.85	399.09
2005	116.96	131.31	139.65	81.04	69.69	98.08	100.86	83.26	40.32
2015	116.96	124.75	104.74	76.51	86.83	93.17	95.82	97.91	62.48
2025	116.96	118.51	103.75	98.87	92.12	91.30	91.03	108.60	71.28
2035	116.96	112.58	84.89	99.37	119.59	95.86	95.58	99.79	42.44
2045	116.96	107.86	105.31	97.69	72.23	100.66	100.36	115.84	97.70
2055	116.96	113.25	131.63	99.70	112.09	105.69	105.38	131.33	103.16
2065	116.96	118.92	119.38	144.44	143.28	110.97	110.65	106.27	140.53
2075	116.96	124.86	149.22	151.24	150.70	116.52	116.18	110.74	169.75
2085	116.96	131.10	119.06	154.88	185.08	122.35	121.99	138.44	97.83
Both									
1995	224.33	264.82	361.63	506.97	433.94	211.52	214.71	284.25	725.07
2005	224.33	247.78	271.22	175.61	185.40	200.95	203.97	181.19	102.29
2015	224.33	235.39	210.52	216.16	196.76	190.89	193.77	201.49	176.27
2025	224.33	223.62	199.00	196.98	196.55	184.14	184.09	201.69	126.19
2035	224.33	212.44	186.29	197.12	218.80	184.06	183.98	207.30	133.15
2045	224.33	209.21	195.20	190.18	172.18	193.27	192.23	217.42	149.86
2055	224.33	219.67	236.01	192.73	217.04	202.93	201.84	254.30	160.08
2065	224.33	230.66	249.85	287.35	253.47	213.07	211.93	196.01	308.66
2075	224.33	238.19	264.76	255.95	266.40	223.72	222.53	189.93	289.61
2085	224.33	243.57	232.62	265.40	306.57	229.76	233.65	249.24	200.82

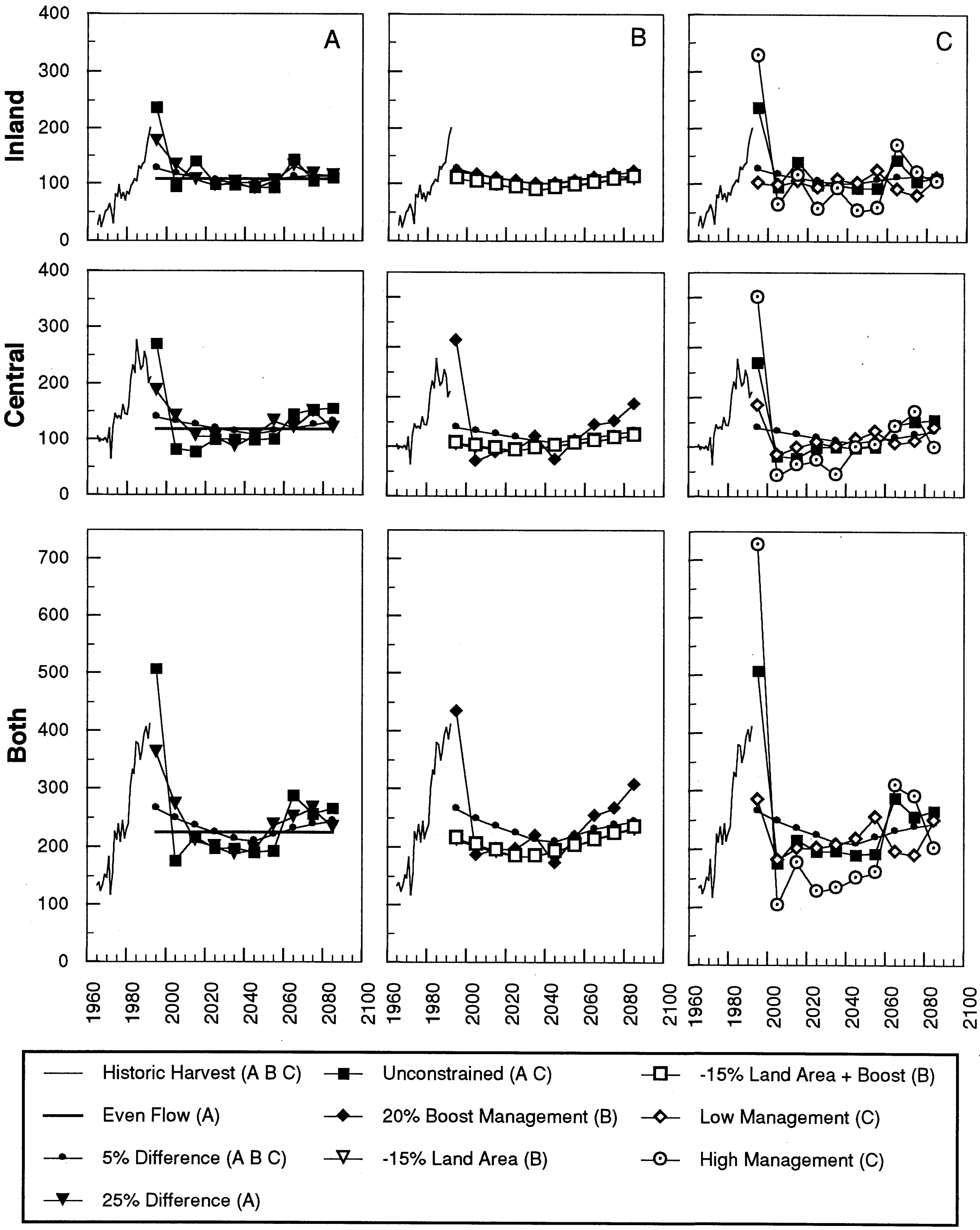


Figure IV.11 Projections of average annual harvest (MMBF) by timbershed for forest industry under four harvest flow variants for initial conditions and for five sensitivity analysis scenarios.

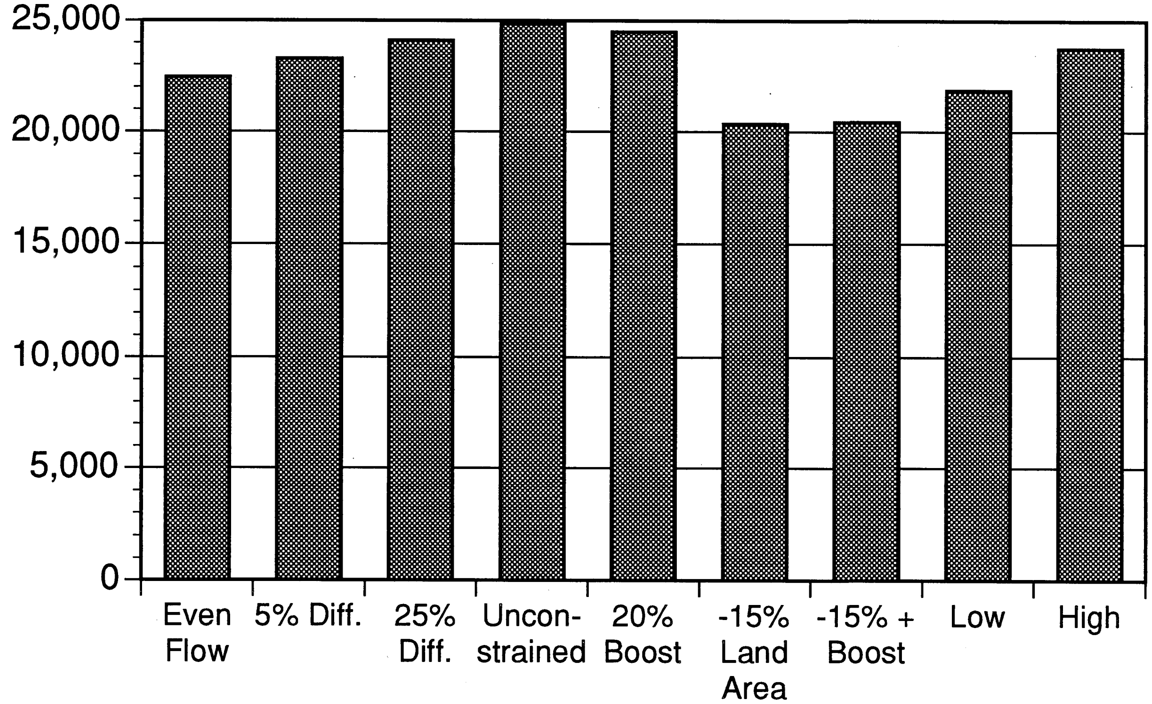


Figure IV. 12 Projection of cumulative harvest (MMBF) over 100 years for forest industry under four harvest flow variants for initial conditions and for five sensitivity analysis scenarios.

Average Size of Harvested Timber. Table IV.12 and Figure IV.13 Panel A depict the time path of the quadratic mean diameter of harvested trees for forest industry lands on the Eastside. The trends show that the quadratic mean diameter of harvested trees is projected to decline from an average of around 14-15 inches during the first decade of the projection period to 12 inches during the last decade. This trend of decreasing size holds for each timbershed when considered separately as well as in the aggregate. Mean diameter shows considerable variation in both timbersheds over time. Differences in mean diameter between the two timbersheds do not appear to be significant over the projection period. In comparison to DNR, forest industry stands do not show as much of a downward trend in harvest size because their inventories are closer to the long-term potential harvest limits.

Table IV.12 Projections of harvested quadratic mean diameter (inches) for forest industry

Inland	evenflow	5%	25%	unconst.	boost	-15%	-15%+boost	low	high
1995	15.10	15.20	14.60	14.70	15.60	14.50	15.20	20.00	13.70
2005	14.60	15.10	13.90	14.00	14.70	14.90	14.70	14.60	9.10
2015	15.30	15.20	15.30	13.10	15.00	15.00	15.20	17.80	15.40
2025	14.50	17.40	17.50	15.00	15.30	14.30	15.10	17.20	10.40
2035	14.10	14.30	16.90	16.60	14.40	17.40	14.30	17.80	12.70
2045	13.30	13.50	13.10	12.50	14.10	13.00	13.30	14.50	11.20
2055	13.00	12.70	11.40	13.80	11.20	13.40	13.30	13.20	13.40
2065	11.60	11.00	12.00	12.80	11.10	10.70	10.80	13.60	10.20
2075	9.20	9.40	10.40	10.10	9.60	8.90	9.20	17.80	8.30
2085	14.00	11.60	11.60	12.60	11.80	11.40	11.30	16.40	10.30
Central									
1995	13.80	15.90	14.60	14.50	15.80	13.60	13.00	19.20	10.70
2005	13.90	13.90	18.20	16.40	21.90	24.10	22.70	22.10	7.20
2015	19.40	18.60	15.80	12.10	14.60	16.20	16.00	18.40	9.20
2025	15.20	15.30	16.30	15.50	14.50	15.30	16.10	16.10	11.20
2035	15.00	15.00	15.70	16.10	15.90	16.80	16.30	19.10	8.70
2045	16.50	16.70	20.70	16.70	16.10	18.80	19.30	20.30	12.50
2055	12.50	12.80	12.40	12.30	12.30	12.70	12.00	15.10	13.20
2065	12.40	12.50	14.70	15.10	13.80	12.10	14.20	19.10	12.90
2075	15.80	13.90	13.80	12.40	10.50	14.00	12.70	15.90	11.20
2085	9.80	9.70	12.10	11.40	11.00	13.10	13.30	13.80	9.90
Both									
1995	14.40	15.60	14.60	14.60	15.70	14.00	14.00	19.50	12.10
2005	14.20	14.40	16.20	15.30	18.60	19.90	19.10	18.70	8.00
2015	17.50	17.00	15.60	12.60	14.80	15.70	15.70	18.10	12.00
2025	14.90	16.20	16.80	15.20	14.90	14.90	15.70	16.60	10.90
2035	14.60	14.70	16.30	16.30	15.20	17.00	15.40	18.50	10.50
2045	15.00	15.20	17.20	14.80	15.20	16.20	16.60	17.60	11.90
2055	12.70	12.70	12.00	12.90	11.80	13.00	12.60	14.20	13.30
2065	12.00	11.80	13.50	14.00	12.60	11.50	12.70	16.60	11.70
2075	12.80	11.90	12.30	11.40	10.10	11.70	11.10	16.70	9.90
2085	11.70	10.60	11.90	11.90	11.40	12.30	12.40	15.00	10.10

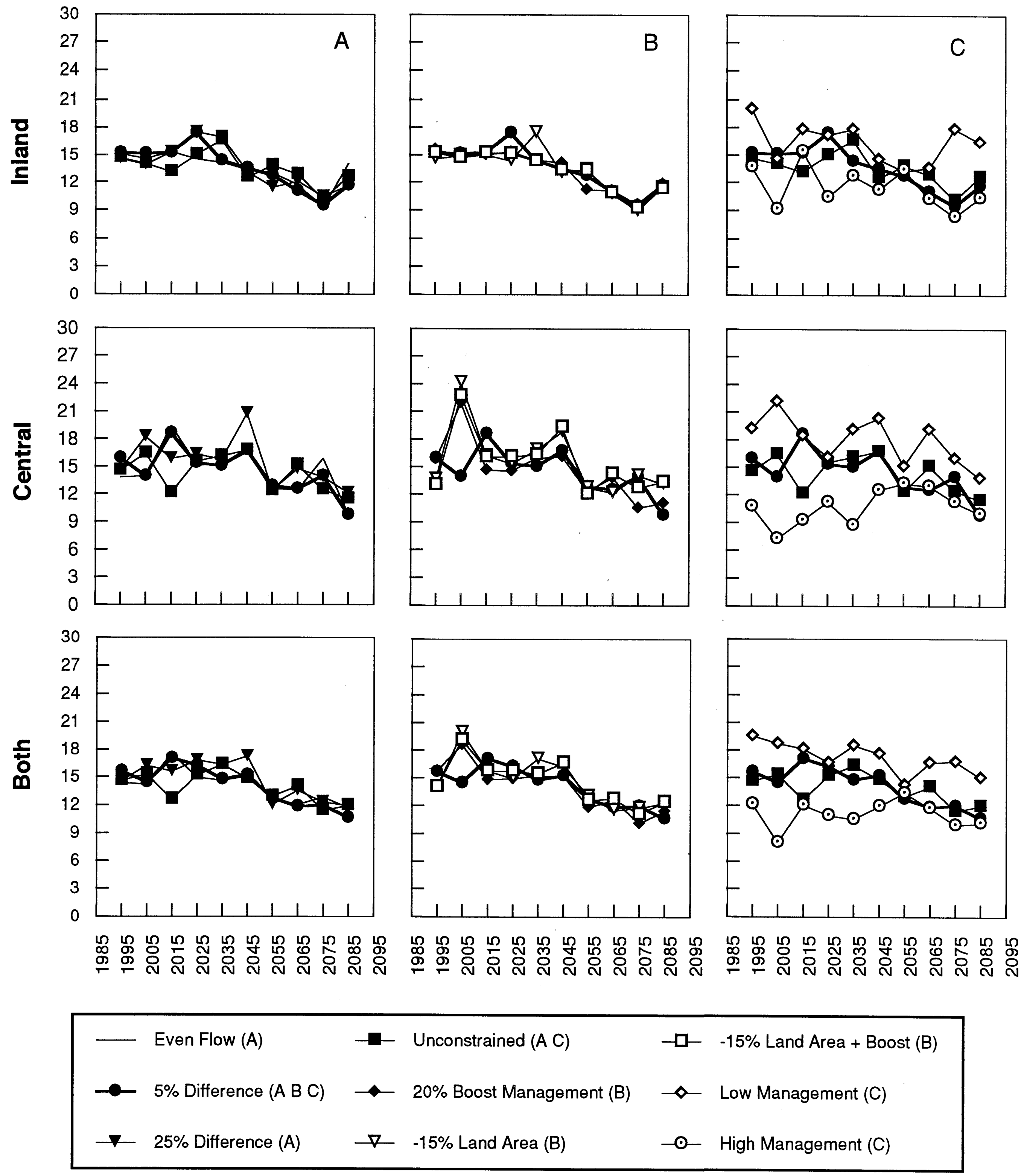


Figure IV.13 Projections of harvested quadratic mean diameter (inches) by timbershed for forest industry under four harvest flow variants for initial conditions and for five sensitivity analysis scenarios.

Timber Inventory. At the start of the first decade of the 100-year projection period, the standing inventory on all forest industry land was estimated at about 10.7 billion bd. ft., with 9.9 billion bd. ft. occurring on managed acres. At the end of the projection period the standing inventory is expected to be approximately 10.9, a 10% increase (under the ±5% harvest variant). These results are depicted in Figure IV.14. The initial and projected tenth-decade inventory volumes stratified by timbershed show that the ending inventory volume is about evenly split between the two timbersheds. In general, this shows that the forest industry has largely completed a downward adjustment in inventory with some increase expected over the next 100 years. Higher-than-estimated management levels could result in some additional decline in inventory.

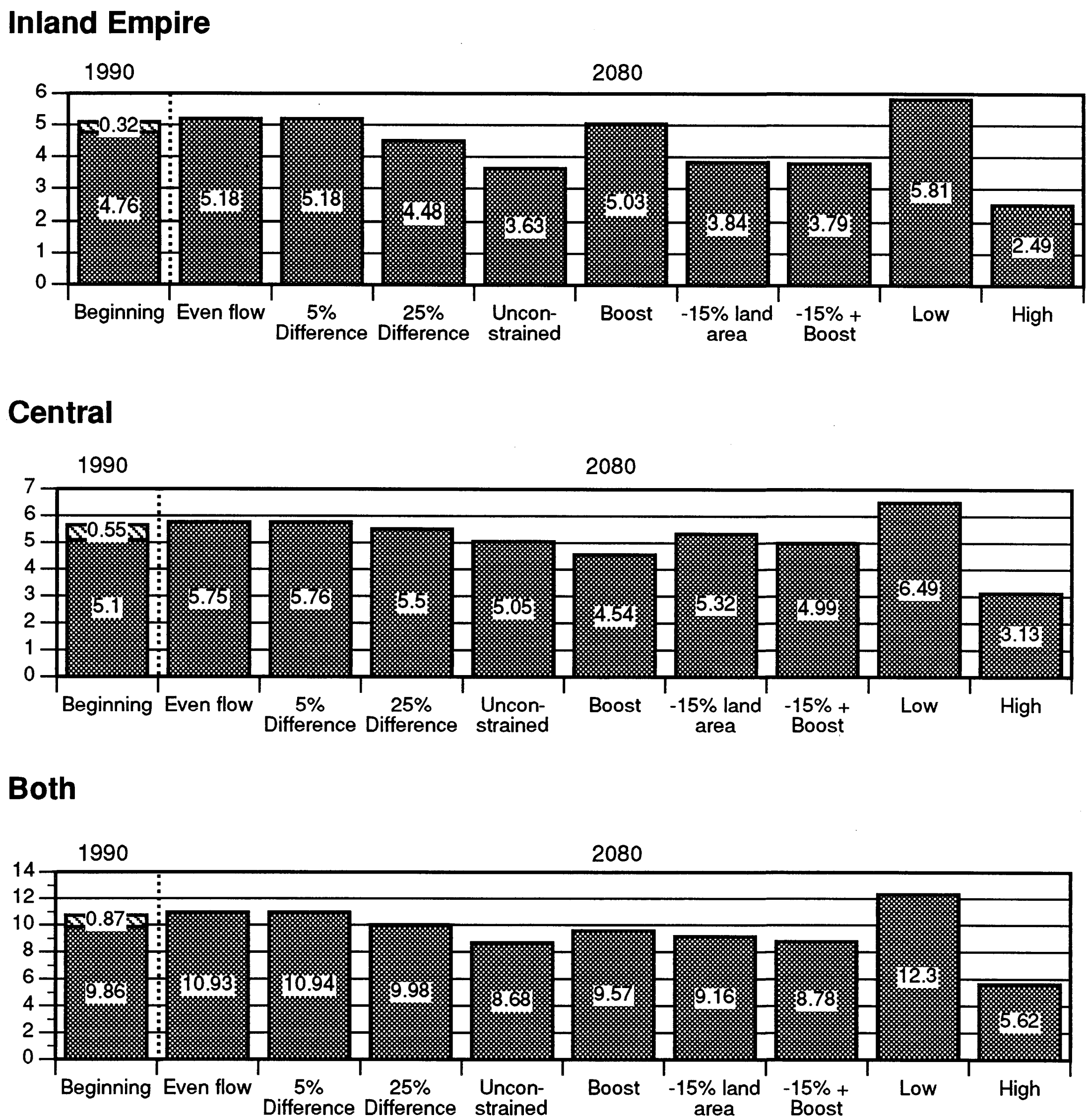


Figure IV.14 Forest inventory (billion bd.ft.) by timbershed in 1990 and 2080 for forest industry under four harvest flow variants for initial conditions and for five sensitivity analysis scenarios. Crosshatched area in beginning period indicates inventory on unmanaged acres. Ending period inventories are on managed acres only.

Species Composition of Harvest. Tables IV.13-IV.15 depict species composition of the projected timber harvest over the 100-year projection period by timbershed and for the total forest industry Eastside ownership. Only the most prevalent timber species are summarized in these tables and figures. In the Central Cascades timbershed, the forest industry harvest is composed primarily of Douglas-fir, ponderosa pine, and grand fir throughout the projection period. In the Inland Empire, the harvest over the entire projection period is composed largely of Douglas-fir, ponderosa pine, grand fir, and western redcedar. Western larch makes up a significant portion of the estimated harvest in the first decade. For both timbersheds considered together, the harvest is composed primarily of Douglas-fir, ponderosa pine, and grand fir throughout the projection period. Western larch makes up a significant portion of the estimated harvest in the first two decades and western redcedar during the first, fourth through sixth, and last decade. Tables showing the impact of the five sensitivity analysis scenarios for forest industry on species composition are contained in Appendix 6.

Table IV.13 Projections of average annual harvest by species (MMBF) for forest industry, in both timbersheds, under different harvest flow constraints.

SPECIES	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
					Even-Flow					
White Pine	3.42	1.55	2.16	1.35	2.12	4.48	4.52	23.02	17.98	7.65
Western Larch	19.79	18.34	7.90	9.33	7.08	7.41	1.56	1.96	2.78	3.15
Douglas-fir	108.16	105.94	111.11	94.02	101.47	83.06	96.03	90.63	75.36	71.98
Grand fir	31.29	35.80	24.96	40.34	26.67	38.64	46.74	36.47	53.07	73.75
Western Hemlock	1.73	0.00	0.00	1.59	0.26	0.67	4.75	3.02	1.74	1.29
Western Redcedar	10.88	4.72	7.41	10.25	21.35	10.66	9.2	5.42	8.40	13.74
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	4.50	0.18
Engelman Spruce	2.12	3.62	2.22	1.06	1.90	8.76	3.00	3.78	2.85	6.90
Subapine fir	0.91	0.79	3.41	2.44	2.42	3.64	4.43	15.40	2.84	4.15
Ponderosa Pine	38.36	42.36	56.46	58.63	56.72	60.84	48.82	36.13	47.63	33.04
Other	7.23	10.90	8.72	5.27	4.32	6.07	4.83	6.38	4.04	3.92
					± 5%					
White Pine	3.42	1.55	2.27	1.24	2.12	4.48	1.26	27.74	17.22	9.61
Western Larch	20.42	19.55	7.63	7.33	5.99	7.39	1.44	1.93	4.54	2.82
Douglas-fir	120.41	118.03	120.35	95.45	77.71	79.89	88.98	92.83	89.77	69.48
Grand fir	44.06	44.79	24.10	39.54	30.30	42.63	44.72	40.68	56.80	73.13
Western Hemlock	1.73	0.00	0.00	1.59	0.26	0.67	4.75	3.02	1.74	1.29
Western Redcedar	10.88	4.72	7.41	10.24	21.36	11.64	8.96	5.88	8.38	13.80
Lodgepole Pine	0	0.00	0.00	0.00	0.00	0.00	0.00	0.37	5.64	0.16
Engelman Spruce	2.12	3.62	2.22	1.06	1.90	8.76	2.73	4.11	2.85	6.90
Subapine fir	0.91	0.79	3.41	2.44	2.42	3.64	4.43	15.40	2.84	4.15
Ponderosa Pine	48.57	41.13	60.43	60.41	65.95	44.83	56.64	29.77	46.62	52.34
Other	7.86	13.29	7.58	4.27	4.33	5.12	5.36	7.11	2.56	4.99
					± 25%					
White Pine	3.42	1.55	2.27	2.12	3.36	4.32	11.92	14.39	17.44	7.76
Western Larch	31.82	10.56	8.00	6.53	6.76	5.16	1.36	2.26	3.59	2.59
Douglas-fir	175.91	148.58	91.53	87.34	71.14	72.79	94.70	90.69	103.32	75.87
Grand fir	68.67	35.02	17.69	46.70	24.41	43.88	40.51	43.12	85.91	50.93
Western Hemlock	1.73	0.00	0.00	1.59	0.26	0.67	4.75	3.02	1.74	1.29
Western Redcedar	10.88	5.57	7.69	10.39	20.43	11.97	8.56	5.07	7.04	14.02
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	5.94	0.15
Engelman Spruce	2.12	7.10	2.22	1.06	1.90	2.05	3.00	3.78	2.85	6.90
Subapine fir	0.91	1.32	3.41	2.44	2.42	2.02	4.43	15.40	3.01	3.98
Ponderosa Pine	56.45	47.68	70.28	36.87	51.30	46.74	61.19	62.17	27.39	58.98
Other	8.92	13.79	7.44	3.90	4.30	5.38	5.45	7.12	2.47	6.77
					Unconstrained					
White Pine	3.90	1.55	3.62	0.89	2.80	2.39	10.66	21.28	10.98	7.21
Western Larch	35.42	6.92	8.70	7.78	7.53	5.16	1.36	2.26	2.31	2.73
Douglas-fir	219.14	98.66	96.58	82.04	79.41	77.13	85.84	110.75	91.71	98.73
Grand fir	97.98	24.82	23.16	45.89	23.60	36.54	33.87	50.93	74.54	46.84
Western Hemlock	5.45	0.00	0.00	1.05	3.90	0.17	1.48	2.51	3.16	1.29
Western Redcedar	20.16	2.74	6.53	8.31	18.82	10.87	7.24	8.47	7.38	14.02
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.51	6.08
Engelman Spruce	8.20	2.36	1.37	1.06	1.90	2.05	3.00	3.78	2.85	5.67
Subapine fir	9.47	0.54	4.20	1.51	2.04	0.00	4.33	12.97	1.89	17.48
Ponderosa Pine	92.76	28.98	60.61	44.45	50.26	50.26	39.43	62.78	53.25	51.98
Other	11.81	9.04	11.43	3.95	6.39	5.38	5.45	7.12	2.55	6.70

Table IV.14 Projections of average annual harvest by species (MMBF) for forest industry, in the Inland Empire Timbershed, under different harvest flow constraints.

SPECIES	YEAR 1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	Even-Flow									
White Pine	0.00	1.55	0.00	0.00	0.64	1.64	3.25	10.42	3.38	2.32
Western Larch	17.23	6.60	7.62	6.88	6.46	5.56	1.43	1.93	2.74	3.00
Douglas-fir	19.56	54.03	44.80	37.66	49.83	38.62	41.57	38.46	41.48	41.12
Grand fir	28.78	12.18	9.93	28.69	9.81	15.68	22.05	15.34	20.97	16.02
Western Hemlock	1.73	0.00	0.00	1.59	0.26	0.67	4.75	3.02	1.74	1.29
Western Redcedar	10.88	4.72	7.41	10.25	21.35	10.09	7.88	5.42	8.40	13.74
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.49	0.18
Engelman Spruce	2.12	3.62	2.22	1.06	1.90	2.05	1.99	3.78	2.85	6.90
Subapine fir	0.91	0.54	0.91	1.51	2.04	0.00	2.62	12.97	1.72	0.92
Ponderosa Pine	19.64	14.18	28.07	17.11	13.08	30.35	20.47	13.17	15.57	15.67
Other	6.08	9.95	6.43	2.60	1.98	2.61	1.07	2.43	0.91	3.56
	± 5%									
White Pine	0.00	1.55	0.00	0.00	0.64	1.64	0.00	15.64	2.41	2.84
Western Larch	17.23	6.73	7.63	6.69	5.49	5.56	1.44	1.93	4.54	2.82
Douglas-fir	23.19	59.14	45.62	37.33	36.01	38.21	40.18	38.51	53.20	42.70
Grand fir	41.65	16.44	10.01	28.86	9.31	18.70	22.93	16.92	19.18	16.20
Western Hemlock	1.73	0.00	0.00	1.59	0.26	0.67	4.75	3.02	1.74	1.29
Western Redcedar	10.88	4.72	7.41	10.24	21.36	11.07	7.63	5.88	8.38	13.80
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.62	0.16
Engelman Spruce	2.12	3.62	2.22	1.06	1.90	2.05	1.99	3.78	2.85	6.90
Subapine fir	0.91	0.54	0.91	1.51	2.04	0.00	2.62	12.97	1.72	0.92
Ponderosa Pine	18.36	13.04	30.41	15.99	20.76	20.68	23.57	10.09	14.24	17.91
Other	6.08	10.68	6.43	1.80	1.98	2.61	1.08	2.43	0.32	4.25
	± 25%									
White Pine	0.00	1.55	0.00	0.00	0.64	3.60	7.90	5.14	2.41	2.84
Western Larch	18.01	7.58	8.00	5.89	6.26	5.16	1.36	2.26	3.59	2.59
Douglas-fir	61.44	67.60	43.86	36.53	35.33	37.33	31.29	49.73	51.23	41.32
Grand fir	49.72	16.99	8.90	29.32	11.06	17.31	21.57	17.69	22.61	15.24
Western Hemlock	1.73	0.00	0.00	1.59	0.26	0.67	4.75	3.02	1.74	1.29
Western Redcedar	10.88	5.57	7.69	10.39	20.43	11.41	7.24	5.07	7.04	14.02
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.71	0.15
Engelman Spruce	2.12	3.62	2.22	1.06	1.90	2.05	1.99	3.78	2.85	6.90
Subapine fir	0.91	0.54	0.91	1.51	2.04	0.00	2.62	12.97	1.72	0.92
Ponderosa Pine	23.35	16.62	28.50	6.89	21.51	9.33	24.50	27.33	12.89	21.22
Other	6.82	11.51	5.70	2.02	1.95	2.87	1.17	2.44	0.23	4.25
	Unconstrained									
White Pine	0.00	1.55	0.00	0.00	0.50	2.39	7.90	5.14	2.26	3.17
Western Larch	18.02	6.92	8.70	5.89	7.03	5.16	1.36	2.26	2.31	2.59
Douglas-fir	77.35	50.00	59.82	36.88	35.23	33.18	32.63	51.14	41.88	45.23
Grand fir	60.89	15.19	11.67	33.40	10.13	17.31	20.42	21.63	20.76	14.78
Western Hemlock	5.45	0.00	0.00	1.05	3.90	0.17	1.48	2.51	3.16	1.29
Western Redcedar	20.16	2.74	6.53	8.31	18.82	10.87	7.24	8.47	7.38	14.02
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51	4.76
Engelman Spruce	4.73	2.36	1.37	1.06	1.90	2.05	1.99	3.78	2.85	5.67
Subapine fir	0.91	0.54	0.91	1.51	2.04	0.00	2.62	12.97	1.72	0.92
Ponderosa Pine	41.45	8.51	40.94	7.88	16.13	18.33	16.24	31.24	17.31	11.21
Other	6.82	6.76	9.69	2.07	1.95	2.87	1.17	2.44	0.31	4.15

Table IV.15 Projections of average annual harvest by species (MMBF) for forest industry, in the Central Timbershed, under different harvest flow constraints.

SPECIES	YEAR 1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	Even-Flow									
White Pine	3.42	0.00	2.16	1.35	1.48	2.84	1.26	12.60	14.59	5.33
Western Larch	2.56	11.74	0.28	2.46	0.62	1.85	0.12	0.04	0.04	0.14
Douglas-fir	88.60	51.90	66.31	56.36	51.63	44.44	54.46	52.17	33.88	30.86
Grand fir	2.50	23.61	15.03	11.65	16.86	22.96	24.69	21.13	32.10	57.73
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0	0	0.57	1.32	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00
Engelman Spruce	0.00	0.00	0.00	0.00	0.00	6.71	1.01	0.00	0.00	0.00
Subapine fir	0.00	0.25	2.50	0.93	0.38	3.64	1.81	2.43	1.12	3.22
Ponderosa Pine	18.72	28.19	28.39	41.53	43.64	30.49	28.34	22.95	32.06	17.37
Other	1.16	0.95	2.29	2.68	2.34	3.46	3.76	3.95	3.13	0.35
	± 15%									
White Pine	3.42	0.00	2.27	1.24	1.48	2.84	1.26	12.09	14.81	6.78
Western Larch	3.19	12.82	0.00	0.64	0.50	1.83	0.00	0.00	0.00	0.00
Douglas-fir	97.21	58.88	74.72	58.12	41.70	41.68	48.80	54.32	36.57	26.79
Grand fir	2.41	28.35	14.08	10.68	20.99	23.93	21.79	23.76	37.62	56.93
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.57	1.32	0.00	0.00	0.00
Lodgepole Pine	0	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.03	0.00
Engelman Spruce	0.00	0.00	0.00	0.00	0.00	6.71	0.74	0.33	0.00	0.00
Subapine fir	0.00	0.25	2.50	0.93	0.38	3.64	1.81	2.43	1.12	3.23
Ponderosa Pine	30.21	28.09	30.03	44.42	45.19	24.16	33.07	19.67	32.37	34.43
Other	1.79	2.61	1.15	2.47	2.35	2.51	4.28	4.68	2.24	0.74
	± 25%									
White Pine	3.42	0.00	2.27	2.12	2.72	0.72	4.02	9.26	15.03	4.92
Western Larch	13.80	2.98	0.00	0.64	0.50	0.00	0.00	0.00	0.00	0.00
Douglas-fir	114.47	80.98	47.67	50.81	35.81	35.46	63.41	40.96	52.09	34.55
Grand fir	18.95	18.04	8.79	17.39	13.35	26.56	18.95	25.43	63.31	35.69
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.57	1.32	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.23	0.00
Engelman Spruce	0.00	3.47	0.00	0.00	0.00	0.00	1.01	0.00	0.00	0.00
Subapine fir	0.00	0.78	2.50	0.93	0.38	2.02	1.81	2.43	1.30	3.06
Ponderosa Pine	33.10	31.06	41.77	29.98	29.79	37.42	36.69	34.84	14.50	37.77
Other	2.11	2.29	1.74	1.88	2.35	2.51	4.28	4.68	2.24	2.53
	Unconstrained									
White Pine	3.90	0.00	3.62	0.89	2.30	0.00	2.76	16.14	8.73	4.03
Western Larch	17.40	0.00	0.00	1.89	0.50	0.00	0.00	0.00	0.00	0.14
Douglas-fir	141.79	48.65	36.77	45.16	44.18	43.96	53.21	59.61	49.84	53.50
Grand fir	37.09	9.63	11.49	12.49	13.48	19.22	13.45	29.29	53.79	32.07
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	1.32
Engelman Spruce	3.47	0.00	0.00	0.00	0.00	0.00	1.01	0.00	0.00	0.00
Subapine fir	8.55	0.00	3.29	0.00	0.00	0.00	1.71	0.00	0.17	16.56
Ponderosa Pine	51.32	20.47	19.67	36.56	34.13	31.94	23.19	31.54	35.94	40.77
Other	5.00	2.29	1.74	1.88	4.44	2.51	4.28	4.68	2.24	2.56

Native American

Under Initial Conditions. The estimated timber harvest volume over the 100-year projection period for Native American lands is summarized in Table IV.16 and Figure IV.15 Panel A. Shown are the average annual timber harvest volumes in Scribner board feet by decade for each timbershed and for all Native American lands on the Eastside. Results are presented for each of the four timber harvest flow variants examined in this study. Also shown in Figure IV.15 is the historical timber harvest volume for the period 1965-92. These should be used solely to provide perspective vis a vis the projected harvest volumes.

One striking feature shown in Figure IV.15 Panel A is that projected timber harvest volumes over the next 100 years are generally higher than recent historic levels but consistent with levels prior to 1980. As shown in Table IV.16 projected levels of harvest in the Central timbershed are projected to be around 170 MMBF under the four timber harvest flow variants. It appears historic levels of harvest could potentially be sustained and even increased above the last decade. The Inland Empire timbershed shows a similar potential. Estimated harvest levels for this timbershed are projected to be around 130 MMBF depending upon the harvest flow variant assumed. For both timbersheds, it is estimated that the combined harvest could be sustained at about 300 MMBF over the 100-year projection period. This is consistent with historic levels prior to 1980 but an increase since 1985-92, when an average of 168 MMBF was produced. The issue of whether the Native American's non-timber objectives can be better met by set-asides vs active management can affect harvest rates either by larger set-asides or less-intensive selective cuts. This study assumed 7% of their lands would not be managed or harvested.

Figure IV.16 shows the cumulative harvest volume over the 100-year projection period under the various harvest flow variants. The largest total harvest is associated with the unconstrained harvest flow constraint, followed by the harvest volumes associated with the ±25%, the ±5%, and the even-flow variations, respectively. Relative to the total harvest volume under the ±5% harvest flow constraints, the ±25% total harvest is 4.3% higher; the unconstrained total harvest volume is 6.8% higher; and the even-flow harvest is 3.8% lower over the total projection period.

Table IV.16 Annual harvest volumes for Native American (MMBF)

Inland	evenflow	5%	25%	unconst.	boost	-15%	-15%+boost	low	high
1995	128.12	133.93	172.12	240.27	172.11	115.16	144.85	240.27	858.77
2005	128.12	127.23	129.09	128.18	163.53	109.40	137.60	128.19	49.68
2015	128.12	133.59	117.84	145.13	155.33	114.88	130.71	116.47	84.53
2025	128.12	140.27	143.81	114.83	147.57	120.64	124.18	136.49	67.85
2035	128.12	147.29	179.77	170.85	140.19	126.65	117.96	180.44	97.87
2045	128.12	140.75	165.65	135.80	137.57	121.10	121.25	135.80	91.90
2055	128.12	133.72	124.24	161.36	137.50	115.06	120.64	161.32	144.28
2065	128.12	127.03	117.29	116.31	144.38	109.30	126.68	116.32	125.57
2075	128.12	133.38	146.61	126.18	151.60	114.78	133.02	147.83	139.76
2085	128.12	140.05	183.26	204.50	159.19	120.51	139.65	178.00	113.85
Central									
1995	168.79	173.05	175.61	209.79	220.78	148.81	191.24	172.49	1,126.94
2005	168.79	178.34	176.96	182.96	209.73	155.47	181.66	189.45	72.69
2015	168.79	173.78	166.00	194.10	202.79	147.70	173.46	162.23	260.10
2025	168.79	182.47	198.97	159.24	192.65	155.08	164.78	195.72	177.38
2035	168.79	184.90	166.29	195.05	183.01	159.13	156.55	167.07	98.42
2045	168.79	175.66	176.90	169.56	173.87	151.16	148.73	178.35	61.91
2055	168.79	171.62	187.05	167.89	165.16	150.81	141.28	183.97	154.70
2065	168.79	163.04	159.16	172.62	156.90	143.25	134.22	157.72	110.58
2075	168.79	162.83	163.59	152.64	164.75	138.33	140.93	166.01	168.42
2085	168.79	164.37	170.42	151.33	172.99	145.27	147.97	173.57	133.90
Both									
1995	296.91	306.98	347.73	450.06	392.89	263.98	336.09	412.76	1,985.70
2005	296.91	305.58	306.05	311.14	373.26	264.87	319.26	317.65	122.37
2015	296.91	307.37	283.84	339.23	358.12	262.58	304.17	278.71	344.62
2025	296.91	322.74	342.78	274.07	340.22	275.72	288.97	332.22	245.23
2035	296.91	332.19	346.06	365.90	323.20	285.78	274.51	347.51	196.28
2045	296.91	316.41	342.55	305.36	311.44	272.26	269.98	314.15	153.81
2055	296.91	305.34	311.29	329.25	302.66	265.87	261.92	345.29	298.98
2065	296.91	290.07	276.45	288.93	301.28	252.55	260.90	274.04	236.15
2075	296.91	296.21	310.20	278.82	316.36	253.10	273.96	313.84	308.17
2085	296.91	304.42	353.68	355.83	332.17	265.78	287.62	351.57	247.75

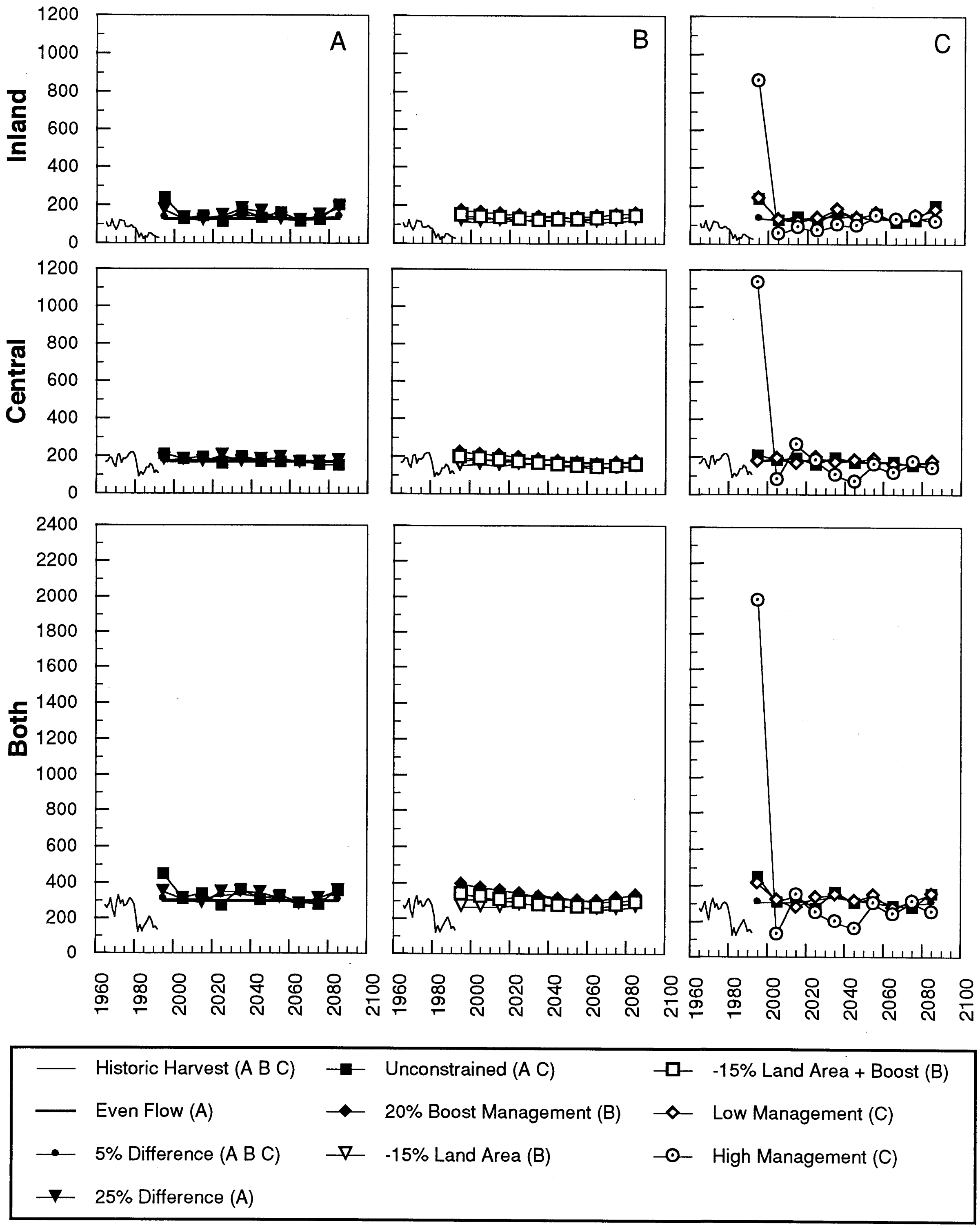


Figure IV. 15 Projections of average annual harvest (MMBF) by timbershed for Native American under four harvest flow variants for initial conditions and for five sensitivity analysis scenarios.

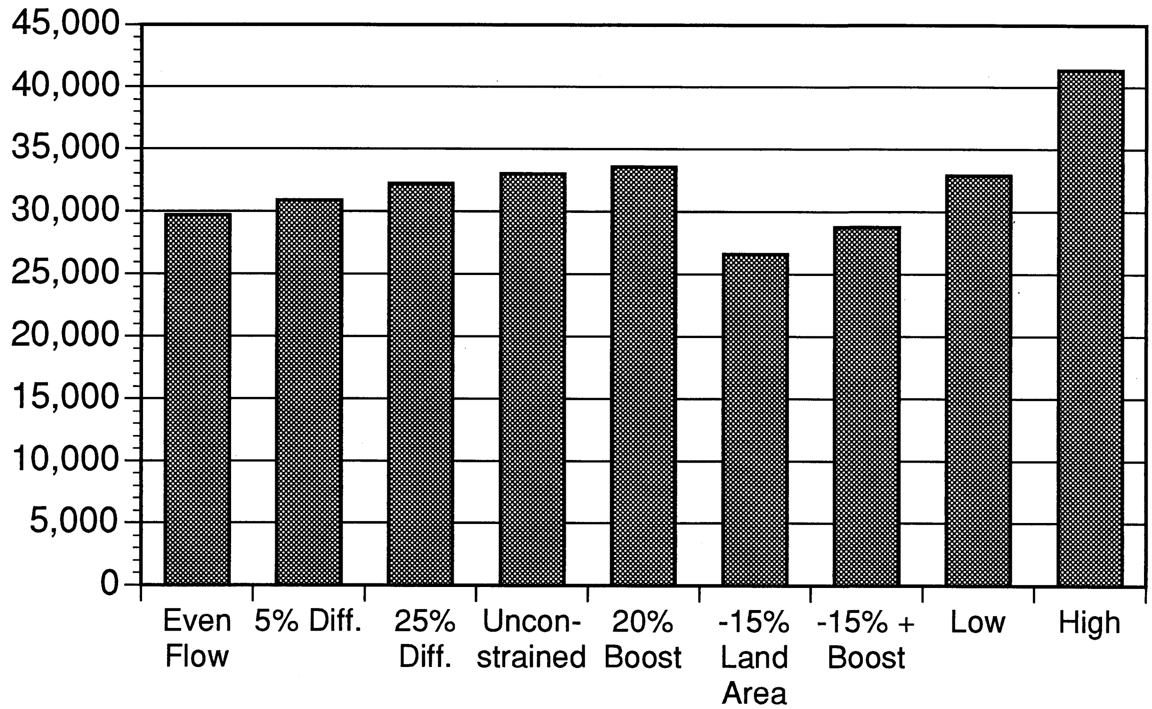


Figure IV. 16 Projection of cumulative harvest (MMBF) over 100 years for Native American under four harvest flow variants for initial conditions and for five sensitivity analysis scenarios.

Average Size of Harvested Timber. Table IV.17 and Figure IV.17 Panel A depict the time path of the quadratic mean diameter of harvested trees for Native American lands on the Eastside. The trends show that the quadratic mean diameter of harvested trees is projected to decline from an average of around 24-25 inches during the first decade of the projection period to 16-17 inches during the last decade. This trend of decreasing size holds for each timbershed when considered separately as well as in the aggregate. Mean diameter shows considerable variation in the Inland Empire timbershed, with the mean size decreasing from about 17-18 inches in the first decade to about 16 inches in the tenth decade. However, in the second decade average tree size increases to 25-26 inches and then begins to decline over the remaining decades. In the Central Cascades timbershed, mean diameter is expected to decrease from about 30-31 inches to 16-17 inches over the same time span. Clearly, the larger trees are being scheduled by the LP for harvest in the early decades in order to maintain the level of harvest.

The diameter of the stands on Native American lands is larger than for all owners throughout the projection period. At the beginning of the period the diameters are larger than for DNR, the other owner with substantial mature inventory, but by the end of the period they are comparable. Native American landowners may well adopt management regimes that maintain more large trees to accommodate non-timber objectives.

Table IV.17 Projections of harvested quadratic mean diameter (inches) for Native American

Inland	evenflow	5%	25%	unconst.	boost	-15%	-15%+boost	low	high
1995	17.30	17.40	18.20	27.30	18.20	14.80	22.20	27.30	16.80
2005	23.60	25.20	22.60	22.60	19.00	25.20	19.10	22.60	18.20
2015	21.40	21.40	19.90	20.30	15.50	23.10	18.10	20.30	15.10
2025	20.30	20.30	19.30	19.40	18.90	19.60	18.70	19.40	11.20
2035	19.20	15.10	15.10	15.10	15.10	19.40	15.10	15.10	13.20
2045	18.50	18.90	19.80	19.80	19.80	20.10	20.20	19.80	9.30
2055	18.30	17.60	17.00	17.00	14.90	17.60	14.90	17.00	13.00
2065	16.90	17.50	17.40	17.30	15.10	18.20	12.10	17.30	14.60
2075	16.90	16.90	17.20	17.30	17.30	16.80	17.20	17.30	16.90
2085	16.70	16.00	16.00	16.00	16.00	16.40	16.00	16.00	13.70
Central									
1995	31.30	30.00	31.10	31.10	20.50	29.60	20.70	31.00	11.30
2005	26.20	25.50	25.30	25.30	14.30	26.40	14.40	25.20	15.80
2015	22.40	22.60	23.20	23.20	18.30	22.60	18.80	23.00	13.30
2025	20.30	20.40	20.10	20.10	16.90	20.50	17.70	20.40	11.30
2035	20.10	19.70	19.60	19.60	16.10	19.20	15.80	19.60	11.60
2045	16.50	17.10	17.00	17.00	16.20	16.60	16.10	16.90	11.90
2055	18.10	18.00	17.90	17.90	15.80	18.00	15.60	17.70	11.90
2065	17.90	19.10	19.60	19.60	16.30	19.00	16.00	19.60	9.40
2075	18.40	18.00	17.60	17.60	14.30	17.70	14.50	17.70	12.40
2085	16.60	16.20	16.30	16.30	15.30	17.00	15.60	16.70	8.80
Both									
1995	24.90	24.30	25.20	29.40	19.40	22.90	21.40	29.30	13.80
2005	25.10	25.40	24.10	24.10	16.50	25.90	16.60	24.00	16.90
2015	21.90	22.00	21.70	21.80	17.00	22.80	18.50	21.70	14.10
2025	20.30	20.30	19.80	19.80	17.90	20.10	18.20	19.90	11.20
2035	19.70	17.60	17.50	17.50	15.60	19.30	15.50	17.50	12.30
2045	17.40	17.90	18.30	18.30	17.80	18.20	17.90	18.20	10.70
2055	18.20	17.80	17.40	17.40	15.40	17.80	15.30	17.40	12.40
2065	17.40	18.30	18.60	18.50	15.70	18.70	14.20	18.60	11.80
2075	17.70	17.50	17.40	17.50	15.70	17.30	15.70	17.50	14.50
2085	16.70	16.10	16.20	16.20	15.60	16.70	15.80	16.40	11.00

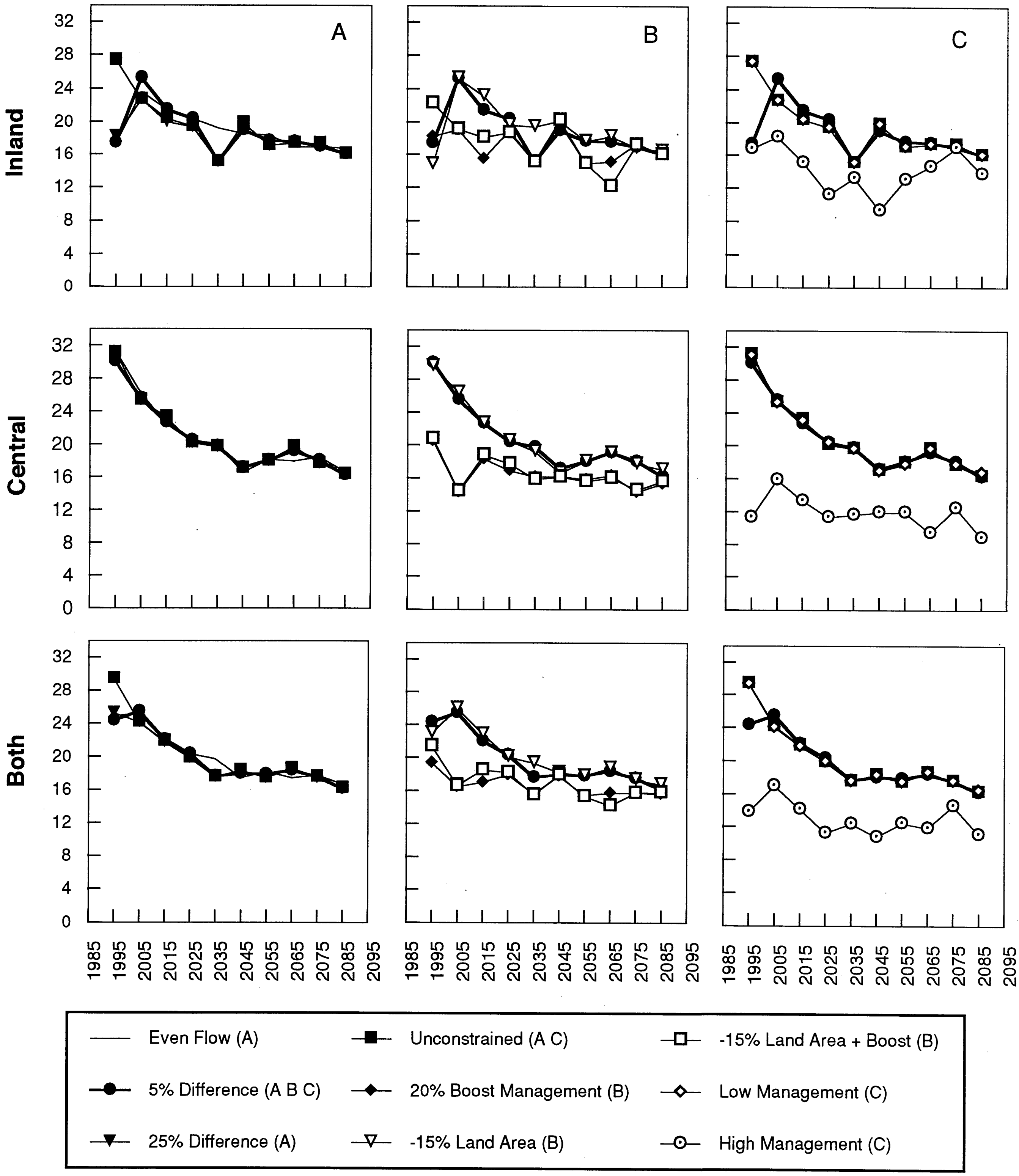
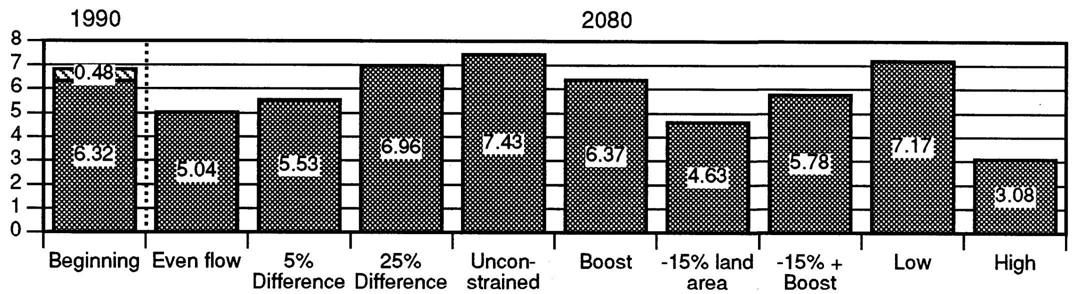


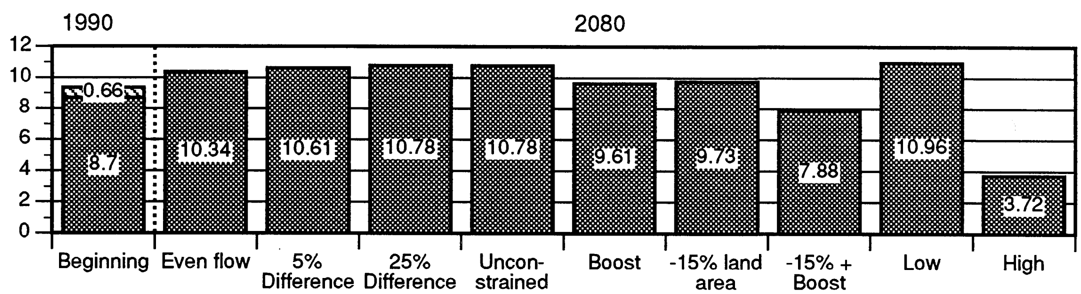
Figure IV.17 Projections of harvested quadratic mean diameter (inches) by timbershed for Native American under four harvest flow variants for initial conditions and for five sensitivity analysis scenarios.

Timber Inventory. At the start of the first decade of the 100-year projection period, the standing inventory on all Native American land was estimated at about 16 billion bd. ft., with 15 billion bd. ft. occurring on managed acres. At the end of the projection period the standing inventory is expected to increase to approximately 16 billion bd. ft. depending upon the harvest flow variant assumed. These results are depicted in Figure IV.18. The initial and projected tenth-decade inventory volumes stratified by timbershed show that about 60% of the ending inventory volume is contained in the Central Cascades timbershed. The substantial reduction in diameter with an increase in standing inventory, while producing a higher sustainable timber harvest over the projection period, implies that growth can increase with smaller trees. The variation in management across Native American timberlands is known to be large as it reflects both non-market values and considerations of forest health. It is therefore quite possible that larger-diameter trees will be retained in the inventory, thus slowing the rate of harvest and the decline in average size of harvested timber shown in the baseline results. However, based upon the assumptions of this study, which was focussed on timber production, the above harvest projections are presented.

Inland Empire



Central



Both

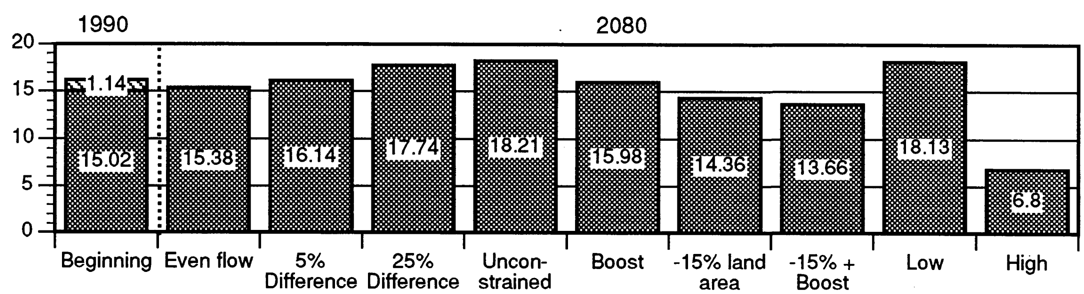


Figure IV.18 Forest inventory (billion bd.ft.) by timbershed in 1990 and 2080 for Native American under four harvest flow variants for initial conditions and for five sensitivity analysis scenarios. Crosshatched area in beginning period indicates inventory on unmanaged acres. Ending period inventories are on managed acres only.

Species Composition of Harvest. Tables IV.18-IV.20 depict species composition of the projected timber harvest over the 100-year projection period by timbershed and for the total Native American Eastside ownership. In the Central Cascades timbershed, the Native American harvest is composed primarily of ponderosa pine, grand fir, and Douglas-fir throughout the projection period. However, ponderosa pine makes up a steadily decreasing portion of the estimated harvest while grand fir and Douglas-fir increase. In the Inland Empire, the harvest over the entire projection period is composed largely of Douglas-fir and ponderosa pine. Grand fir makes up a significant portion of the estimated harvest in the first decade under some variants of the harvest flow constraints. For both timbersheds considered together, the harvest is composed primarily of Douglas-fir, ponderosa pine, and grand fir throughout the projection period. However, the percentage of the harvest contributed by ponderosa pine decreases while that of Douglas-fir and grand fir increase. Tables showing the impact of the five sensitivity analysis scenarios for forest industry on species composition are contained in Appendix 6.

Table IV.18 Projections of average annual harvest by species (MMBF) for Native American, in both timbersheds, under different harvest flow constraints.

SPECIES	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
					Even-Flow					
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	2.83
Western Larch	18.19	12.96	10.43	6.31	12.35	7.41	4.46	1.42	4.43	1.79
Douglas-fir	67.77	90.60	90.60	103.83	122.11	127.79	130.01	131.56	130.51	109.52
Grand fir	36.30	38.37	48.63	56.24	68.39	60.68	65.45	42.51	49.50	62.38
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	1.15	2.84	0.00	6.02	3.25	3.17	4.40
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.12	0.13
Engelman Spruce	11.21	6.33	1.47	3.14	3.35	6.33	6.01	13.52	2.07	2.30
Subapine fir	0.00	0.00	4.56	0.00	1.17	3.61	1.44	3.84	3.67	0.00
Ponderosa Pine	159.41	134.23	116.50	104.55	71.69	78.39	69.37	75.53	74.47	87.85
Other	3.52	13.92	24.20	21.20	14.46	12.29	13.69	24.67	27.62	24.04
					± 5%					
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	29.63
Western Larch	12.25	11.33	11.86	8.46	18.25	5.90	7.44	0.51	0.38	0.00
Douglas-fir	76.16	86.39	92.37	92.37	135.54	129.02	127.79	121.98	114.54	96.16
Grand fir	43.75	38.37	57.34	63.09	69.18	63.67	71.42	46.03	64.49	66.48
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.08	0.00	0.00	1.15	3.07	0.00	6.02	3.25	3.17	4.40
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.12	0.13
Engelman Spruce	15.48	10.93	0.00	1.15	2.97	6.33	6.01	13.52	2.07	2.30
Subapine fir	0.00	0.00	4.56	0.00	1.17	3.61	1.44	3.84	3.67	0.00
Ponderosa Pine	155.21	142.97	116.78	133.11	79.95	83.16	62.98	67.18	70.31	72.39
Other	3.54	15.06	23.97	22.83	21.47	24.27	21.78	33.26	36.16	30.83
					± 25%					
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
Western Larch	18.88	12.73	13.19	19.80	18.64	12.99	10.69	2.46	0.38	0.00
Douglas-fir	80.87	82.77	77.61	100.19	130.74	134.92	142.59	123.65	130.33	146.43
Grand fir	73.04	42.57	56.93	63.09	69.18	63.67	62.59	47.58	71.70	91.01
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	5.12	0.00	0.00	1.15	21.25	0.00	6.02	3.25	3.17	4.61
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00
Engelman Spruce	15.48	10.93	0.00	1.15	2.97	6.33	6.01	13.52	2.07	2.30
Subapine fir	0.00	0.00	4.56	0.00	1.17	3.61	1.44	3.84	3.67	0.00
Ponderosa Pine	148.48	141.48	107.11	133.37	80.38	96.51	60.96	53.66	69.56	77.00
Other	5.23	15.06	23.97	23.39	20.96	23.94	20.60	28.24	28.81	27.66
					Unconstrained					
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	28.44
Western Larch	21.67	17.21	13.57	18.47	15.60	12.09	10.69	2.46	0.38	0.00
Douglas-fir	100.94	82.77	100.80	99.53	117.79	129.96	152.93	121.94	128.05	134.47
Grand fir	114.38	42.57	56.93	63.09	69.18	63.67	85.24	47.58	71.70	102.50
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	7.94	0.00	0.00	1.15	31.46	0.00	6.02	3.25	3.17	4.74
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00
Engelman Spruce	15.48	10.93	0.00	1.15	2.97	6.33	6.01	13.52	2.07	2.30
Subapine fir	0.00	0.00	4.56	0.00	1.17	3.61	1.44	3.84	3.67	0.00
Ponderosa Pine	148.35	136.10	108.24	104.11	71.45	68.43	60.09	50.03	46.13	66.30
Other	6.15	15.06	26.45	25.84	26.85	28.19	25.44	32.54	33.88	34.03

Table IV.19 Projections of average annual harvest by species (MMBF) for Native American, in the Inland Empire Timbershed, under different harvest flow constraints.

SPECIES	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	Even-Flow									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
Western Larch	8.93	9.65	2.46	5.17	8.04	3.46	3.02	0.10	0.38	0
Douglas-fir	37.94	54.89	59.57	60.88	76.11	63.16	61.00	71.32	69.50	50.92
Grand fir	14.62	12.88	2.87	3.79	6.48	5.68	19.28	0	5.38	11.72
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	1.152	2.8416	0.00	6.016	3.25	3.17	4.40
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
Engelman Spruce	5.17	0.00	0.00	1.15	2.97	5.89	5.07	6.63	2.07	2.30
Subapine fir	0.00	0.00	4.56	0	0	3.61	0.59	1.18	2.41	0.00
Ponderosa Pine	60.93	50.23	49.02	48.97	28.83	40.68	28.70	33.25	34.30	54.48
Other	0.00	0.00	9.14	6.55	2.36	5.17	4.02	11.96	10.42	3.33
	± 5%									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	26.91
Western Larch	3.40	6.37	2.46	5.30	15.87	3.40	6.30	0.51	0.38	0.00
Douglas-fir	43.90	56.06	61.49	52.81	88.81	73.11	66.02	75.57	65.41	50.30
Grand fir	22.07	12.88	2.87	3.79	6.48	5.68	21.40	0.00	15.80	12.01
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.08	0.00	0.00	1.15	3.07	0	6.016	3.25	3.17	4.40
Lodgepole Pine	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
Engelman Spruce	5.17	0.00	0.00	1.15	2.97	5.89	5.07	6.63	2.07	2.30
Subapine fir	0.00	0.00	4.56	0.00	0.00	3.61	0.59	1.18	2.41	0.00
Ponderosa Pine	58.75	51.40	52.58	68.71	24.60	43.34	23.8336	27.57	32.31	39.99
Other	0.03	0	9.14	6.86	4.89	5.17	4.0192	11.96	11.52	3.17
	± 25%									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
Western Larch	3.40	6.37	2.61	7.53	9.47	3.40	6.30	2.46	0.38	0.00
Douglas-fir	51.48	49.92	48.49	58.47	91.01	78.49	71.65	74.96	81.89	95.36
Grand fir	51.35	17.08	2.87	3.79	6.48	5.68	9.73	0.00	15.80	32.41
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	5.12	0.00	0.00	1.15	21.25	0.00	6.02	3.25	3.17	4.61
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Engelman Spruce	5.17	0.00	0.00	1.15	2.97	5.89	5.07	6.63	2.07	2.30
Subapine fir	0.00	0.00	4.56	0.00	0.00	3.61	0.59	1.18	2.41	0.00
Ponderosa Pine	53.22	55.22	49.72	64.10	45.54	63.08	21.61	21.61	36.51	45.03
Other	1.72	0.00	9.14	7.07	2.36	4.84	2.84	6.94	4.17	0.00
	Unconstrained									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	28.44
Western Larch	6.20	10.85	3.00	6.20	6.43	2.51	6.30	2.46	0.38	0.00
Douglas-fir	71.55	49.92	71.68	57.80	78.05	73.52	82.00	73.24	79.62	83.40
Grand fir	92.70	17.08	2.87	3.79	6.48	5.68	32.38	0.00	15.80	43.90
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	7.94	0.00	0.00	1.15	31.46	0.00	6.02	3.25	3.17	4.74
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Engelman Spruce	5.17	0.00	0.00	1.15	2.97	5.89	5.07	6.63	2.07	2.30
Subapine fir	0.00	0.00	4.56	0.00	0.00	3.61	0.59	1.18	2.41	0.00
Ponderosa Pine	53.09	49.84	50.84	34.84	36.61	35.00	20.74	17.97	13.08	34.33
Other	2.64	0.00	11.62	9.52	8.24	9.09	7.68	11.24	9.24	6.37

Table IV.20 Projections of average annual harvest by species (MMBF) for Native American, in the Central Timbershed, under different harvest flow constraints.

SPECIES	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
					Even-Flow					
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	2.72
Western Larch	9.26	3.31	7.97	1.14	4.31	3.96	1.44	1.32	4.04	1.79
Douglas-fir	29.83	35.72	31.03	42.95	46.00	64.64	69.00	60.24	61.00	58.60
Grand fir	21.68	25.49	45.77	52.45	61.91	55.00	46.18	42.51	44.13	50.66
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.12	0.00
Engelman Spruce	6.04	6.33	1.47	1.99	0.38	0.44	0.94	6.89	0.00	0.00
Subapine fir	0.00	0.00	0.00	0.00	1.17	0.00	0.85	2.67	1.26	0.00
Ponderosa Pine	98.48	84.00	67.48	55.58	42.87	37.71	40.67	42.28	40.17	33.37
Other	3.52	13.92	15.06	14.65	12.10	7.12	9.67	12.72	17.20	20.72
					± 5%					
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	2.72
Western Larch	8.85	4.95	9.41	3.16	2.37	2.49	1.14	0.00	0.00	0.00
Douglas-fir	32.26	30.33	30.88	39.56	46.73	55.90	61.76	46.41	49.14	45.85
Grand fir	21.68	25.49	54.47	59.30	62.70	57.98	50.02	46.03	48.70	54.47
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.12	0.00
Engelman Spruce	10.31	10.93	0.00	0.00	0.00	0.44	0.94	6.89	0.00	0.00
Subapine fir	0.00	0.00	0.00	0.00	1.17	0.00	0.85	2.67	1.26	0.00
Ponderosa Pine	96.46	91.56	64.20	64.40	55.35	39.82	39.14	39.61	38.00	32.41
Other	3.52	15.06	14.83	15.97	16.58	19.10	17.76	21.30	24.64	27.66
					± 25%					
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Larch	15.47	6.36	10.58	12.28	9.17	9.58	4.40	0.00	0.00	0.00
Douglas-fir	29.39	32.85	29.12	41.72	39.73	56.43	70.94	48.70	48.43	51.07
Grand fir	21.68	25.49	54.06	59.30	62.70	57.98	52.86	47.58	55.90	58.60
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00
Engelman Spruce	10.31	10.93	0.00	0.00	0.00	0.44	0.94	6.89	0.00	0.00
Subapine fir	0.00	0.00	0.00	0.00	1.17	0.00	0.85	2.67	1.26	0.00
Ponderosa Pine	95.25	86.26	57.40	69.27	34.84	33.43	39.35	32.05	33.05	31.97
Other	3.52	15.06	14.83	16.32	18.61	19.10	17.76	21.30	24.64	27.66
					Unconstrained					
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Larch	15.47	6.36	10.58	12.28	9.17	9.58	4.40	0.00	0.00	0.00
Douglas-fir	29.39	32.85	29.12	41.72	39.73	56.43	70.94	48.70	48.43	51.07
Grand fir	21.68	25.49	54.06	59.30	62.70	57.98	52.86	47.58	55.90	58.60
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00
Engelman Spruce	10.31	10.93	0.00	0.00	0.00	0.44	0.94	6.89	0.00	0.00
Subapine fir	0.00	0.00	0.00	0.00	1.17	0.00	0.85	2.67	1.26	0.00
Ponderosa Pine	95.25	86.26	57.40	69.27	34.84	33.43	39.35	32.05	33.05	31.97
Other	3.52	15.06	14.83	16.32	18.61	19.10	17.76	21.30	24.64	27.66

Nonindustrial

Under Initial Conditions. The estimated timber harvest volume over the 100-year projection period for nonindustrial lands is summarized in Table IV.21 and Figure IV.19 Panel A. Shown are the average annual timber harvest volumes in Scribner board feet by decade for each timbershed and for all nonindustrial lands on the Eastside. Results are presented for each of the four timber harvest flow variants examined in this study. Also shown in Figure IV.19 is the historical timber harvest volume for the period 1965-92. These should be used solely to provide perspective vis a vis the projected harvest volumes.

One striking feature shown in Figure IV.19 Panel A is that there is considerable variation in projected harvests in both timbersheds. The second striking feature shown in Figure IV.19 Panel A is that projected timber harvest volumes over the next 100 years in both timbersheds are generally higher than historic levels of harvest. As shown in Table IV.21 projected levels of harvest are expected to be around 80-100 MMBF in the Central Cascades timbershed under the four timber harvest flow variants and 235-275 MMBF in the Inland Empire timbershed. In both timbersheds, projections indicate a rising potential harvest level over the 100-year period. For both timbersheds, the combined harvest could be sustained at about 330-350 MMBF over the 100-year projection period. While this is an increase over historic levels of harvest of 193 MMBF from 1985-92, it is sustainable over the projection period based on the FIA survey and management assumptions.

Figure IV.20 shows the cumulative harvest volume over the 100-year projection period under the harvest flow variants. Contrary to all other modeled ownerships, the largest total harvest is associated with the ±5% harvest flow variant, followed by the harvest volumes associated with the ±25% and the unconstrained variations, respectively. Relative to the total harvest volume under the ±5% harvest flow constraints, the ±25% total harvest and the unconstrained total harvest volumes are less than 0.3% lower. Thus, all projected total harvest volumes are about equal over the 100-year projection period. The difference between the first decade timber harvest and historic harvest levels is also the largest of all modeled owners. This large departure from history reduces the significance of differences among the even-flow timber harvest variant results as they are all substantial departures from the historical period.

Table IV.21 Annual harvest volume for nonindustrial (MMBF)

Inland	evenflow	5%	25%	unconst.	boost	-15%	-15%+boost	low	high
1995	.	231.85	241.43	241.43	273.14	233.92	262.58	241.43	549.58
2005	.	223.93	203.17	173.25	259.48	212.29	249.45	214.35	104.25
2015	.	235.13	253.96	259.27	272.46	265.36	261.92	304.99	201.96
2025	.	246.89	265.33	248.86	258.83	227.34	248.83	242.32	198.75
2035	.	259.23	254.85	263.57	271.77	250.31	239.19	288.19	238.74
2045	.	272.19	318.56	283.77	279.10	257.09	251.15	280.17	228.68
2055	.	285.80	238.92	251.19	285.73	220.56	253.82	248.64	301.58
2065	.	271.51	298.65	295.53	300.02	260.49	266.51	284.86	246.68
2075	.	276.84	269.12	257.18	313.61	246.57	278.66	257.41	367.85
2085	.	290.68	237.70	305.18	329.29	264.07	292.60	285.43	221.86
Central									
1995	85.72	99.21	110.68	110.68	102.70	90.30	93.67	110.68	190.10
2005	85.72	94.25	93.72	69.49	97.57	85.79	88.99	98.88	55.58
2015	85.72	89.54	75.35	97.12	92.69	81.50	84.54	86.63	60.55
2025	85.72	85.06	91.67	85.75	88.05	77.42	80.31	84.70	26.03
2035	85.72	80.81	76.73	76.55	83.65	73.55	77.36	74.53	92.12
2045	85.72	79.68	89.25	85.22	85.68	77.23	81.23	86.88	53.25
2055	85.72	83.67	70.48	74.35	89.97	75.22	85.29	74.28	104.60
2065	85.72	87.85	88.10	77.13	94.47	78.98	89.55	91.95	82.66
2075	85.72	92.24	104.68	107.02	99.19	82.93	94.03	84.58	142.56
2085	85.72	96.86	96.66	110.23	104.15	87.07	98.73	121.08	83.02
Both									
1995	.	331.07	352.11	352.11	375.84	324.22	356.25	352.11	739.68
2005	.	318.19	296.89	242.74	357.05	298.08	338.44	313.23	159.83
2015	.	324.67	329.31	356.39	365.15	346.86	346.46	391.62	262.51
2025	.	331.95	356.99	334.61	346.88	304.76	329.14	327.02	224.78
2035	.	340.04	331.58	340.12	355.42	323.86	316.55	362.72	330.86
2045	.	351.88	407.81	368.99	364.78	334.32	332.38	367.05	281.93
2055	.	369.47	309.40	325.54	375.70	295.78	339.11	322.92	406.18
2065	.	359.36	386.75	372.66	394.49	339.47	356.06	376.81	329.34
2075	.	369.08	373.79	364.20	412.80	329.50	372.69	341.99	510.41
2085	.	387.53	334.35	415.41	433.44	351.14	391.33	406.51	304.88

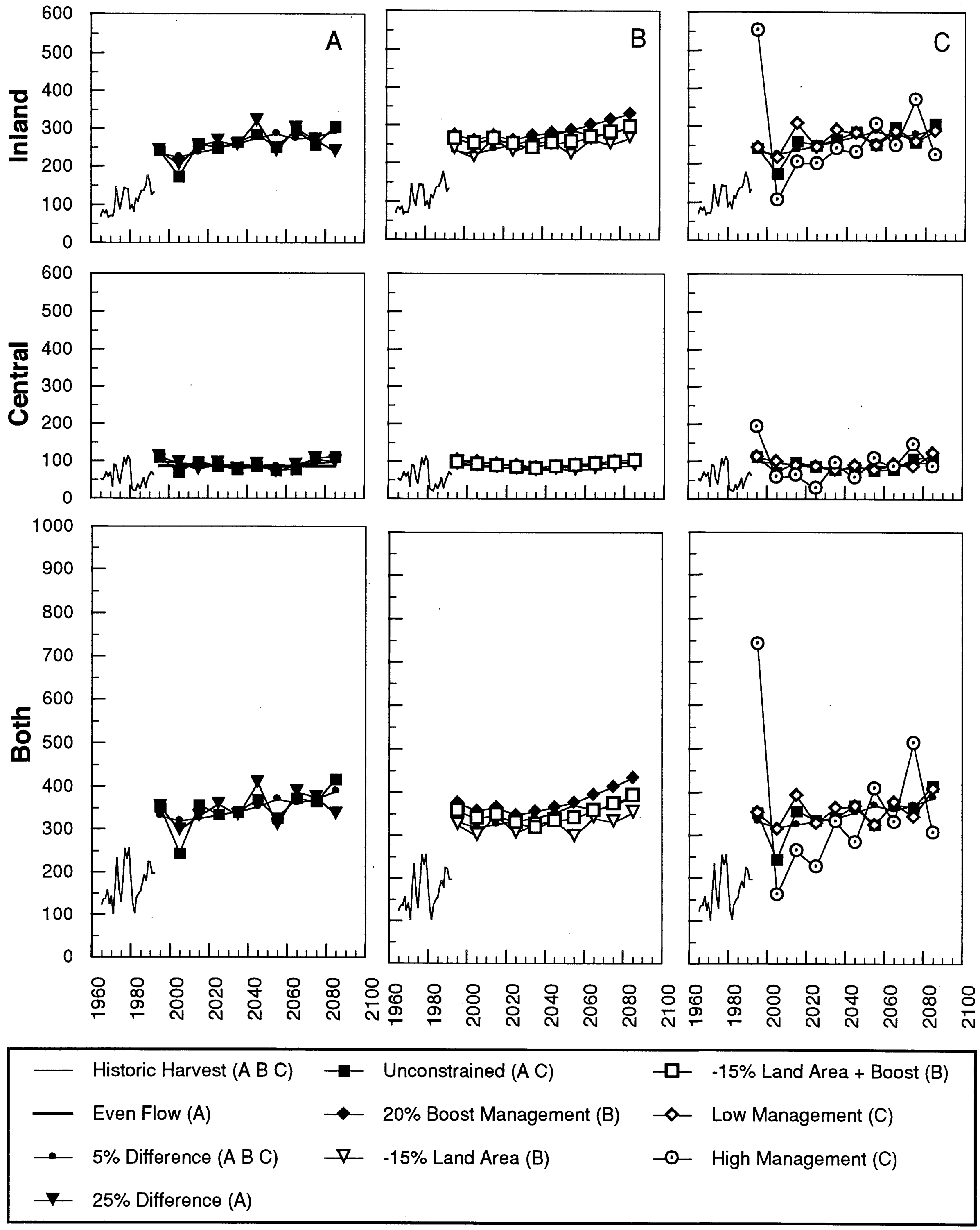


Figure IV.19 Projections of average annual harvest (MMBF) by timbershed for nonindustrial under four harvest flow variants for initial conditions and for five sensitivity analysis scenarios.

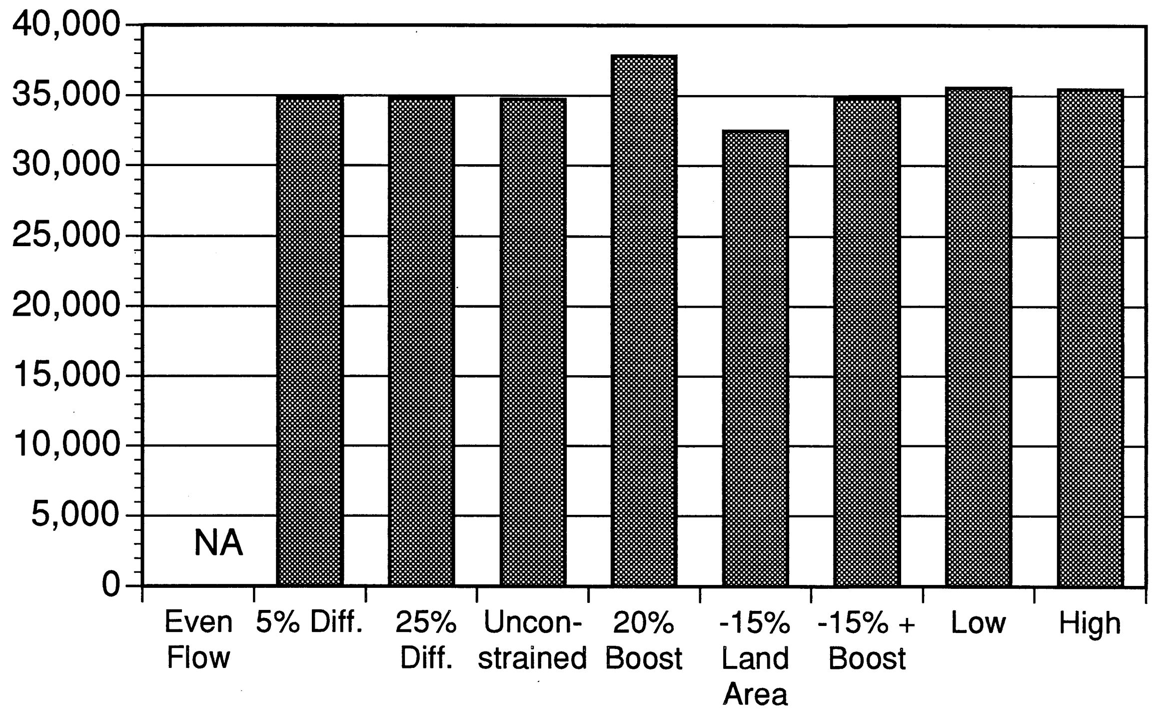


Figure IV. 20 Projection of cumulative harvest (MMBF) over 100 years for nonindustrial under four harvest flow variants for initial conditions and for five sensitivity analysis scenarios.

Average Size of Harvested Timber. Table IV.22 and Figure IV.21 Panel A depict the time path of the quadratic mean diameter of harvested trees for nonindustrial lands on the Eastside. The trends show that the quadratic mean diameter of harvested trees is projected to decline from an average of around 20-21 inches during the first decade of the projection period to 14-15 inches during the last decade. This trend of decreasing size holds for each timbershed when considered separately as well as in the aggregate. By the end of the projection period, the Central Cascades area will produce slightly smaller trees than the Inland Empire area, although at the beginning of the projection period the opposite is true.

Table IV.22 Projections of harvested quadratic mean diameter (inches) for nonindustrial

Inland	evenflow	5%	25%	unconst.	boost	-15%	-15%+boost	low	high
1995	.	20.00	20.10	20.10	16.30	19.80	16.20	20.40	12.80
2005	.	19.20	15.60	15.70	16.20	18.50	16.20	18.60	9.10
2015	.	14.10	14.10	14.20	14.20	15.50	15.10	15.70	11.80
2025	.	17.40	17.10	17.20	15.10	16.80	15.50	17.00	8.60
2035	.	17.00	17.00	17.00	15.30	17.10	15.30	17.20	13.00
2045	.	13.60	13.70	13.70	16.30	16.80	16.30	16.80	13.10
2055	.	16.30	15.80	16.20	12.70	16.10	12.70	16.00	13.10
2065	.	13.30	13.40	12.30	12.90	12.50	13.30	13.40	11.30
2075	.	13.00	13.10	13.00	14.80	15.30	14.70	15.40	10.70
2085	.	15.20	15.10	15.00	13.80	13.20	13.80	13.30	8.80
Central									
1995	23.80	24.10	21.50	21.90	16.40	22.10	16.60	22.90	13.10
2005	21.30	20.20	20.10	20.00	16.00	20.00	16.80	19.60	11.60
2015	16.90	16.60	16.50	18.90	19.50	19.00	19.20	18.70	17.60
2025	18.20	18.00	18.20	18.30	18.00	17.40	21.40	17.80	12.20
2035	17.50	18.20	18.70	18.70	14.90	18.10	14.50	18.50	11.90
2045	17.20	16.80	17.10	17.10	16.30	16.90	16.30	17.00	9.70
2055	13.10	17.30	17.10	17.40	13.70	13.30	13.30	17.30	15.60
2065	17.10	16.80	17.20	17.40	15.00	16.80	16.50	17.10	11.50
2075	16.90	16.00	16.10	13.90	14.20	13.90	14.10	14.00	14.50
2085	13.20	13.00	13.80	14.30	12.50	13.10	12.80	13.10	13.90
Both									
1995	.	21.10	20.50	20.50	16.30	20.40	16.30	21.00	12.90
2005	.	19.40	16.80	16.80	16.20	18.90	16.40	18.80	9.70
2015	.	14.80	14.80	15.40	15.60	16.40	16.20	16.50	13.30
2025	.	17.50	17.40	17.50	15.90	17.00	17.10	17.20	9.60
2035	.	17.30	17.50	17.50	15.20	17.40	15.10	17.50	12.70
2045	.	14.40	14.60	14.60	16.30	16.80	16.30	16.90	12.20
2055	.	16.60	16.20	16.50	12.90	15.30	12.90	16.30	13.80
2065	.	14.30	14.40	13.60	13.50	13.60	14.10	14.40	11.40
2075	.	13.80	13.90	13.20	14.60	15.00	14.60	15.00	11.70
2085	.	14.70	14.70	14.80	13.50	13.20	13.50	13.20	10.10

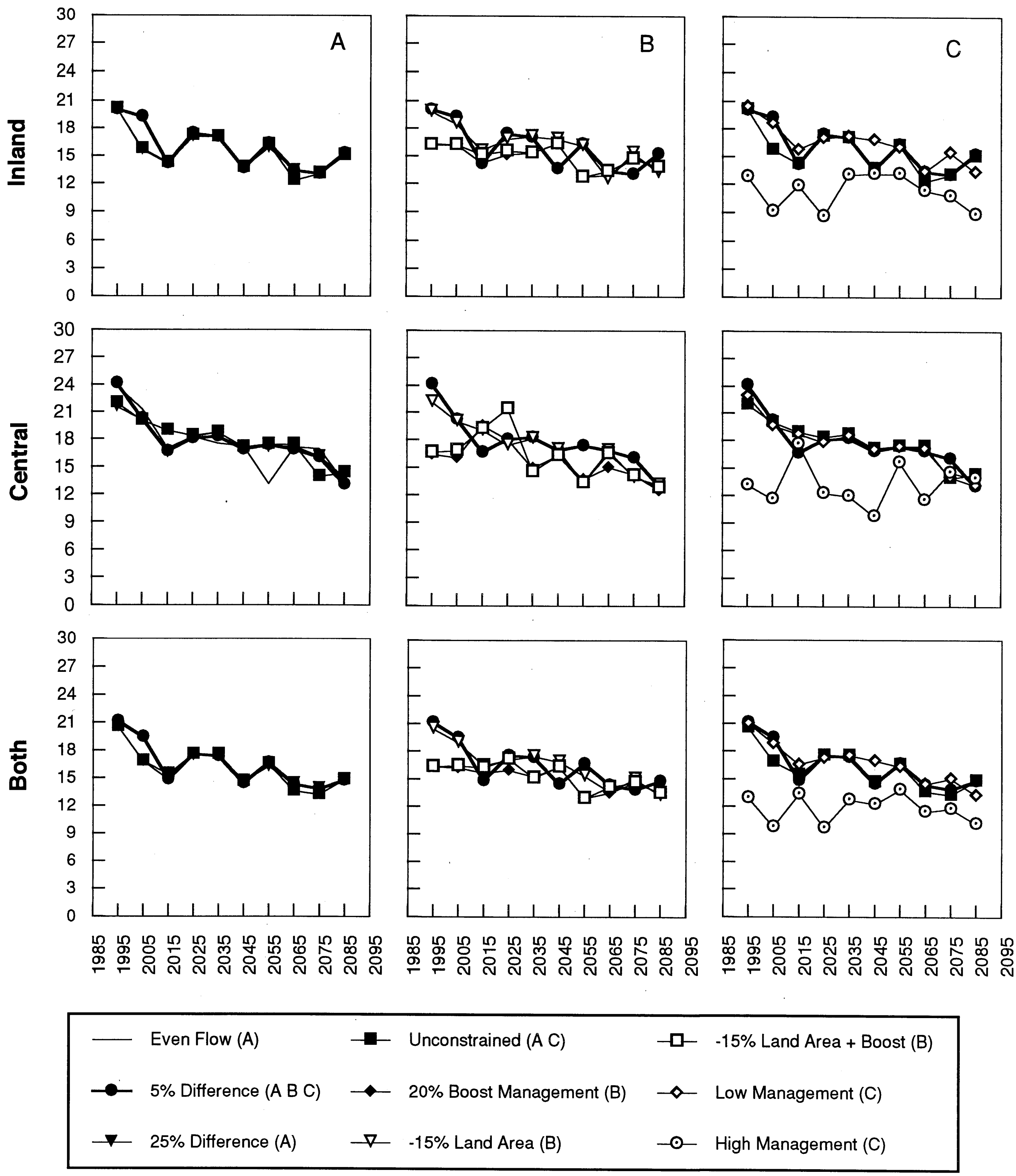


Figure IV.21 Projections of harvested quadratic mean diameter (inches) by timbershed for nonindustrial under four harvest flow variants for initial conditions and for five sensitivity analysis scenarios.

Timber Inventory. At the start of the first decade of the 100-year projection period, the standing inventory on all nonindustrial land was estimated at about 14 billion bd. ft., with 13.5 billion bd. ft. occurring on managed land. At the end of the projection period the standing inventory is expected to increase to approximately 16 billion bd. ft., varying slightly depending upon the harvest flow variant assumed. These results are depicted in Figure IV.22. The unmanaged areas were few in number and exclusive to the Central timbershed, so the proper inventory comparison from the end of the period to the beginning would include the unmanaged acres--unlike the other owners. The initial and projected tenth-decade inventory volumes stratified by timbershed show that about 70% of the ending inventory volume is contained in the Inland Empire timbershed. The inventory per acre is the lowest of any ownership group although increasing. The nonindustrial owners have the capacity to increase their standing inventory over the next 100 years, while simultaneously increasing their rates of harvest.

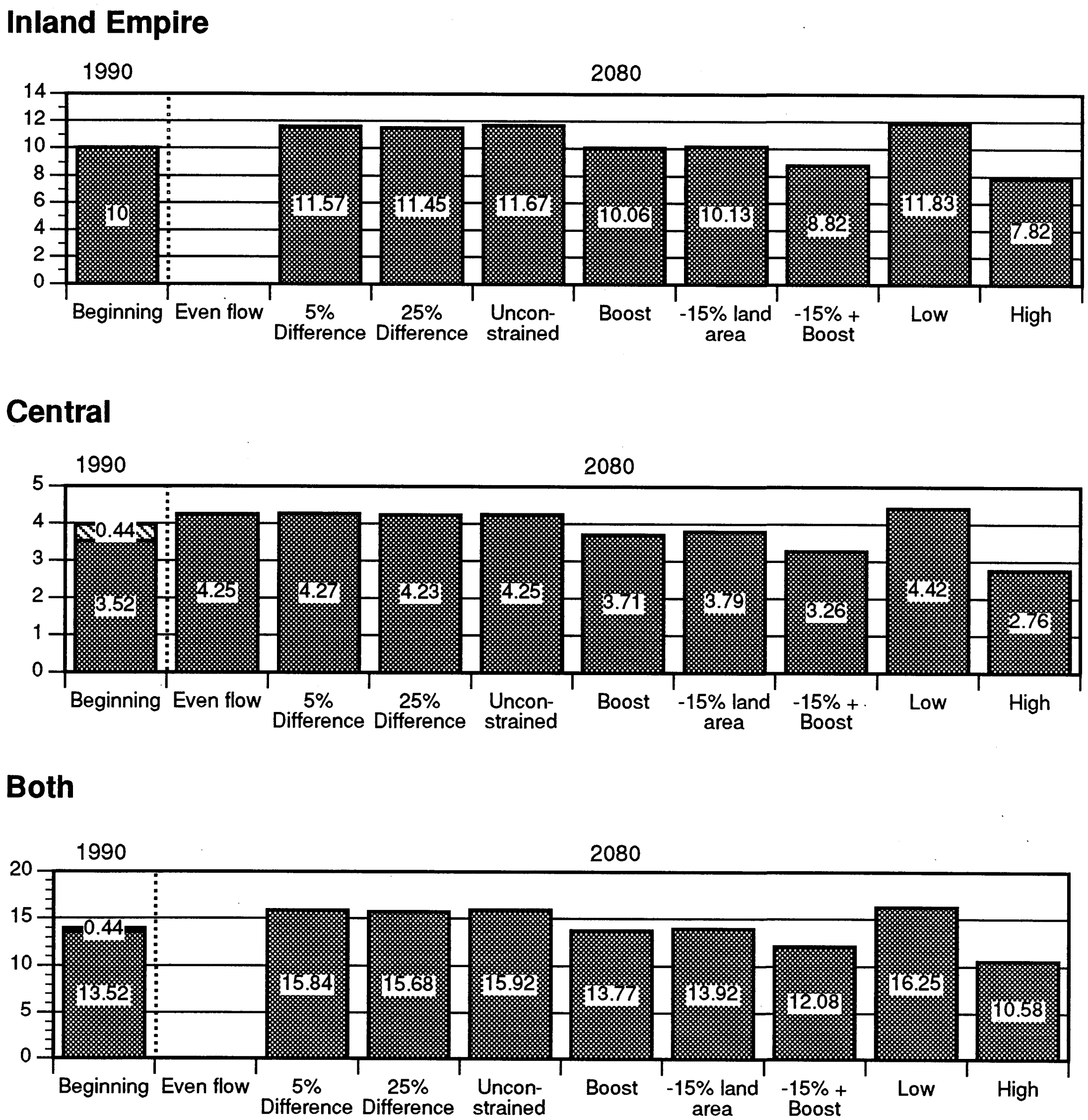


Figure IV.22 Forest inventory (billion bd.ft.) by timbershed in 1990 and 2080 for nonindustrial under four harvest flow variants for initial conditions and for five sensitivity analysis scenarios. Crosshatched area in beginning period indicates inventory on unmanaged acres. Ending period inventories are on managed acres only.

Species Composition of Harvest. Tables IV.23-IV.25 depict the species composition of the projected timber harvest over the 100-year projection period by timbershed and for the total nonindustrial Eastside ownership. In the Central Cascades timbershed, the nonindustrial harvest is composed primarily of Douglas-fir, ponderosa pine, and grand fir throughout the projection period. However, ponderosa pine makes up a steadily decreasing portion of the estimated harvest while grand fir and Douglas-fir increase. In the Inland Empire, the harvest over the entire projection period is composed largely of Douglas-fir, ponderosa pine, and grand fir. For both timbersheds considered together, the harvest is composed primarily of Douglas-fir, ponderosa pine, and grand fir throughout the projection period.

Table IV.23 Projections of average annual harvest by species (MMBF) for nonindustrial, in both timbersheds, under different harvest flow constraints.

SPECIES	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	YEAR									
	Even-Flow									
—	-	-	-	-	-	-	-	-	-	-
	± 5%									
White Pine	3.03	2.04	0.00	1.81	0.00	0.00	0.00	3.92	15.86	10.84
Western Larch	12.71	17.75	21.37	8.04	17.36	9.33	10.96	16.45	15.57	9.32
Douglas-fir	116.13	122.03	114.22	143.95	140.49	158.53	156.02	154.17	151.46	175.29
Grand fir	37.91	26.23	35.62	29.78	38.09	31.81	35.76	38.51	23.07	26.89
Western Hemlock	0.00	0.00	0.85	3.01	2.49	1.98	0.00	0.12	1.67	0.76
Western Redcedar	8.82	1.56	8.68	9.84	11.24	7.89	6.98	10.72	7.82	6.48
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	1.50	9.51
Engelman Spruce	0.00	1.10	1.14	0.75	0.00	0.23	0.82	1.89	1.23	2.61
Subapine fir	1.61	2.69	3.11	2.65	0.45	1.59	2.94	2.66	3.86	2.40
Ponderosa Pine	113.38	104.66	110.05	108.50	112.62	119.12	132.99	102.43	116.40	125.91
Other	37.77	40.15	29.63	23.64	17.32	21.34	22.77	27.66	28.81	14.96
	± 25%									
White Pine	3.03	2.04	0.00	1.81	0.00	0.00	0.00	3.92	15.86	12.74
Western Larch	14.14	16.32	19.53	9.76	16.46	9.14	11.99	16.57	16.60	8.34
Douglas-fir	126.70	108.59	118.67	156.79	134.92	169.76	141.35	152.39	166.99	147.52
Grand fir	37.91	26.23	32.03	37.33	33.58	35.50	32.25	42.03	24.01	18.40
Western Hemlock	0.00	0.00	0.85	3.01	2.49	1.98	0.00	0.15	1.65	0.76
Western Redcedar	8.82	1.56	8.03	10.48	11.24	7.89	6.98	10.78	7.77	6.48
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	1.50	6.64
Engelman Spruce	0.00	1.10	1.14	0.75	0.00	0.23	0.82	1.89	1.23	2.61
Subapine fir	1.61	2.69	2.21	3.54	0.45	1.59	2.94	2.66	3.86	2.42
Ponderosa Pine	122.02	103.79	110.97	113.54	114.34	154.62	94.74	126.68	106.51	108.62
Other	38.18	34.60	35.87	20.01	18.10	26.96	18.15	28.72	25.96	17.54
	Unconstrained									
White Pine	3.03	2.04	0.00	1.81	0.00	0.00	0.00	3.92	8.82	23.85
Western Larch	14.14	16.32	17.52	11.76	15.99	9.19	10.21	17.62	14.22	11.22
Douglas-fir	126.70	87.99	132.47	145.92	141.15	150.91	137.69	155.64	159.47	186.21
Grand fir	37.91	26.23	31.33	33.39	35.92	31.94	34.88	43.15	21.37	20.42
Western Hemlock	0.00	0.00	0.85	3.01	2.49	1.98	0.00	0.15	1.65	0.76
Western Redcedar	8.82	1.56	8.94	9.57	11.24	7.89	6.98	10.78	7.77	6.48
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	1.50	7.00
Engelman Spruce	0.00	1.10	1.14	0.75	0.00	0.23	0.82	1.89	1.23	2.61
Subapine fir	1.61	2.69	2.21	3.54	0.45	1.59	2.94	2.66	3.86	2.40
Ponderosa Pine	122.02	77.14	121.43	103.69	113.66	140.79	112.63	107.98	114.98	136.40
Other	38.18	27.69	40.49	21.19	19.21	24.42	19.12	27.91	28.13	14.65

Table IV.24 Projections of average annual harvest by species (MMBF) for nonindustrial, in the Inland Empire Timbershed, under different harvest flow constraints.

SPECIES	YEAR 1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	Even-Flow									
—	-	-	-	-	-	-	-	-	-	-
	± 5%									
White Pine	3.03	2.04	0	1.81	0%	0	0	2.62	5.19	4.04
Western Larch	10.09	15.36	19.39	6.88	14.13	8.82	10.85	14.54	14.95	7.44
Douglas-fir	70.31	85.01	85.14	108.36	107.93	119.81	120.91	100.81	114.68	128.68
Grand fir	21.91	16.11	22.80	18.42	26.65	19.62	24.79	31.74	14.93	24.24
Western Hemlock	0.00	0.00	0.85	3.01	2.49	1.98	0.00	0.12	1.67	0.76
Western Redcedar	8.82	1.56	8.68	9.84	11.24	7.89	6.98	10.72	7.82	6.48
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	1.05	5.92
Engelman Spruce	0.00	1.10	1.14	0.00	0.00	0.00	0.82	1.89	1.23	2.61
Subapine fir	0.00	0.00	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ponderosa Pine	89.26	80.85	79.21	82.79	84.03	98.08	110.26	88.84	97.90	100.07
Other	28.45	21.93	17.04	15.80	12.75	15.93	11.08	19.62	16.13	8.87
	± 25%									
White Pine	3.03	2.04	0	1.81	0%	0	0	2.62	5.19	5.95
Western Larch	11.52	13.93	17.54	8.59	13.23	8.64	11.89	14.66	15.98	6.46
Douglas-fir	75.60	77.31	93.05	118.23	103.17	128.70	104.43	107.04	118.07	103.58
Grand fir	21.91	16.11	22.66	22.99	21.66	23.31	21.29	35.27	15.86	15.74
Western Hemlock	0.00	0.00	0.85	3.01	2.49	1.98	0.00	0.15	1.65	0.76
Western Redcedar	8.82	1.56	8.03	10.48	11.24	7.89	6.98	10.78	7.77	6.48
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	1.05	2.01
Engelman Spruce	0.00	1.10	1.14	0.00	0.00	0.00	0.82	1.89	1.23	2.61
Subapine fir	0.00	0.00	0.00	0.89	0.00	0.00	0.00	0.00	0.00	0.02
Ponderosa Pine	92.12	75.93	86.87	84.70	90.14	128.54	84.51	104.35	87.87	82.13
Other	28.45	15.22	23.82	14.63	12.89	19.38	8.96	21.17	13.14	11.02
	Unconstrained									
White Pine	3.03	2.04	0.00	1.81	0.00	0.00	0.00	2.62	5.19	10.03
Western Larch	11.52	13.93	15.54	10.60	12.76	8.69	10.11	16.67	12.63	10.00
Douglas-fir	75.60	64.75	99.45	109.47	110.29	114.14	98.62	116.47	105.97	137.65
Grand fir	21.91	16.11	21.96	19.06	24.00	22.02	24.58	33.44	13.22	17.77
Western Hemlock	0.00	0.00	0.85	3.01	2.49	1.98	0.00	0.15	1.65	0.76
Western Redcedar	8.82	1.56	8.94	9.57	11.24	7.89	6.98	10.78	7.77	6.48
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	1.05°	2.38
Engelman Spruce	0.00	1.10	1.14	0.00	0.00	0.00	0.82	1.89	1.23	2.61
Subapine fir	0.00	0.00	0.00	0.89	0.00	0.00	0.00	0.00	0.00	0.00
Ponderosa Pine	92.12	61.28	87.15	78.66	88.76	112.18	100.01	92.52	92.31	107.48
Other	28.45	12.51	24.24	15.81	14.00	16.83	9.93	20.36	15.31	8.13

Table IV.25 Projections of average annual harvest by species (MMBF) for nonindustrial, in the Central Timbershed, under different harvest flow constraints.

SPECIES	YEAR 1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	Even-Flow									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	1.34	1.30	3.56	6.85
Western Larch	2.62	2.39	1.98	1.16	2.76	0.47	0.61	1.91	0.63	0.82
Douglas-fir	42.53	37.41	22.88	37.74	32.52	39.28	40.41	47.10	41.92	37.59
Grand fir	12.60	12.63	8.19	15.34	11.96	13.20	10.64	6.85	6.44	3.86
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.12	2.00
Engelman Spruce	0.00	0.00	0.00	0.75	0.00	0.23	0.00	0.00	0.00	0.00
Subapine fir	0.77	2.49	2.64	3.26	0.36	1.15	3.24	2.81	3.95	2.40
Ponderosa Pine	19.81	19.82	30.50	21.96	31.16	22.80	22.89	16.27	18.33	21.71
Other	7.66	10.97	19.52	5.50	6.95	8.62	6.46	9.16	10.42	9.56
	± 5%									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.30	10.67	6.79
Western Larch	2.62	2.39	1.98	1.16	3.23	0.51	0.10	1.91	0.63	1.88
Douglas-fir	45.82	37.02	29.08	35.59	32.56	38.72	35.11	53.35	36.78	46.61
Grand fir	16.00	10.12	12.83	11.36	11.44	12.19	10.97	6.76	8.15	2.65
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45	3.59
Engelman Spruce	0.00	0.00	0.00	0.75	0.00	0.23	0.00	0.00	0.00	0.00
Subapine fir	1.61	2.69	2.21	2.65	0.45	1.59	2.94	2.66	3.86	2.40
Ponderosa Pine	24.12	23.81	30.85	25.71	28.60	21.04	22.73	13.59	18.50	25.84
Other	9.32	18.22	12.59	7.84	4.57	5.40	11.68	8.04	12.68	6.10
	± 25%									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.30	10.67	6.79
Western Larch	2.62	2.39	1.98	1.16	3.23	0.51	0.10	1.91	0.63	1.88
Douglas-fir	51.09	31.28	25.62	38.56	31.75	41.07	36.93	45.35	48.92	43.94
Grand fir	16.00	10.12	9.37	14.34	11.92	12.19	10.97	6.76	8.15	2.65
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45	4.63
Engelman Spruce	0.00	0.00	0.00	0.75	0.00	0.23	0.00	0.00	0.00	0.00
Subapine fir	1.61	2.69	2.21	2.65	0.45	1.59	2.94	2.66	3.86	2.40
Ponderosa Pine	29.90	27.86	24.10	28.84	24.20	26.08	10.22	22.32	18.64	26.49
Other	9.72	19.38	12.06	5.38	5.21	7.58	9.19	7.56	12.82	6.52
	Unconstrained									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.30	3.64	13.83
Western Larch	2.62	2.39	1.98	1.16	3.23	0.51	0.10	0.95	1.59	1.22
Douglas-fir	51.09	23.24	33.02	36.45	30.86	36.77	39.08	39.17	53.51	48.56
Grand fir	16.00	10.12	9.37	14.34	11.92	9.92	10.29	9.70	8.15	2.65
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45	4.63
Engelman Spruce	0.00	0.00	0.00	0.75	0.00	0.23	0.00	0.00	0.00	0.00
Subapine fir	1.61	2.69	2.21	2.65	0.45	1.59	2.94	2.66	3.86	2.40
Ponderosa Pine	29.90	15.87	34.28	25.04	24.90	28.61	12.61	15.46	22.68	28.92
Other	9.72	15.18	16.25	5.38	5.21	7.58	9.19	7.56	12.82	6.52

US Forest Service

Under Initial Conditions. The expected timber harvest levels for the national forests are not modeled but are taken from available forest plans and other relevant documents. Much uncertainty surrounds current and future levels of sustained timber production from these lands. This is largely due to the reductions in timber harvest required to support populations of the spotted owl and wild salmon stocks and to issues related to forest ecosystem health.[2]

Five national forests lie wholly or in part in Eastern Washington. Two of these, the Wenatchee and a portion of the Okanogan, lie within the range of the northern spotted owl. The remaining three, the Colville, Umatilla, and Panhandle plus a portion of the Okanagon, lie to the east of the spotted owl's range. Thus, we speak of "owl forests" and "non-owl forests" with reference to these two categories. Probable sale quantities (PSQ) for owl forests are reported in the Final SEIS (see footnote two, below). These represent likely harvest levels under Option 9 (the Administration's preferred alternative) that can be maintained under a nondeclining flow policy over the long term and are based on lands considered suitable for timber production. They differ from allowable sale quantities (ASQ) which set maximum sale levels under a similar policy of nondeclining flow. For non-owl forests, the ASQ's were gathered from personal contact with officers of each individual forest. Generally, these harvest levels concur with those found in the most recent set of forest plans produced around 1990. As reported in the FEMAT Report[3] ASQ levels for the non-owl forests in Eastern Washington are estimated to fall to 102 MMBF. These PSQ's are what we assume to be likely baseline harvest levels.

Table IV.26 shows the baseline timber harvest levels we estimate for Eastern Washington's five national forests.[4] Because data are not available to do otherwise, we make the further assumption that these first-decade average annual harvest levels will be maintained on an even-flow basis throughout the 100-year planning horizon. This assumption holds for the three forests which lie wholly within Washington State as well as for the two which lie only partially within the state's borders. The baseline harvest levels shown in Table IV.26 can be interpreted as PSQ's and are measured in Scribner board feet (16 foot logs) by timbershed. These projected harvest levels are substantially below harvest levels of recent years.

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[2] For an overview of these issues we recommend the *Final SEIS on Management of Habitat for Late-Successional and Old-Growth Forest Related Species within the Range of the Spotted Owl*, Volume I, US Forest Service and USDI Bureau of Land Management, Washington DC, February 1994 and *Eastside Forest Ecosystem Health Assessment*, Volumes I and II, US Forest Service Pacific Northwest Research Station, GTR-317 and 318, Portland OR, February 1994.

[3] Forest Ecosystem Management Assessment Team, *Forest Ecosystem Management: An Ecological, Economic, and Social Assessment*, US Forest Service, USDI National Park Service, Bureau of Land Management, and Fish and Wildlife Service. US Department of Commerce, NOAA National Marine Fisheries Service, EPA, Washington DC, July 1993.

[4] Details of the rationale used when developing these estimates are contained in Appendix 2.

Table IV.26 Estimates of average annual harvest (MMBF) by national forest and timbershed under initial conditions.

	Baseline Harvest (MMBF/Yr)	Suitable Area (thousand acres)
National Forest		
Owl Forests		
Wenatchee	24	290
Okanogan	6	85
Total	30	375
Non-owl Forests		
Okanogan	23	334
Colville	61	616
Umatilla	12	136
Panhandle (Kaniksu)	7	94
Total	103	1180
Eastern WA Total	133	1555
Timbershed		
Central Cascades	53	709
Inland Empire	80	846
Total	133	1555

Summary of All Ownerships (Including the National Forests)

Under Initial Conditions. In order to present an overall picture of projected harvest levels for the entire Eastside, a summary of projected harvest levels for the modeled ownerships plus the estimated harvest for the national forests is provided. Figure IV.23 characterizes the 100-year projection period for all Eastside owners. The ±5% harvest flow variant for the modeled owners is shown with a breakdown by timbershed. The historic harvest level for the period 1965-92 is also shown.

Table IV.27 presents additional details concerning the total potential harvest for all Eastside forests. Shown are historic harvest levels for three time periods and potential harvests for the first decade of the 100 year planning horizon under the initial condition harvest flow variants. Under the ±5% harvest flow constraint for the four modeled ownerships (and the estimated national forest annual harvest of 133 MMBF), the first decade harvest is estimated at 1,207 MMBF. As the harvest flow constraints are relaxed to ±25% and unconstrained, this potential harvest volume increases to 1,468 and 1,897 MMBF, respectively. As stated earlier, under the more relaxed forms of harvest flow, the potential harvest volume will decline in future decades from these initially high levels. The annual harvest gained--690 MMBF--in moving from the ±5% to the unconstrained harvest flow variant during the first decade leads to about 7 billion bd. ft. of potentially harvestable inventory that is not needed to sustain long term production. It provides a cushion which individual owners can use to respond to changing policy or market signals.

Potential harvest volumes under the ±5% harvest flow variant are not significantly different from historic rates of harvest on the Eastside, especially during the period 1985-92. However, the potential harvests shown in Table IV.27 differ substantially from the historic picture when examined by individual ownerships.

Focusing on the ±5% harvest flow variant and the 1985-92 historic time period, we see that the annual harvest on the national forests and forest industry lands are estimated to decline by 229 and 119 MMBF, respectively. To offset this decline of 348 MMBF per year, the remaining three ownership groups have the potential to increase their respective annual harvests by 350.5 MMBF, leading to a net increase of about 2.5 MMBF. Thus, under initial conditions, the forests of the Eastside have the potential to maintain the harvest volume near historic levels. There are many reasons, however, to expect that these potential harvest volumes may not be attained. These will be presented below after we discuss the potential harvests when viewed at the timbershed level.

Figures IV.24-IV.25 provide additional detail concerning individual Eastside ownership groups by timbershed. In these figures, individual ownership harvest levels are displayed against their historic rates by timbershed as well as for the entire Eastside. From these figures one can visualize the relative size of projected harvest across the differing ownership groups. For the Inland Empire, Figure IV.25 shows that the nonindustrial owners are expected to produce the largest portion of the harvest, while in the Central Cascades area the Native American owners

Table IV.27 Comparison of historic average annual harvest with various potential harvest levels (MMBF) under initial conditions.

(MMBF)

Owner	Historic average annual harvests			Potential first decade annual harvests under different harvest flow constraints		
	1965-92	1985-92	1990-92	±5%	±25%	Unconstrained
National forest	368	362	284	133	133	133
DNR	81	98	71	171	274	455
Forest industry	255	384	402	265	362	507
Native American	232	168	145	307	348	450
Nonindustrial	172	193	206	331	352	352
Total	1,107	1,205	1,108	1,207	1,468	1,897

	Change in first decade for ± 5% constraints			Change in first decade for ± 25% constraints			Change in first decade for unconstrained harvest flow		
	Relative to average harvest			Relative to average harvest			Relative to average harvest		
Owner	1965-92	1985-92	1990-92	1965-92	1985-92	1990-92	1965-92	1985-92	1990-92
National forest	-235	-229	-151	-235	-229	-151	-235	-229	-151
DNR	90	73	100	193	176	203	374	357	384
Forest industry	10	-119	-137	107	-22	-40	252	123	105
Native American	76	139	162	116	180	202	219	283	305
Nonindustrial	159	138	126	180	159	147	180	159	147
Total	100	3	99	361	264	360	790	693	789

Note: National forest harvest level is fixed at 133 MMBF/year.

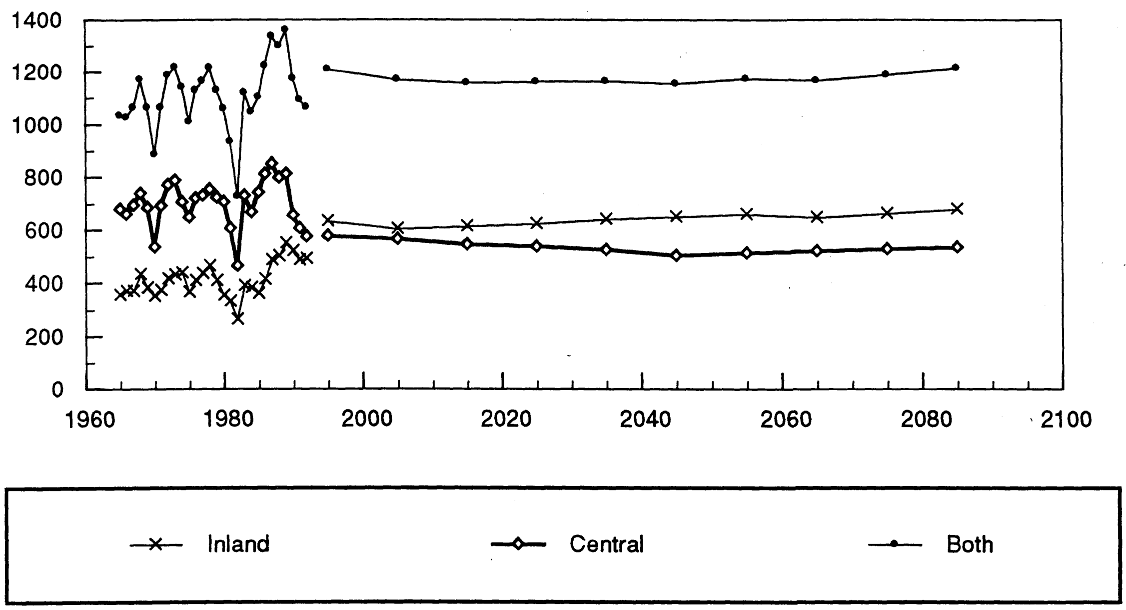

Figure IV.23 Summary of average annual harvest (MMBF) by timbershed for all owners (including the national forests) for initial conditions. For all owners but the national forests, the 5% variant of harvest flow is assumed.

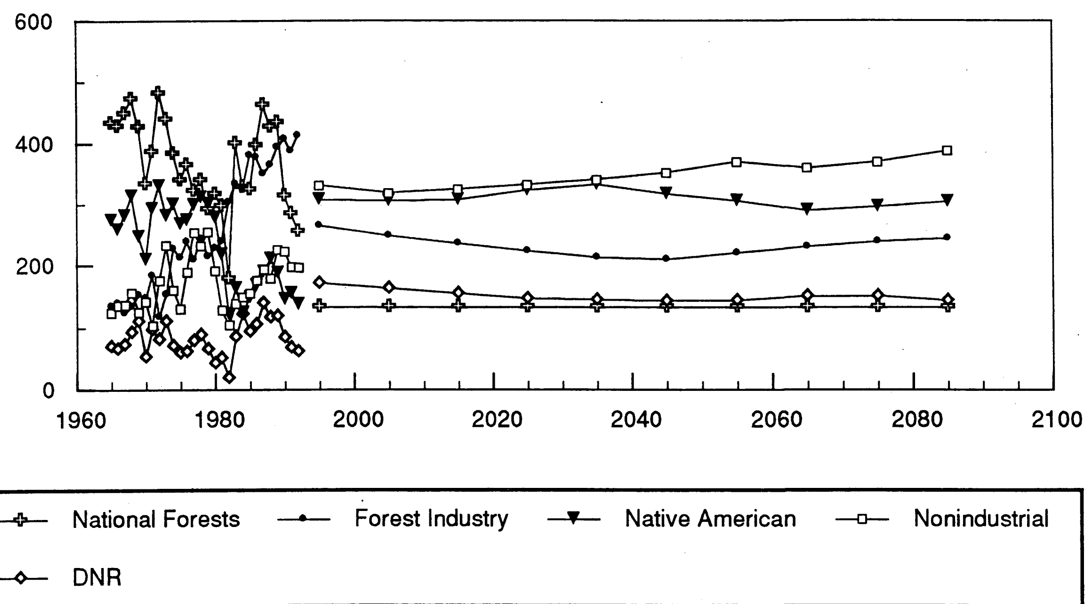

Figure IV.24 Summary of average annual harvest (MMBF) for both timbersheds by ownership (including the national forests) for initial conditions. For all owners but the national forests, the 5% variant of harvest flow is assumed.

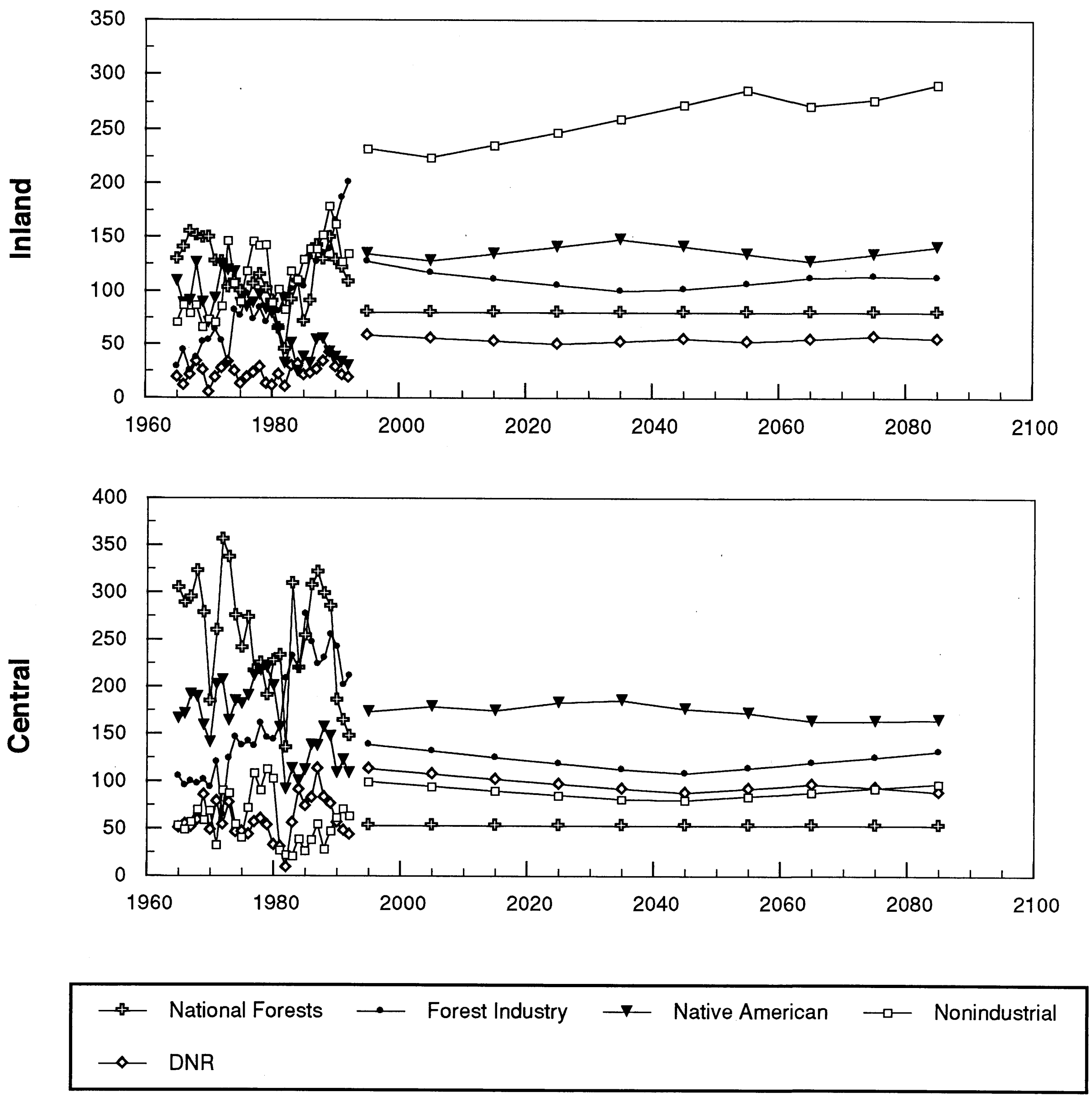

Figure IV.25 Summary of average annual harvest (MMBF) for each timbershed by ownership (including the national forests) for initial conditions. For all owners but the national forests, the 5% variant of harvest flow is assumed.

assume this role. Also, this figure shows that the timber supply picture in the Central Cascades timbershed is better balanced than in the Inland Empire area where nonindustrial owners are projected to produce a substantial proportion of the total harvest. Both figures also suggest that all ownerships are capable of sustainable forest production over the 100-year projection period. On balance, when examined by individual timbershed, rates of harvest in the Inland Empire are projected to rise over historic levels while those in the Central Cascades area are projected to decrease relative to historic levels.

A number of factors must be considered if these projections (under varying assumptions) are to be transformed to forecasts of future harvests.

(1) Prognosis simulations may overstate growth. Appendix 4 shows that prognosis projections of the 1980 survey to 1990 in comparison with the actual 1990 survey yields a somewhat higher volume than experienced. A one-decade test does not make a statistical sample since weather and other conditions may well explain this difference. But assuming a 5% overproduction in volume may be prudent. Review comments suggested that PROGNOSIS overestimates growth in certain situations where forest health is an issue and thus may overstate volumes available for some acres.

(2) Harvest losses in volume are not explicit. While losses from breakage and less-than-optimum cutting will vary considerably over different owners and stand structures, it might be prudent to assume a loss of 5% in comparing prognosis projections with historical harvests.

(3) Historical harvests may involve under-reporting. In the Westside study, it was believed that reported harvests understated actual harvests due to an incomplete, or less-than-perfect, sampling of harvests. Any factors of this nature could partially offset the adjustments included in 1 or 2 above.

(4) Timberland area decreases have been significant over the last ten years and may continue to be significant. Given the uncertainty of reductions in timberland areas through either changing uses or environmental protection, the initial conditions are benchmarked to the known timberland area in 1991. The FIA survey shows a 6% decline in available timber area in just the last ten years. A sensitivity analysis of a 15% decline in area was included in the sensitivity scenarios. Increased set-asides to a no-management class whether considered "reserved" or just not to be managed may be equally significant.

(5) Inventory measurement differences. The inventory derived by Prognosis from the FIA survey plots is not the same as that used by the FIA. This raises concerns about the consistency of the estimates of sawtimber volume produced by the Prognosis model compared to that reported by the FIA or, more importantly, the reported harvests provided by the state. The possibility exists that the inventory of merchantable volumes is overstated relative to the way harvest volumes historically have been reported. However,

merchantability standards are becoming less restrictive with new technology over time, so that harvest levels will increase relative to a consistently-defined sawtimber inventory.

(6) The simulations assume maximum utilization of the resource by each ownership. In reality, there are many individual owners with different objectives within a group and, as can be seen by the different harvest flow constraints, there can easily be a 6% differences in harvest just by emphasizing different degrees of flow constraints. There could be a substantial fall down from potential harvest levels for several ownerships.

(7) Management intensity levels have increased over time and may increase much more over the next few decades. While the sensitivity impact of immediate management changes has been examined, a forecast of changes of management levels over time has not been made. If economic conditions permit, some owners will respond by increasing their level of management--thus contributing to increased timber supplies.

Another dimension of this problem concerns the possibility of increasing environmental constraints, changing management practices, market conditions, forest health, and natural disturbance. As discussed later in this chapter, a 15% reduction in available timberland on all the national forests leads to a drop in first-decade potential harvest levels of 10-12% relative to the initial conditions ±5% harvest flow constraints. By shifting management up one level on 20% of the acres, part of this decline can be offset (approximately 60%).

The decline in the harvest from the national forests along with reduced forest industry harvests due to declining mature inventories is viewed as more certain than are the increased harvests from the DNR, Native American, and nonindustrial ownerships. With declining harvests resulting in higher timber prices, increased harvests from the nonindustrial owners are more likely than are similar increases on DNR and Native American lands. Depending on how these latter two groups react, the initial conditions harvest is likely to drop by 9-18% from the 1985-92 historical period. This is in the absence of additional constraints from changing forest practices.

As another check on consistency with past performance, in Figures IV.26-IV.27, projected harvest rates are presented on a per acre basis for all owners including the national forests. This allows one to view each ownership's projected harvest in relation to the productivity of its land base. The historical data show the reported harvest per acre. To correct these figures properly for land productivity, adjustments for increasing or decreasing inventory must be made. Also, since the projected harvest levels are constrained, it will take many decades to reach the ultimate productivity potential. The Native American harvest rate appears to be the highest but the projections have this group reducing its inventory of large trees for much of the period. The forest industry is restoring inventory and therefore productivity appears to be somewhat lower. The DNR appears to have the second highest productivity but is also reducing excess inventory which holds the harvest levels up. More significantly, nonindustrial lands show an increase in productivity even as they are increasing inventory but they still remain below the other modeled owners.

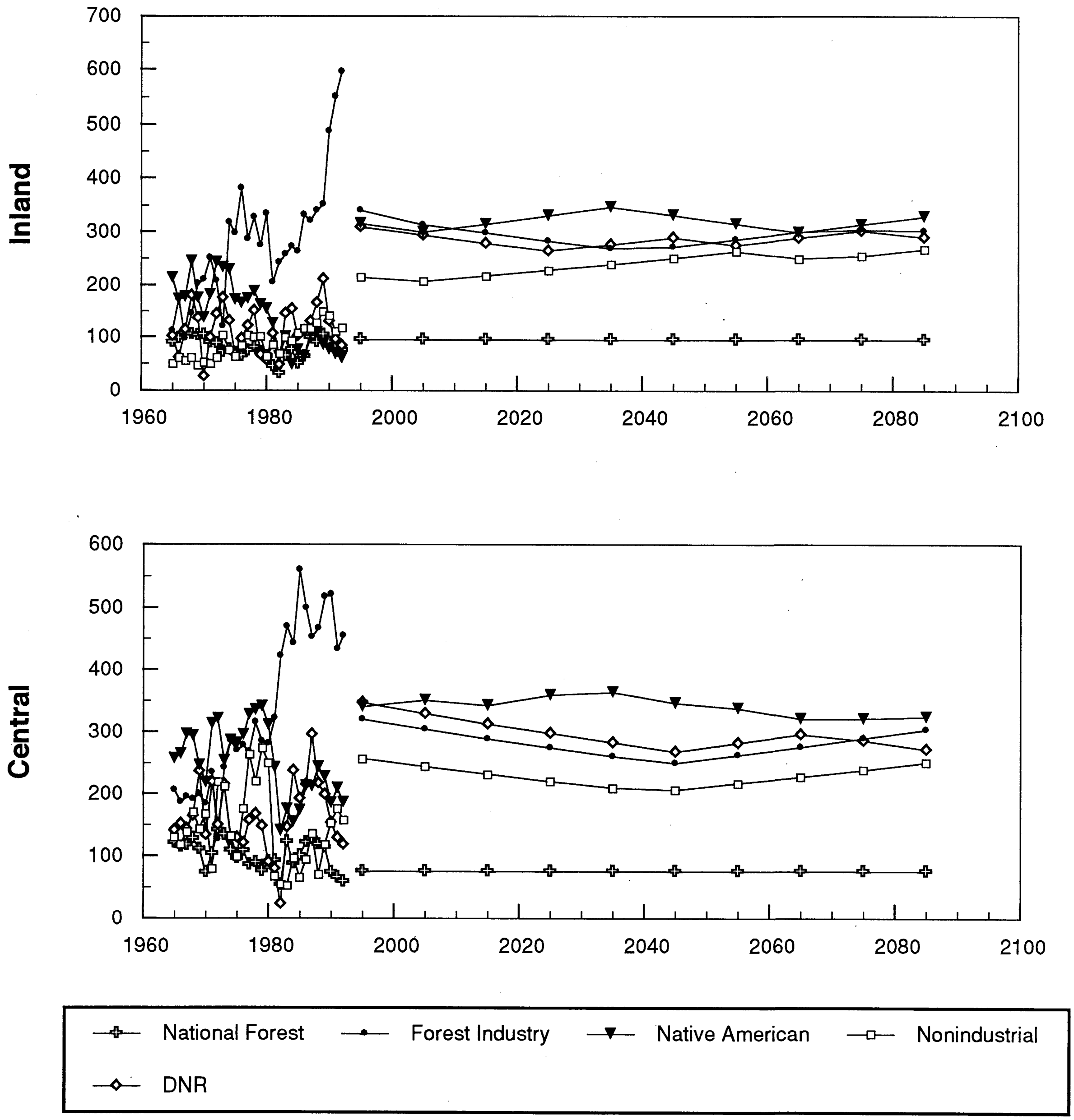

Figure IV.26 Summary of average annual harvest rate (bd.ft./acre) for each timbershed by ownership (including the national forests) for initial conditions. For all owners but the national forests, the 5% variant of harvest flow is assumed.

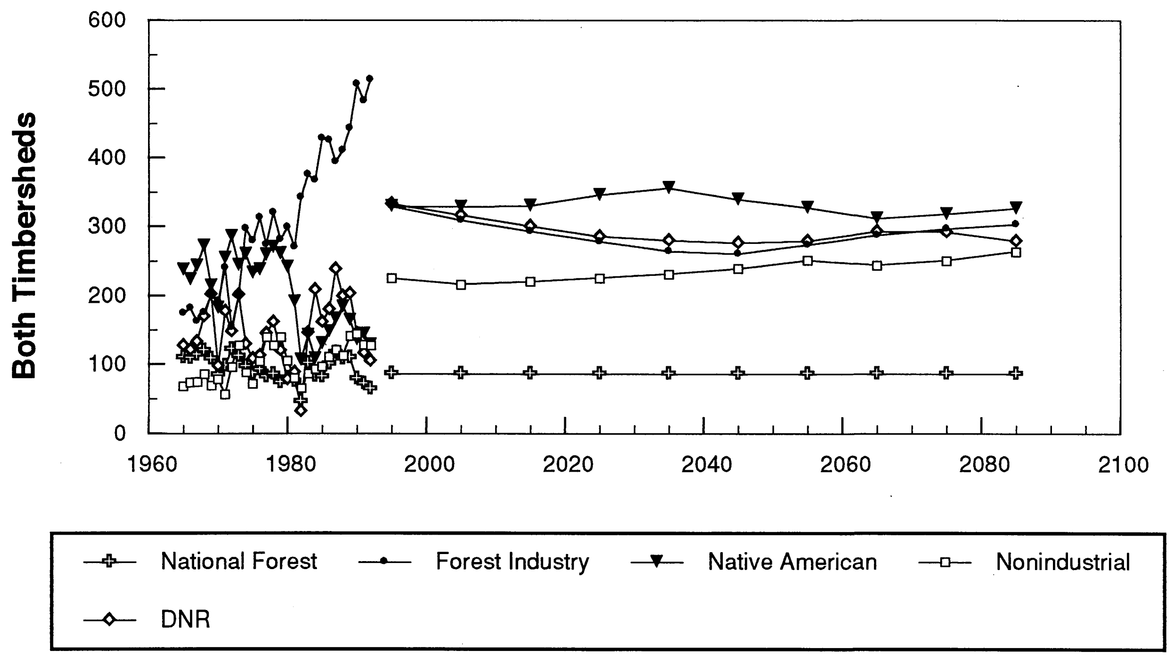

Figure IV.27 Summary of average annual harvest rate (bd.ft./acre) for both timbersheds by ownership (including the national forests) for initial conditions. For all owners but the national forests, the 5% variant of harvest flow is assumed.

The harvest rate per acre for the national forests show little change from the historic period even though well below that of other owners. The large increase in federal acres designated for reserved status explains the reduction in their harvest. National forest productivity for these remaining acres does not change from the historical period although well below that of other owners.

Summary Sensitivity Analyses

Ten Decade Comparisons: Sensitivity Analysis for All Modeled Owners (Excludes the National Forests). In the ten-decade comparisons for all modeled owners (Tables IV.1 and IV.28 and Figures IV.1 Panels B and C and IV.2 and IV.3), 4.8% less timber is projected to be harvested under the low and 6.8% more timber under the high management scenarios compared with the harvest projections under the unconstrained harvest flow variant for initial conditions. The 20% boost run results in an increase of 7%; the 15% acreage reduction in a 10.7% decrease; and the boost plus 15% scenario in a 6.0% decrease in harvest levels relative to projected harvest levels under the ±5% harvest flow variant for initial conditions. A portion of the increase under the boost scenario is due to the relaxation of the harvest flow constraints for industrial owners in the Central Cascades timbershed. A portion of the loss of 15% of the timberland base is mitigated by a relaxation in the timber harvest flow constraints for nonindustrial owners in the Inland Empire timbershed. Both of these ownership/timbershed combinations required the use of additional timing choices resulting in delayed harvest prescriptions.

First Two and Last Two Decade Comparisons: Comparisons covering the first two and the last two decades in the ten-decade projection period are also shown in Table IV.28. These results generally show that changes in management intensity assumptions are reflected in much larger percentage changes in the first two decades than in the last two decades when compared to the initial conditions under an unconstrained harvest flow. Under the ±5% harvest flow assumptions, differences between the first two and the last two decades are not as dramatic. For example, under the low management scenario, harvest volumes decrease by 19.3% during the first two decades (relative to the initial conditions unconstrained harvest volumes), while comparable figures during the last two decades show a decrease of 3.0%. Under the high scenario, harvest levels in the first two decades increase 70.7% (relative to the initial conditions unconstrained harvest volumes), but decrease 4.1% during the last two decades. Under the boost scenario, harvest volumes for all modeled owners increase 16.9% in the first two decades (relative to the initial conditions ±5% harvest flow variant) and increase 11.2% during the last two decades. A portion of this increase is due to the relaxation of the harvest flow constraints for industrial owners in the Central Cascades timbershed. The immediate loss of 15% of the timberland base results in harvest reductions of 11.5% in the first two decades and 10.2% during the last two decades (relative to the initial conditions ±5% harvest flow variant). A portion of this decrease is mitigated by a relaxation in the timber harvest flow constraints for nonindustrial owners in the Inland Empire timbershed. Lastly, the boost plus 15% land reduction scenario results in a decrease of 1.4% in the first two decades and a 3.9% reduction during the last two decades. Thus, management intensification of one level increase for 20% of the acres does not compensate for the loss in the land base.

Harvest Stability vs Flow Constraint and Management Level: It should be evident that flow constraints to stabilize harvest also reduce the long-term harvest potential. In effect, acres are being managed for reasons other than full productivity. Different owners have different criteria that might affect their willingness to depart from even-flow or to constrain their harvest at all.

Table IV.28 Comparison of projected annual harvest volumes (MMBF) under four harvest flow variants for initial conditions and for five sensitivity analysis scenarios.

	All modeled owners			DNR			Forest Industry			Native American			Nonindustrial		
Harvest Volumes (MMBF)	1995-2005	2075-2085	total	1995-2005	2075-2085	total	1995-2005	2075-2085	total	1995-2005	2075-2085	total	1995-2005	2075-2085	total
Even-flow harvest flow constraint (HFC)	.	.	.	146.5	146.5	14,647	224.3	224.3	22,433	296.9	296.9	29,691	.	.	.
5% HFC	1,054.1	1,066.1	104,046	166.9	146.6	15,087	256.3	240.9	23,254	306.3	300.3	30,873	324.6	378.3	34,832
25% HFC	1,207.4	1,077.6	107,378	239.6	142.9	16,311	316.4	248.7	24,071	326.9	331.9	32,206	324.5	354.1	34,790
Unconstrained HFC	1,332.5	1,106.1	110,116	313.2	138.3	17,559	341.3	260.7	24,844	380.6	317.3	32,986	297.4	389.8	34,728
20% boost	1,232.4	1,185.4	111,377	173.2	151.6	15,575	309.7	286.5	24,471	383.1	324.3	33,516	366.4	423.1	37,816
15% land area reduction	932.7	957.2	92,952	150.9	130.7	13,505	206.2	226.7	20,343	264.4	259.4	26,625	311.2	340.3	32,480
15% land area reduction + 20% Boost	1,038.8	1,024.8	97,830	154.5	133.9	13,845	209.3	228.1	20,427	327.7	280.8	28,774	347.3	382.0	34,784
Low management	1,075.9	1,073.3	104,794	145.3	146.8	14,469	232.7	219.6	21,828	365.2	332.7	32,877	332.7	374.3	35,620
High management	2,274.1	1,060.9	117,564	356.6	130.1	16,949	413.7	245.2	23,720	1054.0	278.0	41,391	449.8	407.6	35,504
% diff. from %5 HFC															
Even-flow (HFC)	.	.	.	-12.2%	-0.1%	-2.9%	-12.5%	-6.9%	-3.5%	-3.1%	-1.1%	-3.8%	.	.	.
5% HFC	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
25% HFC	14.5%	1.1%	3.2%	43.6%	-2.5%	8.1%	23.5%	3.2%	3.5%	6.7%	10.5%	4.3%	0.0%	-6.4%	-0.1%
Unconstrained HFC	26.4%	3.8%	5.8%	87.7%	-5.6%	16.4%	33.2%	8.2%	6.8%	24.3%	5.7%	6.8%	-8.4%	3.0%	-0.3%
20% boost	16.9%	11.2%	7.0%	3.8%	3.4%	3.2%	20.8%	18.9%	5.2%	25.1%	8.0%	8.6%	12.9%	11.8%	8.6%
15% land area reduction	-11.5%	-10.2%	-10.7%	-9.6%	-10.9%	-10.5%	-19.5%	-5.9%	-12.5%	-13.7%	-13.6%	-13.8%	-4.2%	-10.0%	-6.8%
15% land area reduction + 20% Boost	-1.4%	-3.9%	-6.0%	-7.4%	-8.6%	-8.2%	-18.3%	-5.3%	-12.2%	7.0%	-6.5%	-6.8%	7.0%	1.0%	-0.1%
% diff. from unconstrained HFC															
Low management	-19.3%	-3.0%	-4.8%	-53.6%	6.1%	-17.6%	-31.8%	-15.8%	-12.1%	-4.0%	4.8%	-0.3%	11.8%	-4.0%	2.6%
High management	70.7%	-4.1%	6.8%	13.9%	-5.9%	-3.5%	21.2%	-5.9%	-4.5%	176.9%	-12.4%	25.5%	51.2%	4.6%	2.2%

Industry lands, being the most impacted by economics, would be expected to be unconstrained for the purpose of gaining maximum timber revenue but partially constrained to support the economic life of processing facilities. The all-owner harvest for ten decades shows the relaxation to ±25% produces a 3.2% harvest increase and the totally unconstrained alternative produces a 5.8% increase both relative to the ±5% flow constraint level. However, a similar relaxation during the first two decades yields 15% and 26% increases, respectively.

Shifting all acres to the lowest level of management intensity relative to the unconstrained initial conditions base case reduces the average annual harvest by 19% during the first two decades. However, this is still greater than the initial conditions average annual harvest under ±5% harvest flow constraints. Over the entire 100 years, the adoption of the lowest level of management intensity leads to a 5% reduction relative to the unconstrained initial conditions case. At the opposite extreme, shifting all acres to the highest level of management intensity relative to the unconstrained initial conditions base case increases the average annual harvest by 71% during the first two decades. However, over the entire 100 years, this amounts to only a 7% increase. This, in part, occurs due to the excess mature inventory present in 1991 that is not needed to sustain production in the long term.

With 15% land withdrawal there is nearly an 11% decline in the harvest over the ten decades with the decline in the first two decades at roughly 12%.

Boosting 20% of the acres one level of management higher reduces the impact of land withdrawal from an 11% impact to only 7% although it reduces the first two decades' impact even more, offsetting all but 1% of land withdrawals. A 20% boost in management acres by only one level provides a 7% overall increase in harvest but 28% increase in the first decade as the ±5% even-flow constraint was relaxed to reduce excessive area constrained in the LP. The comparability of this case since it results in relaxed flow constraints is questionable.

Table IV.2 and Figure IV.4 show the impact of scenarios 1-5 for all modeled owners on quadratic mean diameter of harvest volume. Tables showing the impact of scenarios 1-5 for all modeled owners on changes in species composition are contained in Appendix 6.

Sensitivity Analysis for DNR. In the ten-decade comparisons for the DNR (Tables IV.6 and IV.28 and Figures IV.8 and IV.8 Panels B and C), 17.6% less timber is projected to be harvested under the low and 3.5% less timber under the high management scenarios as compared to the harvest projections under the unconstrained harvest flow variant for initial conditions. The 20% boost run results in an increase of 3.2%; the 15% acreage reduction in a 10.5% decrease; and the boost plus 15% scenario in a 8.2% decrease in harvest levels relative to projected harvest levels under the ±5% harvest flow variant for initial conditions.

Comparisons covering the first two and the last two decades in the ten-decade projection period are also shown in Table IV.28. These results generally show that changes in management intensity assumptions are reflected in much larger percentage increases (decreases) in the first two decades than in the last two decades when compared to the initial conditions under an unconstrained harvest flow. Under the ±5% harvest flow assumptions, differences between the first two and the last two decades are not as dramatic. For example, under the low management scenario, harvest volumes decrease by 53.6% during the first two decades (relative to the initial conditions unconstrained harvest volumes), while comparable figures during the last two decades show an increase of 6.1%. Under the high management scenario, harvest levels in the first two decades increase 13.9% (relative to the initial conditions unconstrained harvest volumes), but decrease 5.9% during the last two decades. Under the Boost scenario, harvest volumes for the DNR increase 3.8% in the first two decades (relative to the initial conditions ±5% harvest flow variant) and increase 3.4% during the last two decades. The immediate loss of 15% of the timberland base results in harvest reductions of 9.6% in the first two decades and 10.9% during the last two decades (relative to the initial conditions ±5% harvest flow variant). Lastly, the Boost plus 15% land reduction scenario results in a decrease of 7.4% in the first two decades and an 8.6% decrease during the last two decades. Thus, management intensification does not compensate for the loss in the land base.

Table IV.7 and Figure IV.9 show the impact of scenarios 1-5 for the DNR on quadratic mean diameter of harvest volume. Tables and Figures showing the impact of scenarios 1-5 for the DNR on changes in species composition are contained in Appendix 6.

Sensitivity Analysis for Forest Industry. In the ten decade comparisons for the forest industry (Tables IV.11 and IV.28 and Figures IV.11 and IV.12 Panels B and C), 12.1% less timber is projected to be harvested under the low and 4.5% less timber under the high scenarios as compared to the harvest projections under the unconstrained harvest flow variant for initial conditions. The Boost run results in an increase of 5.2%; the 15% acreage reduction in a 12.5% decrease; and the Boost plus 15% scenario in a 12.2% decrease in harvest levels relative to projected harvest levels under the ±5% harvest flow variant for initial conditions. A portion of the increase under the Boost scenario is due to the relaxation of the harvest flow constraints for industrial owners in the Central Cascades timbershed. Also recall that this ownership/timbershed combination required the use of additional timing choices resulting in delayed harvest prescriptions.

Comparisons covering the first two and the last two decades in the ten-decade projection period are also shown in Table IV.28. These results generally show that changes in management intensity assumptions are reflected in much larger percentage changes in the first two decades than in the last two decades when compared to the initial conditions unconstrained harvest flow results. Under the ±5% harvest flow assumptions, differences between the first two and the last two decades are not as dramatic. For example, under the low scenario, harvest volumes decrease by 31.8% during the first two decades (relative to the initial conditions unconstrained harvest volumes), while comparable figures during the last two decades show a decrease of 17.7%. Under the high scenario, harvest levels in the first two decades increase 21.2% (relative to the initial conditions unconstrained harvest volumes), but decrease 5.9% during the last two decades. Under the Boost scenario, harvest volumes for forest industry increase 20.8% in the first two decades (relative to the initial conditions ±5% harvest flow variant) and increase 18.9% during the last two decades. A portion of the increase under the Boost scenario is due to the relaxation of the harvest flow constraints in the Central Cascades timbershed. The immediate loss of 15% of the timberland base results in harvest reductions of 19.5% in the first two decades and 5.9% during the last two decades (relative to the initial conditions ±5% harvest flow variant). Lastly, the Boost plus 15% land reduction scenario results in a decrease of 18.3% in the first two decades and a 5.3% decrease during the last two decades. Thus, a relatively low level of management intensification does not compensate for the loss in the land base.

Table IV.12 and Figure IV.13 show the impact of scenarios 1-5 for the forest industry on quadratic mean diameter of harvest volume. Tables and Figures showing the impact of scenarios 1-5 for forest industry on changes in species composition are contained in Appendix 6.

Sensitivity Analysis for Native Americans. In the ten decade comparisons for Native Americans (Tables IV.16 and IV.28 and Figures IV.15 and IV.16 Panels B and C), 0.3% less timber is projected to be harvested under the low and 25.5% more timber under the high management scenarios as compared to the harvest projections under the unconstrained harvest flow variant for initial conditions. The Boost run results in an increase of 8.6%; the 15% acreage reduction in a 13.8% decrease; and the Boost plus 15% scenario in a 6.8% decrease in harvest levels relative to projected harvest levels under the ±5% harvest flow variant for initial conditions.

Comparisons covering the first two and the last two decades in the ten-decade projection period are also shown in Table IV.28. These results generally show that changes in management intensity assumptions are reflected in much larger percentage changes in the first two decades than in the last two decades when compared to the initial conditions unconstrained harvest flow results. Under the ±5% harvest flow assumptions, differences between the first two and the last two decades are not as dramatic. For example, under the low scenario, harvest volumes decrease by 4% during the first two decades (relative to the initial conditions unconstrained harvest volumes), while comparable figures during the last two decades show a 4.8% increase. Under the high management scenario, harvest levels in the first two decades increase 176.9% (relative to the initial conditions unconstrained harvest volumes), but decrease 12.4% during the last two decades. Under the Boost scenario, harvest volumes for Native Americans increase 25.1% in the first two decades (relative to the initial conditions ±5% harvest flow variant) and increase 8.0% during the last two decades. The immediate loss of 15% of the timberland base results in harvest reductions of 13.7% in the first two decades and 13.6% during the last two decades (relative to the initial conditions ±5% harvest flow variant). Lastly, the boost plus 15% land reduction scenario results in an increase of 7.0% in the first two decades and a 6.5% decrease during the last two decades. Thus, management intensification does not generally compensate for the loss in the land base but it may provide sufficient timber in the first decade.

Table IV.17 and Figure IV.17 show the impact of scenarios 1-5 for Native Americans on quadratic mean diameter of harvest volume. Tables and figures showing the impact of scenarios 1-5 for Native Americans on changes in species composition are contained in Appendix 6.

Sensitivity Analysis for Nonindustrial (Including Other Public). In the ten decade comparisons for nonindustrial owners (Tables IV.21 and IV.28 and Figure IV.19 and IV.20 Panels B and C), 2.6% more timber is projected to be harvested under the low and 2.2% more timber under the high scenarios as compared to the harvest projections under the unconstrained harvest flow variant for initial conditions. While this result seems out of line with the impact on other owners, it should be noted that the large increase from historical harvests makes the difference between flow constraints less significant. Also, the area constraints under the initial conditions were too severe, requiring some relaxation that has somewhat reduced the consistency of cross-scenario comparisons. The boost run results in an increase of 8.6%; the 15% acreage reduction in a 6.8% decrease; and the Boost plus 15% scenario in a 0.1% decrease in harvest levels relative to projected harvest levels under the ±5% harvest flow variant for initial conditions. A portion of the loss of 15% of the timberland base is mitigated by a relaxation in the timber harvest flow constraints for nonindustrial owners in the Inland Empire timbershed. This ownership/timbershed combination required the use of additional timing choices resulting in delayed harvest prescriptions.

Comparisons covering the first two and the last two decades in the ten-decade projection period are also shown in Table IV.28. These results generally show that changes in management intensity assumptions are reflected in much larger percentage changes in the first two decades than in the last two decades when compared to the initial conditions unconstrained harvest flow results. For example, under the low scenario, harvest volumes increase by 11.8% during the first two decades (relative to the initial conditions unconstrained harvest volumes), while comparable figures during the last two decades show a decrease of 4.0% change. Under the high scenario, harvest levels in the first two decades increase 51.2% (relative to the initial conditions unconstrained harvest volumes), and increase 4.6% during the last two decades. Under the Boost scenario, harvest volumes for nonindustrial owners increase 12.9% in the first two decades (relative to the initial conditions ±5% harvest flow variant) and increase 11.8% during the last two decades. The immediate loss of 15% of the timberland base results in harvest reductions of 4.2% in the first two decades and 10.0% during the last two decades (relative to the initial conditions ±5% harvest flow variant). A portion of this decrease is mitigated by a relaxation in the timber harvest flow constraints in the Inland Empire timbershed. Lastly, the Boost plus 15% land reduction scenario results in an increase of 7.0% in the first two decades and a 1.0% increase during the last two decades. Thus, management intensification appears to be able to compensate for the loss in the nonindustrial owner land base largely because the expected management level under initial conditions was very low.

Table IV.22 and Figure IV.21 show the impact of scenarios 1-5 for the nonindustrial owners on quadratic mean diameter of harvest volume. Tables and figures showing the impact of scenarios 1-5 for nonindustrial owners on changes in species composition are contained in Appendix 6.

V. EASTERN WASHINGTON FOREST INDUSTRY EMPLOYMENT

Over the past decade, the counties of Eastern Washington have supported 16-20% of the state-wide employment in lumber and wood products manufacturing (Washington State Employment Security Department, 1987-93). "Lumber and wood products," is an aggregation of the wood products manufacturing industries as defined under the US Standard Industrial Classification (SIC) system as used by various state and federal government agencies for reporting industrial statistics. It comprises the logging, sawmilling, wood-based panels, and secondary wood products (except wood furniture) industries. The lumber and wood products category, SIC Group 24, includes the industries shown in Table V.1.

Table V.1. Manufacturing industries within SIC Group 24, Lumber and Wood Products.

Industry	SIC Codes
logging contractors	2411
sawmills and planing mills, including softwood and hardwood dimension mills and special product sawmills (mostly shake and shingle mills)	2421, 2426, 2429
hardwood and softwood veneer and plywood mills	2434, 2435
secondary wood products, including millwork, cabinets, boxes, pallets, treated wood, structural wood members, prefabricated buildings, mobile homes, and miscellaneous specialty products	2431, 2434, 2441, 2448, 2449, 2491, 2493, 2499, 2439, 2451, 2452

This classification, used here to define "direct" employment, excludes a number of jobs that are in reality directly tied to harvesting or processing. Proprietors and some corporate officers are not included in state reports of employment in these categories, and may add as much as 10% to employment levels. Service industries such as wood products distributors are not included in these "manufacturer-only" categories. In addition, transportation that is contracted will appear as employment as an indirect transportation service rather than as employment within a lumber and wood products company. The indirect employment generated from lumber and wood products manufacturing has been estimated to be roughly 3.3 jobs for every direct lumber and wood products job (Conway, 1994).

Figure V.1 shows the distribution of Eastern Washington employment between the two timbersheds defined in this study. As one would expect based on harvest levels,

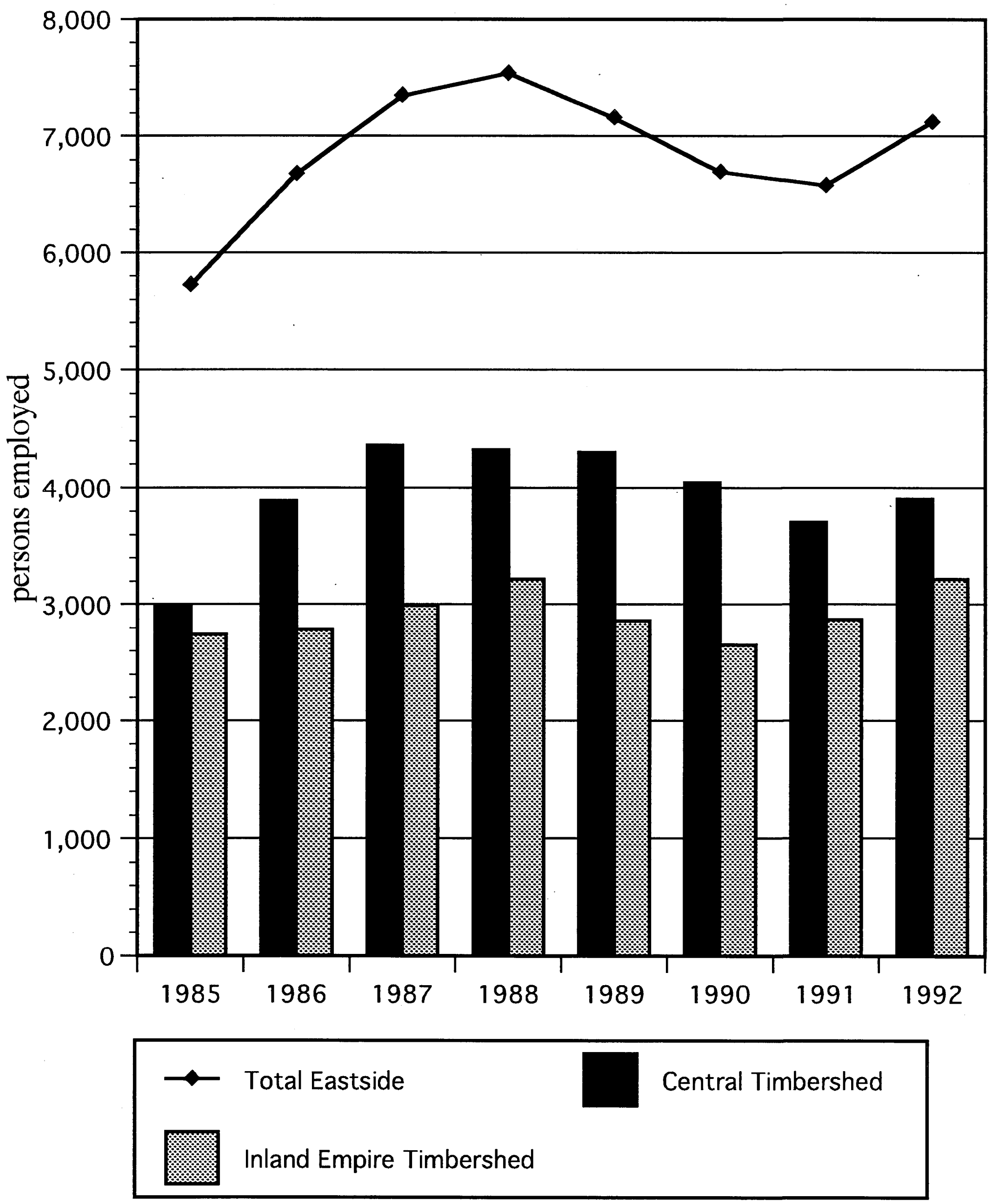

Figure V.1 Lumber and wood products employment for Eastern Washington, 1985-92. (Source: Washington State Employment Security Department).

employment in the Central timbershed for lumber and wood products is consistently higher than employment in the Inland Empire timbershed. Employment levels in both timbersheds have fluctuated with the last business cycle, peaking in the late 1980s with combined average employment of over 7,500 persons in 1988 and reaching a low in the early 1990s with combined average employment of just under 6,600 persons in 1991. Employment trends for Eastern Washington correspond to the lumber and wood products employment trend for Western Washington and the entire state. Over the same period, direct state-wide employment in lumber and wood products has fluctuated between 35,500 and 41,500 workers.

Eastside Employment Projection

This section will present a projection of direct employment in Eastern Washington for all industries contained within SIC Group 24, lumber and wood products, for the period 1995-2085, based on an analysis of the historical period 1985-1992. An extensive and detailed analysis of employment was not possible in this study. One of the problems in analyzing employment in an area as sparsely populated as Eastern Washington is that employment data are often not reported at the county level due to non-disclosure issues. For example, if fewer than three companies in a given industry exist in a county, or if one company dominates employment within a county, employment data are not reported by state agencies in their quarterly or annual reports. Further complicating matters, industry-specific data (for the sawmill or logging industries alone, for example) are often not reported for counties in Eastern Washington because of similar non-disclosure issues (Washington State Employment Security Department, 1986-1993). Due to data inadequacies, timbersheds were aggregated in this analysis.

Pulp and paper mills (SIC Group 26) were not included in this assessment. According to a directory published by an industry association, only four pulp and paper facilities are located in Eastern Washington (Northwest Pulp and Paper Association, 1993), making any attempt at forecasting pulp and paper employment for the region problematic. Similarly, wood furniture producers (SIC Group 25) were not included. Furniture manufacturers in the Northwest have been shown to be less dependent on local timber harvest than other primary and secondary wood products manufacturing industries (Dirks and Briggs, 1991); an analysis of furniture employment based upon timber harvest therefore would be somewhat irrelevant.

The results reported here are not directly comparable to those reported for Western Washington in the companion analysis (Adams, *et al.*, 1992). The Westside study modeled and forecast employment for individual industries within the lumber and wood products group as well as additional employment categories including forestry services, pulp and paper, trucking, and stevedoring. Overall employment-to-harvest ratios for Eastern Washington are therefore significantly lower than those reported or implied in the Westside analysis. This should not be interpreted as a lower use of labor in Eastern

Washington relative to the Western Washington industry, but only as a difference in the categories of employment data used as the basis for analysis.

Adams, *et al.*, (1992) showed the importance of using the price of timber as a means of estimating employment in the Westside timber supply study. The projection presented here is based on the response of the employment-to-harvest ratio to the fluctuating price of stumpage in Eastern Washington between the years 1985-1992. Average DNR stumpage prices as reported by Warren (1989-1994) were used as an estimate of market prices for stumpage. An employment-to-harvest ratio was determined using direct lumber and wood products employment data published by the Washington State Employment Security Dept. for Eastern Washington counties and total harvest levels reported in the previous section of this report. Employment was adjusted upward 4% to account for county-level data not reported by the Employment Security Department due to non-disclosure laws. The 4% adjustment was calculated by subtracting the lumber and wood products employment for Western Washington counties from the state totals, and then comparing the total "derived" Eastern Washington employment with the figures reported on a county-by-county basis; county-by-county totals were found to under-represent employment due to non-reported data points.

The rationale for including a price term in the analysis is that producers substitute labor inputs for wood (and vice versa) based on the relative cost of each (Adams, *et al.*, 1992). During the period on which the employment projections are based (1985-1992), high prices of wood relative to labor resulted in increased labor inputs. Figure V.2 illustrates this point. As prices for stumpage have increased, the number of persons employed each year per million board feet harvested have also increased. Over the recent period, rising prices seem to have offset any productivity shifts, raising rather than lowering the employment-to-harvest ratio. This is not to say that there is a direct causal relationship between these two factors, but only that shifts in stumpage prices are correlated with changes in the employment/harvest ratio over the historical period. A more extensive analysis is needed to understand employment-to-harvest changes for individual industries within the aggregate lumber and wood products group, *i. e.*, logging, sawmilling, millwork and secondary manufacturing industries.

A regression analysis was performed using historical employment, harvest, and price data. The equation resulting in a "best fit" employment-to-harvest ratio based on an independent price variable is represented as the straight line in Figure V.2 and can be expressed as:

$$E/H = 4.819 + .005 (\$/MBF) + e$$

where:

- E is direct employment in SIC 24, Lumber and Wood Products, for Eastern Washington counties

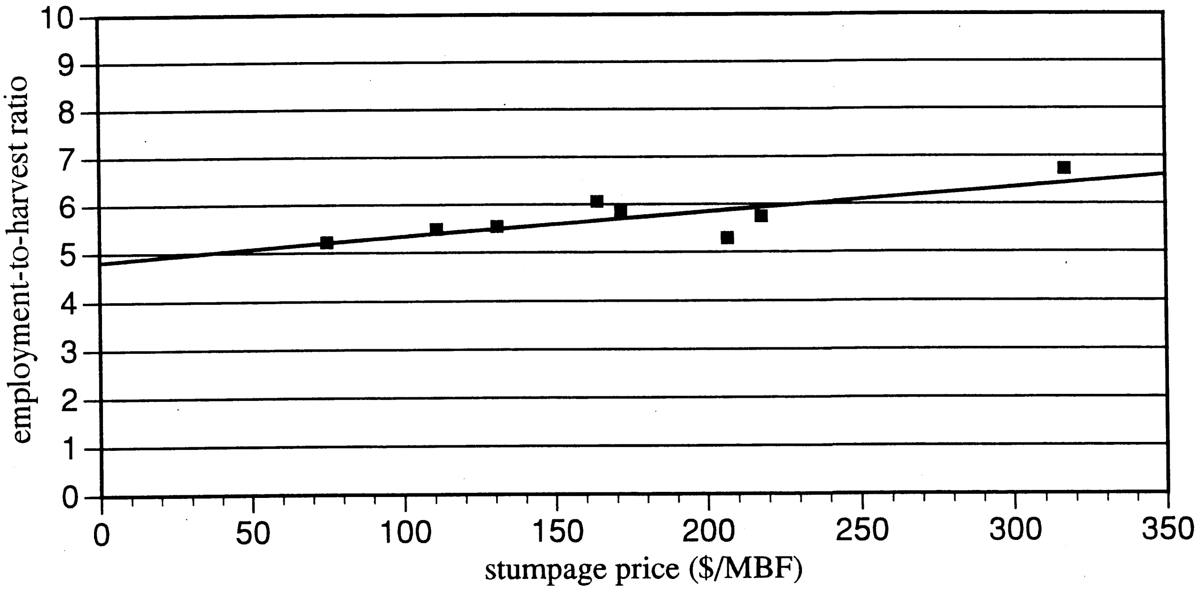

Figure V.2 Eastside employment-to-harvest ratio by DNR average stumpage prices

- *H* is the total timber harvested in Eastern Washington in MMBF,
- *$/MBF* represents real DNR stumpage prices, and
- *e* is an error term associated with this probabilistic model.

This equation implies a 0.1% increase in employment for a 1% increase in prices over the historical period--not a large adjustment for rising or falling prices, but one which accounts for most of the employment shifts.

Potential employment levels for the period 1991-2085 were computed by multiplying expected harvest volumes under two potential harvest levels (±5% harvest flow constraint and 15% land reduction) using the following equation, which was derived from the regression equation presented above:

$$E = H(4.819 + .005\ (\$/MBF))$$

In this equation, prices were held constant over the forecast period at $273/MBF and were calculated as the average of annual DNR stumpage prices in Eastern Washington for the period 1990-1993. No adjustment was made in this analysis for increased productivity as can be found in some other analyses of employment, as productivity gains or losses were thought to be best determined for individual industries within an SIC group rather than for a combination of industries whose employment may be driven by different macroeconomic factors (Wall and Oswald, 1975). However, industry-specific data were not available for Eastern Washington. In addition, for the rather short interval evaluated, price trends were thought to have been more important than any productivity changes in explaining shifts in employment relative to harvest.

Results

The results of the forecast are shown in Figure V.3. Two alternative scenarios were forecast. The first assumes harvest levels under initial conditions with the ±5% harvest flow constraint presented in an earlier section of this report. The second assumes a 15% reduction in the land base dedicated to timber production. Each of the forecast years shown is the midpoint of a decade and represents average employment conditions for that decade. Stumpage prices were held constant for the projection of each harvest alternative, even though a real increase in stumpage prices should have a net positive impact on employment.

Under the ±5% harvest flow constraint, employment levels fluctuate between 7,100 and 7,500 persons throughout the projection period. The initial trend is for employment to decrease slightly by each decade until the decade 2050-2060, when timber harvests in Eastern Washington are forecast to increase. Employment reaches its peak during the final decade in the projection period (2080-2090), when lumber and wood products employment exceeds 7,500 persons per year in Eastern Washington.

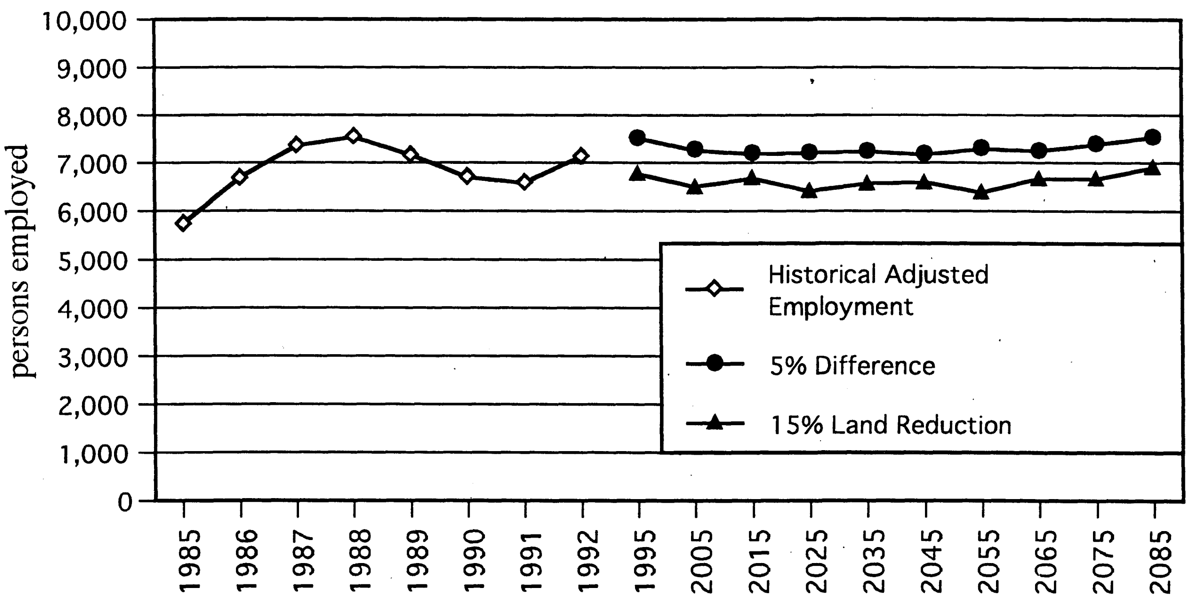

Figure V.3 Projected employment for Eastern Washington in lumber and wood products under two alternative scenarios

Reducing the land base devoted to timber production by 15% reduces employment in Eastern Washington between 7% and 12%, depending upon the decade. Average employment levels with the reduced land reduction fluctuate between 6,300 and 6,900 persons employed, and also peak at the end of the projection period. As prices were held constant in both cases, employment fluctuations over the projection period are due entirely to changes in the amount of timber harvested. These projections reflect the full harvest potential of all owners. As previously discussed, actual harvest levels may be lower than these potentials, resulting in less employment.

This analysis was limited in scope and should be interpreted only as an indication of the potential employment conditions given two alternative harvest scenarios. The projections presented show the relationship between harvest levels and employment, and the differences that exist due to changes in the Eastern Washington forest land base. Employment projections could be lower with productivity gains, similar to the gains in primary manufacturing experienced since the 1950s. These gains might, for example, result from higher levels of investment in plant and equipment. Higher levels of investment would normally be associated with an attractive market. With an attractive market, we might also expect expansion in the relatively labor-intensive secondary manufacturing industries, and increases in secondary processing which could offset any employment losses from productivity gains in primary processing. Ultimately, the employment situation will be dependent upon many factors. Figure V.3 suggests a reasonable range for the amount of direct employment that is dependent upon timber supply.

VI. CONCLUSIONS AND IMPLICATIONS

Under initial condition assumptions, potential harvest levels from the Eastside are essentially stable over the 100-year projection period. However, Eastern Washington non-federal lands show a potential for increased harvests. Changes in Forest Service harvest projections are substantial but could potentially be offset by other owners. Harvest levels by timberland and ownership are not nearly as stable as the overall total, consistent with the significant changes observed in owner shares over history. The expected reduction in national forest annual harvest of roughly 229 MMBF/year and a decline in forest industry harvest of 119 MMBF/year relative to the 1985-1992 base period (see Table IV.27) may be offset by potential increases of 300-350 MMBF/year by other owners on a sustainable basis. In any event, the Central timbershed is likely to see a further decline in share as the Inland Empire increases in share--a trend shift that is evident in the last few years. The beginning inventory based on the prior history of harvests and fires are important contributors to the share captured by each ownership.

If there are significant additions in reserve acreages or no-management zones consequent to new regulations, there will be nearly proportionate reductions to subsequent harvest levels. However, each ownership has a varying amount of mature inventory that could be harvested earlier than projected to fill the void caused by land reductions--but only temporarily. In the long term, much of this reduction could be offset by increased management practices. The ultimate outcome would be sensitive to the nature of the regulation or other cause of land reduction and its impact on the motivation to increase or decrease management. The worst case would be if regulations increase costs in such a way as to motivate reductions in management intensity. Then harvests would decline both from land reductions and reduced management. While we did not illustrate this case, it can be estimated from the separate impacts of timberland set-asides and lower management scenarios conducted as part of the sensitivity analysis.

The response of the Eastside to policy changes may be different than that of the Westside. Management regimes are different and the ability to accelerate harvest given the selective harvest regimes practiced on the Eastside appears to be larger than for the Westside, where the optimum harvest age is more critical.

Since the decline in national forest harvest plans on the Eastside represents a greater percentage of the Eastside harvest than that expected on the Westside, the pressure on state and private owners to deviate more from their historical harvests will also be greater. This potential for non-federal Eastside owners to increase harvest for several decades could be severely tested.

The potential to increase management on the Eastside remains just that, a *potential*. It does not appear that there has been a large shift to more intensive management over time. No analysis of the economic motivation to increase management intensity was undertaken other than to reflect owner intentions. So, while the potential exists for increased harvest through increased management on state and private lands, to make up for losses in national forest harvests or increased reserves on private land, the ultimate decision by individual owners will remain dependent upon market economics and the policy climate relative to owner objectives. There is no experience on which to base a prediction of the outcome.

Forest health problems have increased as a consequence of selective harvesting and less frequent fires. While the high management intensity scenarios increase partial cutting and restore productivity to some degree, they are not entirely substituting for the impact of frequent fires. One indicator is that grand fir continues to increase in share. More complex management treatments could be designed to cope with forest health problems. An examination of such approaches goes beyond the scope and budget of this study.

While there are many uncertainties in making predictions--even when tied to specific assumptions on initial conditions, the methodology suggests there does exist the potential for increased harvests by some owners.

As a bottom line on all of our analysis we believe that the decline in the harvest from the national forests along with reduced forest industry harvests due to declining mature inventories is more certain than are the increased harvests from the DNR, Native American, and nonindustrial ownerships. However, with declining harvests resulting in higher timber prices, increased harvests from the nonindustrial owners are more likely than are similar increases on DNR and Native American lands. Depending on how these latter two groups react, the initial conditions harvest is likely to drop by 9-18% from the 1985-1992 historical average. Thus, average annual harvest levels under our initial condition assumptions during the first decade of the projection period (1991-2000) could be in the range of 990-1,100 MMBF. Again, this assumes no additional constraints from forest practices regulations.

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APPENDIX 1

HARVEST SCHEDULING LINEAR PROGRAM FORMATION

As described in Chapter III under Timber Harvest Scheduling Methods, a linear programming (LP) model was developed to schedule acres for harvest over the 100-year projection period. The details of the model are shown in this Appendix.

Objective Function:

$$\text{MAX VOL} = \sum_{i}^{I} \sum_{j}^{J} \left(\sum_{l}^{L} y_{ijl}\right) x_{ij}$$

where

x_{ij} = the number of acres represented by plot **i** assigned to management prescription **j** for a given owner and timbershed.

y_{ijl} = the Scribner board foot yield per acre associated with plot **i** under management prescription **j** during planning period **l**.

i = plot identifier running from 1, 2, ... , 560. (**I** = 560)

j = management prescription identifier running from 1, 2, ... , 8. No management is when **j** = 1; even-aged management is when **j** = 2-5; and uneven-aged management is when **j** = 6-8. (**J** = 8)

l = planning period (*i.e.*, decade) identifier running from 1, 2, ... , 10. Decade 1 runs from 1990-1999, decade 2 from 2000-2009, etc., and decade 10 from 2080-2089. (**L** = 10)

VOL = Total Scribner board foot harvest volume over the 100 year planning horizon for a given owner and timbershed.

Acreage Constraints:

$$\sum_{i \varepsilon \Omega_i} x_{ij} = S_i \qquad i = 1, 2, \ldots I$$

where

$\mathbf{S}_i$ = the total area in acres represented by plot **i**.

Ω_i = the set of management prescriptions which apply to plot **i**.

$$\sum_{j \varepsilon Y_i} x_{ij} = M_j \qquad j = 1, 2, \ldots 8$$

where

$\mathbf{M}_j$ = the total area in acres which must be assigned to management prescription **j**

Y_j = the set of plots which are subject to management prescription **j**

Timber Harvest Flow Constraints:

$$[(1 + \alpha) \sum_i \sum_j y_{ijl} x_{ij}] - [\sum_i \sum_j y_{ij(l+1)} x_{ij}] \geq 0$$

$$[(1 - \alpha) \sum_i \sum_j y_{ijl} x_{ij}] - [\sum_i \sum_j y_{ij(l+1)} x_{ij}] \leq 0 \qquad l = 1, 2, \ldots L\text{-}1$$

where

α = a parameter which controls the tolerable variation in timber harvest flow between periods.

If this parameter is set equal to 0, the effect of the two timber harvest flow equations is to require the even-flow of harvest between sequential planning periods. If the parameter is set equal to 0.05, the effect is to require that the timber harvest flow between sequential periods differ by no more than ±5%. If the parameter is set equal to 0.25, the effect is to require that the timber harvest flow between sequential periods differ by no more than ±25%. Lastly, an unconstrained run is made by deleting the timber harvest flow constraints in their entirety.

APPENDIX 2

NATIONAL FOREST HARVEST UNDER INITIAL CONDITIONS

National Forest	PSQ/ASQ MMBF	Suitable Area '000 acres	Source	Baseline Harvest[g] MMBF
<u>Owl Forests</u>				
Wenatchee	24	290	a, b	24
Okanogan	6	85	a, b	6
Total	30	375		30
<u>Non-owl Forests</u>				
Okanogan	47	334	c, f	23
Colville	123	616	c, f	61
Umatilla	25	136	c, d, f	12
Panhandle	12	94	e, f	7
Total	207	1,180		103
Eastern Washington Total	237	1,555		133

[a]PSQ from Table 3 and 4 - 44, Option 9, Final SEIS on Management of Habitat for Late-Successional and Old-Growth Forest-Related Species Within the Range of the Northern Spotted Owl, Volume I, USDA Forest Service and USDI Bureau of Land Management, Washington DC, February 1994. All volumes expressed on 16 foot basis.

[b]Suitable acres from Table 11, Option 9, Sustainable Harvest Levels and Short-Term Timber Sales for Options Considered in the Report of the Forest Ecosystem Management Assessment Team: Methods, Results, and Interpretations, Johnson, *et al.*, 1993. (Report available from Interagency Team Leader, Post Office Box 3623, Portland OR 97208.)

[c]ASQ and suitable acres from personal communication with Sarah Crim, Timber Management Analyst, Pacific Northwest Region, USDA Forest Service, Portland Or, dated 15 February 1994.

[d]ASQ and suitable acres only reflect that portion of the Umatilla National Forest in Washington State.

[e]Suitable acres only reflect that portion of the Idaho Panhandle National forest (former Kaniksu National Forest) in Washington State. Personal communication from Karl Krueger, Idaho Panhandle National Forest, Coeur d'Alene ID, dated 27 May 1992. ASQ estimated by authors of the Eastern Washington Timber Supply Report.

[f]For non-owl forests the ASQ and suitable acre numbers reflect published information from the most recent forest plans. It is likely that these numbers will be revised downward when these plans are revised. For example, in 1992 and 1993, the total timber harvest from the Colville was about 29 MMBF. For the Washington portion of the Umatilla, the timber harvest was 9 and 4 MMBF in 1992 and 1993, respectively.

[g]The FEMAT Report of July 1993 shows that the ASQ levels reflected above for non-owl forests may well be further reduced. They estimate in Table VI-2 that PSQs for eastern Washington National Forests will be 102 MMBF under Option 9. This is a reduction of about 50% of the above ASQ levels. Thus, our baseline estimates for non-owl forests is approximately 50% of the ASQs shown in the first column.

Summary of National Forest Statistics by Timbershed

Timbershed	PSQ MMBF	Suitable Area '000 Acres	Baseline Harvest MMBF
Central Cascades	77	709	53
Inland Empire	160	846	80
Total	237	1,555	133

APPENDIX 3

FIA PLOT DISTRIBUTION BY OWNER AND TYPE

Central timbershed: Expansion factor (acres/plot)	Central timbershed: Plot frequency	Inland Empire timbershed: Expansion factor (acres/plot)	Inland Empire timbershed: Plot frequency
Department of Natural Resources			
4670.4	3	2301.3	2
6330.2	12	4811.8	2
7951.3	12	6640.8	19
8620.4	16	6903.8	11
8707.9	5		
Subtotal	48	Subtotal	34
Forest Industry			
6484.6	6	5855.5	34
7287.4	14	6443.6	1
7331.1	21	6995.9	5
8221.5	8	8696.4	18
8491.7	14		
Subtotal	63	Subtotal	58
Native Americans			
5872	30	2147.9	3
6087.6	1	6571.4	34
6606.5	19	8851.1	1
8283.9	25	9279.3	27
8742.6	8		
Subtotal	83	Subtotal	65
Nonindustrial landowners			
3473.9	3	5292.9	1
5492	1	5408	2
6021.4	3	5648.6	10
6658.3	6	6492.9	76
7719.7	3	7231.7	61
7922.1	19	8486.3	4
7991.2	1	10401.8	3
8751.7	15	12334.8	1
Subtotal	51	Subtotal	158
Total	245	Total	315

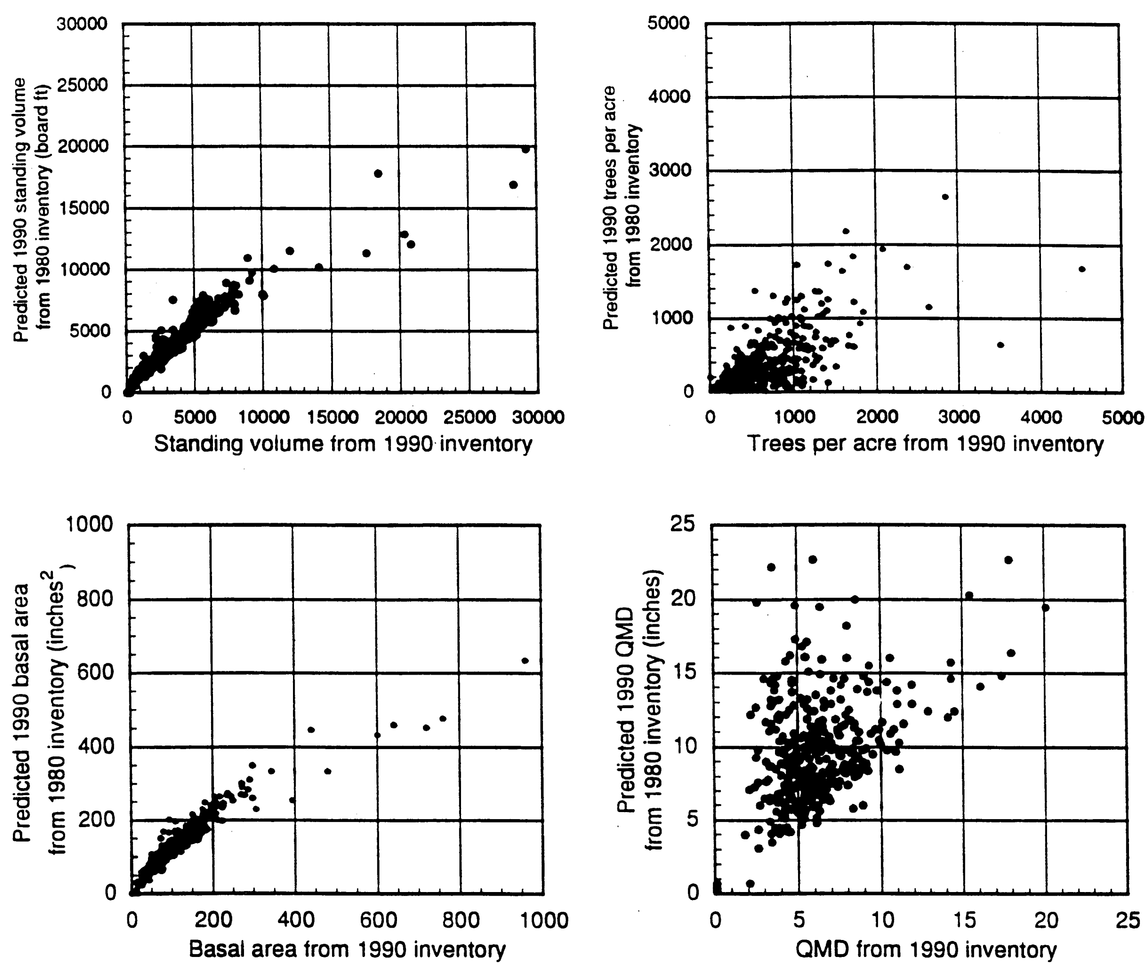
APPENDIX 4

PREDICTION ANALYSIS OF 1990 INVENTORY FROM 1980 INVENTORY

The process for verifying the accuracy of PROGNOSIS projections included an evaluation of predicting the results of the 1990 survey from the 1980 survey for those plots that were not harvested. Table A.4.1 shows a comparison of the actual inventory for 1990 and the predicted 1990 inventory starting from the 1980 survey.

For volume there is a slight tendency to overpredict the volume on low-volume stands but to underpredict volume on high-volume stands. The same is true for basal area.

The prediction of trees per acre is much less certain, as is the general measurement uncertainty of the number of trees per acre. The prediction for diameter shows more trees with large diameters than were observed, which, when coupled with a smaller discrepancy on volume suggests that there are offsetting errors between height and diameter.



These plots show the results of a comparision between predicted parameters from 1980 inventory data, and the condition of those parameters in 1990 inventory. Individual plots are compared for this analysis. Only the 384 plots that did not have any harvesting or silvicultural management from 1980 to 1990 were included in this analysis.

APPENDIX 5

CONVERSION RATIOS

Conversion ratios from cubic foot to board foot by owner for the inventory data are shown in the table below. Differences among owners reflect differences in the tree diameter distribution inherent in the inventory data.

	Softwoods	Hardwoods	Combined species
Central Timbershed			
DNR	3.73	2.09	3.70
Forest industry	3.47	2.45	3.46
Native American	3.43	1.88	3.40
Nonindustrial	3.05	3.12	3.06
Inland Empire Timbershed			
DNR	2.99	3.22	3.00
Forest industry	3.12	2.15	3.10
Native American	3.41	3.40	3.40
Nonindustrial	2.82	3.25	2.84

APPENDIX 6

SENSITIVITY ANALYSIS TABLES FOR SPECIES CHANGE

Table 6.1a: Projections of average annual harvest (MMBF), Inland Empire and Central Timbersheds, with all ownerships aggregated and for different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have harvest constraints that allow variation of ± 5%. The LESS 15% LP run for nonindustrial in the Inland Empire Timbershed, however, required harvest constraints of 25% in order to generate a feasible solution.

SPECIES	YEAR 1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	BASE LP RUN									
White Pine	7.52	4.48	2.45	3.05	2.12	4.48	1.26	39.22	33.89	50.39
Western Larch	59.17	56.09	52.07	33.04	48.18	30.72	25.21	29.78	27.81	18.03
Douglas-fir	388.94	396.70	403.17	379.69	411.10	426.86	426.49	431.07	418.90	393.43
Grand fir	137.87	117.85	120.72	146.71	142.26	149.19	164.43	142.40	162.32	191.93
Western Helmock	1.73	0.00	0.85	4.61	4.49	3.86	4.75	3.14	3.41	6.53
Western Redcedar	22.18	13.47	18.51	28.56	40.54	23.88	28.87	23.35	27.01	28.41
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.69	7.27	9.95
Engelman Spruce	34.87	30.24	16.96	21.87	17.64	23.05	22.86	28.03	11.32	19.34
Subapine fir	2.52	3.48	11.08	11.43	7.19	12.23	9.59	24.80	17.22	9.02
Ponderosa Pine	357.82	338.51	325.42	329.95	300.02	274.65	294.82	233.06	267.33	281.61
nonindustrial	56.78	72.46	70.19	64.57	54.49	69.97	58.47	72.02	74.21	58.76
	LOW LP RUN									
White Pine	7.52	4.48	2.45	3.94	3.36	2.27	15.78	4.58	11.40	22.57
Western Larch	60.61	48.36	56.32	43.51	50.09	36.91	33.33	29.04	28.63	17.21
Douglas-fir	443.37	330.83	387.06	381.08	413.46	422.74	470.77	419.57	406.52	417.18
Grand fir	194.10	94.91	120.25	135.97	139.10	161.97	170.35	140.35	158.12	141.16
Western Helmock	1.73	0.00	0.85	4.61	4.49	3.86	4.75	3.16	3.38	6.53
Western Redcedar	29.34	12.57	20.14	25.98	66.86	25.16	29.05	26.62	24.04	21.56
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	1.75	10.16
Engelman Spruce	37.00	30.92	18.65	14.52	17.45	23.05	27.50	27.79	11.70	15.20
Subapine fir	2.52	3.48	11.08	7.94	7.19	12.23	17.76	14.02	16.76	8.72
Ponderosa Pine	369.61	347.89	335.45	319.34	301.04	273.36	240.19	237.96	223.25	236.19
nonindustrial	53.36	77.55	74.04	66.98	56.56	74.64	63.10	74.09	72.93	46.46
	HIGH LP RUN									
White Pine	19.06	0.00	0.77	7.29	0.45	2.14	5.19	54.64	44.43	2.32
Western Larch	335.15	38.71	19.90	33.28	30.03	15.66	15.80	9.03	12.10	5.48
Douglas-fir	1362.57	192.49	328.07	181.90	270.02	238.15	372.16	338.01	424.44	312.57
Grand fir	607.81	39.92	70.44	162.11	123.47	94.28	117.33	206.01	236.27	130.76
Western Helmock	28.57	6.04	0.00	0.85	7.12	0.00	0.00	2.30	2.61	2.37
Western Redcedar	92.46	11.91	15.65	8.96	13.96	26.24	15.38	13.23	20.34	15.67
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.01	0.21	2.84	2.08	10.39
Engelman Spruce	111.35	37.07	11.07	16.13	7.98	5.42	6.58	23.77	0.00	8.08
Subapine fir	36.42	6.96	3.08	9.24	12.16	14.19	4.52	24.74	9.26	33.22
Ponderosa Pine	1110.73	195.88	423.37	208.82	234.71	272.73	372.07	341.30	406.00	315.59
nonindustrial	254.59	22.80	37.62	63.55	49.70	34.82	51.24	11.44	25.70	41.14
	BOOST LP RUN									
White Pine	9.83	3.77	1.96	5.59	2.94	1.64	12.67	39.24	38.24	44.11
Western Larch	74.96	54.17	40.45	39.73	39.13	24.64	26.95	29.26	29.70	16.82
Douglas-fir	485.24	354.77	414.14	355.43	377.44	382.04	388.08	407.62	425.56	457.57
Grand fir	285.53	120.76	94.93	170.59	117.73	153.16	181.57	156.65	197.83	181.17
Western Helmock	3.23	0.00	0.00	2.34	5.52	1.91	4.75	3.19	3.38	5.79
Western Redcedar	26.97	12.83	16.01	27.86	41.51	22.06	26.77	23.40	29.01	29.29
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.02	0.52	0.60	14.37	9.69
Engelman Spruce	40.41	28.70	17.37	26.38	15.95	15.55	22.63	27.07	10.76	19.30
Subapine fir	11.08	3.24	11.87	12.39	6.82	8.58	9.56	21.96	16.50	21.93
Ponderosa Pine	374.95	425.53	417.29	320.67	377.16	317.03	311.07	328.49	301.44	357.24
nonindustrial	64.63	79.42	66.15	72.73	59.67	66.66	57.01	58.43	65.07	63.38

Table 6.1b (continuation): Projections of average annual harvest (MMBF), Inland Empire and Central Timbersheds, with all ownerships aggregated and for different LP runs. The harvest flow constraint varies among LP runs; the Low and HIGH runs have no constraints, while the others have harvest constraints that allow variation of ± 5%. The LESS 15% LP run for nonindustrial in the Inland Empire Timbershed, however, required harvest constraints of 25% in order to generate a feasible solution.

SPECIES	YEAR									
	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	less 15% LP RUN									
White Pine	3.47	3.58	2.27	3.94	3.41	2.32	10.68	33.14	10.64	41.73
Western Larch	48.09	40.18	44.17	26.48	45.53	28.17	26.12	24.03	25.18	14.11
Douglas-fir	323.46	351.46	365.60	324.01	345.95	361.83	370.85	383.61	379.58	368.57
Grand fir	150.60	98.86	113.19	150.67	131.19	155.29	158.08	140.61	160.49	156.23
Western Helmock	1.73	0.00	0.85	4.61	4.49	3.86	2.92	3.16	3.38	6.53
Western Redcedar	20.16	11.11	16.35	25.05	40.67	23.75	28.72	23.59	25.67	28.79
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.44	12.88	6.76
Engelman Spruce	34.25	27.71	16.50	24.26	16.70	23.05	22.53	27.42	11.22	16.64
Subapine fir	2.52	3.48	10.18	12.35	7.19	13.11	9.59	24.59	17.44	9.81
Ponderosa Pine	322.17	303.37	313.98	268.08	279.44	242.94	210.05	214.09	217.95	260.41
nonindustrial	47.16	70.68	56.40	56.02	46.52	70.74	51.09	61.87	66.93	55.13
	Boost and less 15% LP RUN									
White Pine	5.01	3.10	2.27	6.44	3.41	3.81	10.53	31.84	23.84	30.30
Western Larch	53.82	51.46	38.06	32.41	35.90	23.76	19.88	22.68	26.09	13.08
Douglas-fir	346.62	344.46	387.03	331.18	331.30	336.72	346.84	355.50	367.21	389.22
Grand fir	248.87	113.34	84.64	155.27	104.43	144.67	176.46	141.58	180.30	163.44
Western Helmock	2.16	0.00	0.00	2.20	5.52	1.91	2.92	3.16	3.38	6.02
Western Redcedar	23.92	10.86	13.69	24.35	37.23	20.79	24.91	22.51	24.13	25.71
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.24	13.34	9.47
Engelman Spruce	33.80	26.22	15.64	27.34	16.09	23.05	21.63	27.95	11.12	15.02
Subapine fir	1.66	2.97	10.22	11.90	5.27	13.11	7.12	23.60	16.04	9.50
Ponderosa Pine	298.53	389.71	380.61	279.94	324.50	291.10	272.17	279.96	268.16	313.32
nonindustrial	49.33	68.87	55.00	64.86	41.55	64.25	49.91	53.39	58.50	54.30

Table 6.2a: Projections of average annual harvest (MMBF), Inland Empire Timbershed, with all ownerships aggregated and for different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have harvest constraints that allow variation of ± 5%. The LESS 15% LP run for nonindustrial, however, required harvest constraints of 25% in order to generate a feasible solution.

SPECIES	YEAR									
	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	BASE LP RUN									
White Pine	4.11	4.48	0.18	1.81	0.64	1.64	0.00	18.27	7.59	34.10
Western Larch	44.29	33.73	36.65	25.40	39.28	21.73	23.44	23.29	23.53	13.07
Douglas-fir	160.23	220.37	209.10	221.01	256.48	253.74	249.37	243.70	264.01	246.74
Grand fir	90.10	50.95	38.22	55.27	42.83	44.53	70.54	50.18	56.54	54.63
Western Helmock	1.73	0.00	0.85	4.61	4.49	3.86	4.75	3.14	3.41	6.53
Western Redcedar	21.25	13.32	18.51	23.78	39.18	21.31	25.70	22.71	25.45	27.08
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	6.67	6.21
Engelman Spruce	7.30	4.77	3.73	2.64	6.75	8.38	7.75	12.30	6.14	11.81
Subapine fir	0.91	0.54	6.37	1.51	2.04	3.61	3.21	14.15	4.13	0.92
Ponderosa Pine	178.31	161.29	183.71	179.14	141.87	175.20	171.55	140.10	151.59	173.42
nonindustrial	37.59	33.08	34.21	26.57	24.26	34.25	20.61	35.55	29.86	17.81
	LOW LP RUN									
White Pine	4.11	4.48	0.18	1.81	0.64	1.64	11.76	2.62	3.01	10.47
Western Larch	35.49	35.77	37.99	25.37	34.21	21.57	28.11	23.91	23.67	12.54
Douglas-fir	193.45	189.63	235.78	224.54	272.21	256.13	257.48	250.96	254.10	293.17
Grand fir	133.29	48.34	42.09	48.34	43.64	51.70	73.14	50.95	50.25	87.39
Western Helmock	1.73	0.00	0.85	4.61	4.49	3.86	4.75	3.16	3.38	6.53
Western Redcedar	28.72	12.57	20.14	21.29	65.45	22.51	25.81	25.96	22.42	23.07
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	1.14	3.03
Engelman Spruce	7.30	4.72	3.73	4.32	4.87	8.38	10.56	10.23	6.14	10.66
Subapine fir	0.91	0.54	6.37	1.51	2.04	3.61	11.38	2.60	4.10	0.02
Ponderosa Pine	181.21	166.20	186.49	166.49	166.86	172.49	133.00	134.73	136.75	146.80
nonindustrial	38.02	32.79	39.47	27.32	27.19	40.39	22.34	34.49	27.27	25.10
	HIGH LP RUN									
White Pine	9.56	0.00	0.00	5.57	0.45	2.01	1.84	21.98	15.01	0.00
Western Larch	180.05	32.51	18.31	23.26	21.59	13.81	12.68	4.05	6.44	5.48
Douglas-fir	609.74	87.90	140.23	129.60	187.47	158.49	225.71	239.69	266.71	208.92
Grand fir	249.04	22.77	38.36	66.41	34.31	37.08	54.26	112.89	103.59	48.46
Western Helmock	12.76	0.00	0.00	0.85	7.12	0.00	0.00	2.30	2.61	2.31
Western Redcedar	82.77	8.31	12.05	8.96	13.96	26.24	10.24	12.65	20.34	15.67
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.01	0.07	0.42	1.47	6.20
Engelman Spruce	41.95	0.87	3.46	0.00	1.32	1.20	0.48	6.40	0.00	1.15
Subapine fir	16.89	0.00	0.00	0.00	0.00	7.64	0.00	12.13	0.04	13.61
Ponderosa Pine	566.99	105.70	199.03	87.22	167.48	162.34	220.93	153.87	218.74	162.75
nonindustrial	133.54	12.09	31.95	32.95	24.62	14.18	19.93	8.07	9.45	29.86
	BOOST LP RUN									
White Pine	4.90	3.77	0.13	4.71	0.64	1.64	1.83	20.85	9.93	34.76
Western Larch	51.96	46.82	30.50	26.62	32.81	20.65	26.63	22.51	24.02	12.59
Douglas-fir	198.00	210.63	239.88	217.93	230.89	219.75	243.25	234.64	271.83	281.08
Grand fir	115.62	60.53	33.77	82.00	44.56	49.47	88.46	70.57	69.50	65.43
Western Helmock	3.23	0.00	0.00	2.34	5.52	1.91	4.75	3.19	3.38	5.79
Western Redcedar	26.35	12.83	16.01	24.60	38.68	19.98	24.61	22.74	27.40	27.91
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.02	0.19	0.19	13.61	4.84
Engelman Spruce	7.30	4.77	3.73	2.64	6.75	8.38	7.88	12.30	6.14	11.81
Subapine fir	0.91	0.54	6.37	1.51	2.04	3.61	3.21	14.15	4.13	0.95
Ponderosa Pine	175.59	217.83	227.19	161.26	180.13	213.03	160.57	182.37	172.25	197.70
nonindustrial	41.00	36.92	33.93	38.18	20.27	32.20	18.15	22.55	23.53	19.15

Table 6.2b (continuation): Projections of average annual harvest (MMBF), Inland Empire Timbershed, with all ownerships aggregated and for different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have harvest constraints that allow variation of ± 5%. The LESS 15% LP run for nonindustrial, however, required harvest constraints of 25% in order to generate a feasible solution.

SPECIES	YEAR									
	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	less 15% LP RUN									
White Pine	3.03	3.58	0.00	1.81	0.64	1.64	0.00	18.27	5.44	32.11
Western Larch	38.68	32.83	32.93	22.15	39.12	21.84	25.37	18.91	22.75	10.04
Douglas-fir	162.02	191.49	211.49	191.23	217.45	214.59	207.28	223.38	237.86	227.60
Grand fir	88.90	50.30	40.70	57.06	42.20	44.93	70.56	51.85	47.57	52.68
Western Helmock	1.73	0.00	0.85	4.61	4.49	3.86	2.92	3.16	3.38	6.53
Western Redcedar	19.60	11.11	16.35	21.59	38.10	21.11	25.48	22.93	24.05	27.41
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	12.30	3.86
Engelman Spruce	7.30	4.77	3.73	2.64	6.75	8.38	7.88	12.30	6.14	11.81
Subapine fir	0.91	0.54	5.47	1.51	2.04	3.61	3.21	14.15	4.13	0.92
Ponderosa Pine	156.76	148.97	185.80	159.67	140.81	164.37	115.77	123.36	124.05	149.50
nonindustrial	30.65	30.92	28.08	23.55	18.09	32.98	18.47	29.43	24.66	16.12
	Boost and less 15% LP RUN									
White Pine	4.35	3.10	0.00	4.31	0.64	2.99	1.02	21.69	10.93	24.31
Western Larch	40.46	44.44	29.88	25.97	29.53	19.80	19.48	20.36	22.91	11.17
Douglas-fir	182.85	188.58	219.30	197.77	199.06	182.98	220.53	202.04	236.83	246.92
Grand fir	116.84	59.03	33.56	82.46	40.04	46.79	85.81	64.43	71.42	65.42
Western Helmock	2.16	0.00	0.00	2.20	5.52	1.91	2.92	3.16	3.38	6.02
Western Redcedar	23.06	10.74	13.69	23.71	36.11	20.23	23.57	22.51	24.13	25.71
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.10	12.84	5.58
Engelman Spruce	7.30	4.77	3.73	2.64	6.75	8.38	7.88	12.30	6.14	11.81
Subapine fir	0.05	0.03	5.51	0.09	0.12	3.61	0.74	13.36	2.55	0.92
Ponderosa Pine	157.62	196.27	206.02	137.76	158.40	195.67	140.36	160.65	148.97	179.79
nonindustrial	33.30	33.27	27.14	34.85	14.45	29.68	13.79	19.10	18.38	13.71

Table 6.3a: Projections of average annual harvest (MMBF), Central Timbershed, with all ownerships aggregated and for different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have harvest constraints that allow variation of ± 5%.

SPECIES	YEAR 1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	BASE LP RUN									
White Pine	3.42	0.00	2.27	1.24	1.48	2.84	1.26	20.96	26.30	16.29
Western Larch	14.88	22.37	15.43	7.63	8.89	8.98	1.76	6.49	4.28	4.97
Douglas-fir	228.71	176.34	194.05	158.67	154.62	173.12	177.11	187.37	154.92	146.68
Grand fir	47.78	66.90	82.51	91.43	99.44	104.64	93.89	92.21	105.79	137.30
Western Helmock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.93	0.15	0.00	4.79	1.36	2.57	3.18	0.64	1.56	1.33
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.54	0.60	3.74
Engelman Spruce	27.58	25.47	13.23	19.23	10.89	14.67	15.20	15.73	5.18	7.53
Subapine fir	1.61	2.94	4.71	9.92	5.15	8.62	6.38	10.66	13.08	8.10
Ponderosa Pine	179.50	177.21	141.72	150.80	158.15	99.44	123.26	92.97	115.73	108.19
nonindustrial	19.20	39.38	35.98	38.00	30.23	35.72	37.86	36.47	44.36	40.95
	LOW LP RUN									
White Pine	3.42	0.00	2.27	2.12	2.72	0.63	4.02	1.95	8.39	12.10
Western Larch	25.12	12.59	18.34	18.15	15.88	15.34	5.23	5.13	4.95	4.66
Douglas-fir	249.92	141.20	151.29	156.52	141.25	166.60	213.30	168.61	152.42	212.37
Grand fir	60.81	46.57	78.16	87.63	95.48	110.26	97.19	89.40	107.87	118.83
Western Helmock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.62	0.00	0.00	4.69	1.41	2.65	3.24	0.66	1.61	1.38
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.61	7.13
Engelman Spruce	29.71	26.20	14.92	10.20	12.58	14.67	16.94	17.57	5.56	5.94
Subapine fir	1.61	2.94	4.71	6.43	5.15	8.62	6.38	11.43	12.66	8.70
Ponderosa Pine	188.39	181.69	148.97	152.86	134.19	100.88	107.20	103.23	86.51	131.47
nonindustrial	15.35	44.76	34.57	39.67	29.39	34.24	40.76	39.60	45.67	43.25
	HIGH LP RUN									
White Pine	9.50	0.00	0.77	1.72	0.00	0.13	3.35	32.65	29.42	2.32
Western Larch	155.11	6.21	1.59	10.01	8.44	1.85	3.12	4.99	5.66	0.00
Douglas-fir	752.83	104.58	187.84	52.30	82.55	79.66	146.45	98.32	157.74	103.65
Grand fir	358.77	17.15	32.08	95.70	89.16	57.21	63.06	93.12	132.67	82.30
Western Helmock	15.82	6.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
Western Redcedar	9.69	3.60	3.59	0.00	0.00	0.00	5.15	0.58	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.15	2.43	0.61	4.20
Engelman Spruce	69.40	36.20	7.61	16.13	6.66	4.22	6.10	17.37	0.00	6.93
Subapine fir	19.54	6.96	3.08	9.24	12.16	6.55	4.52	12.61	9.23	19.62
Ponderosa Pine	543.73	90.17	224.34	121.60	67.22	110.40	151.14	187.44	187.26	152.84
nonindustrial	121.04	10.70	5.69	30.60	25.08	20.64	31.31	3.37	16.25	11.28
	BOOST LP RUN									
White Pine	4.93	0.00	1.83	0.89	2.30	0.00	10.84	18.39	28.31	9.35
Western Larch	23.01	7.35	9.95	13.10	6.32	3.98	0.32	6.75	5.68	4.22
Douglas-fir	287.23	144.14	174.26	137.50	146.56	162.29	144.83	172.98	153.73	176.48
Grand fir	169.92	60.24	61.16	88.58	73.17	103.69	93.11	86.07	128.34	115.76
Western Helmock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.62	0.00	0.00	3.26	2.83	2.08	2.16	0.66	1.61	1.38
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.41	0.77	4.85
Engelman Spruce	33.12	23.93	13.64	23.74	9.20	7.17	14.76	14.77	4.62	7.49
Subapine fir	10.16	2.69	5.50	10.88	4.77	4.98	6.34	7.82	12.37	20.98
Ponderosa Pine	199.36	207.70	190.11	159.42	197.03	103.99	150.49	146.12	129.19	159.54
nonindustrial	23.63	42.49	32.23	34.57	39.41	34.46	38.86	35.88	41.54	44.23

Table 6.3b (continuation): Projections of average annual harvest (MMBF), Central Timbershed, with all ownerships aggregated and for different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have harvest constraints that allow variation of ± 5%.

SPECIES	YEAR 1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	less 15% LP RUN									
White Pine	0.44	0.00	2.27	2.12	2.77	0.68	10.68	14.88	5.20	9.62
Western Larch	9.41	7.35	11.24	4.33	6.41	6.33	0.75	5.12	2.43	4.07
Douglas-fir	161.45	159.96	154.11	132.79	128.49	147.24	163.56	160.24	141.72	140.96
Grand fir	61.71	48.56	72.49	93.61	88.99	110.34	87.51	88.76	112.92	103.55
Western Helmock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.56	0.00	0.00	3.46	2.56	2.65	3.24	0.66	1.61	1.38
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.34	0.58	2.90
Engelman Spruce	26.96	22.94	12.77	21.62	9.95	14.67	14.66	15.12	5.08	4.83
Subapine fir	1.61	2.94	4.71	10.84	5.15	9.50	6.38	10.45	13.31	8.88
Ponderosa Pine	165.41	154.40	128.18	108.42	138.62	78.56	94.28	90.74	93.90	110.91
nonindustrial	16.52	39.75	28.32	32.47	28.43	37.76	32.63	32.44	42.29	39.02
	Boost and less 15% LP RUN									
White Pine	0.66	0.00	2.27	2.12	2.77	0.83	9.51	10.15	12.91	5.99
Western Larch	13.35	7.02	8.17	6.42	6.37	3.95	0.40	2.32	3.18	1.91
Douglas-fir	163.77	155.88	167.72	133.40	132.24	153.74	126.30	153.46	130.37	142.29
Grand fir	132.03	54.31	51.08	72.82	64.38	97.86	90.64	77.14	108.88	98.01
Western Helmock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.85	0.12	0.00	0.64	1.12	0.57	1.33	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.14	0.50	3.88
Engelman Spruce	26.51	21.45	11.92	24.70	9.34	14.67	13.76	15.65	4.98	3.21
Subapine fir	1.61	2.94	4.71	11.81	5.15	9.50	6.38	10.25	13.49	8.58
Ponderosa Pine	140.91	193.45	174.58	142.17	166.12	95.43	131.81	119.30	119.18	133.53
nonindustrial	16.04	35.60	27.86	30.00	27.10	34.57	36.12	34.30	40.12	40.58

Table 6.4a: Projections for DNR, Inland Empire and Central Timbersheds, of average annual harvest (MMBF) under different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have constraints of ± 5%.

SPECIES	YEAR									
	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	BASE LP RUN									
White Pine	1.08	0.89	0.18	0.00	0.00	0.00	0.00	7.56	0.00	0.31
Western Larch	13.79	7.47	11.21	9.20	6.58	8.10	5.37	10.88	7.32	5.89
Douglas-fir	76.25	70.26	76.23	47.92	57.35	59.42	53.70	62.10	63.14	52.50
Grand fir	12.15	8.46	3.66	14.29	4.70	11.07	12.53	17.18	17.95	25.43
Western Hemlock	0.00	0.00	0.00	0.00	1.74	1.21	0.00	0.00	0.00	4.48
Western Redcedar	2.41	7.19	2.42	7.34	4.86	4.35	6.91	3.50	7.64	3.74
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.15
Engelman Spruce	17.27	14.59	13.60	18.92	12.77	7.72	13.52	8.51	5.18	7.53
Subapine fir	0.00	0.00	0.00	6.34	3.15	3.38	0.79	2.89	6.85	2.47
Ponderosa Pine	40.66	49.76	38.16	27.93	41.49	27.53	42.20	33.69	34.00	30.97
nonindustrial	7.61	3.96	9.02	13.83	11.37	19.24	8.56	3.99	6.68	7.98
	LOW LP RUN									
White Pine	1.08	0.89	0.18	0.00	0.00	0.00	0.00	0.00	2.13	2.39
Western Larch	2.07	5.77	10.57	8.80	6.02	7.46	6.14	11.40	9.89	6.05
Douglas-fir	80.27	49.20	64.91	53.35	59.66	57.32	64.33	57.41	49.32	73.75
Grand fir	13.61	8.82	8.19	8.22	8.78	12.60	16.79	13.58	10.30	33.31
Western Hemlock	0.00	0.00	0.00	0.00	1.74	1.21	0.00	0.00	0.00	4.48
Western Redcedar	3.93	4.67	3.34	7.56	2.06	7.16	6.87	5.83	7.40	3.65
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.04	0.94
Engelman Spruce	19.40	15.27	15.29	11.57	12.58	7.73	14.99	10.68	5.56	5.94
Subapine fir	0.00	0.00	0.00	2.85	3.15	3.38	0.79	3.67	6.43	3.24
Ponderosa Pine	30.04	49.87	41.25	35.43	40.42	24.90	31.61	22.20	25.88	24.27
nonindustrial	0.85	4.93	11.21	15.71	8.46	16.44	9.99	6.90	9.46	6.52
	HIGH LP RUN									
White Pine	1.76	0.00	0.00	0.00	0.00	0.00	0.09	9.30	0.20	0.00
Western Larch	46.13	15.39	8.98	14.78	2.18	2.84	2.57	7.10	3.84	0.00
Douglas-fir	269.92	59.84	60.29	35.85	37.51	44.56	39.30	29.17	48.60	75.27
Grand fir	26.94	5.24	13.04	14.83	8.20	15.60	10.08	38.74	13.23	24.86
Western Hemlock	2.90	0.00	0.00	0.39	0.00	0.00	0.00	0.27	0.00	0.00
Western Redcedar	22.30	8.13	8.00	1.05	0.00	3.37	8.42	1.74	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.41	0.01	3.73
Engelman Spruce	38.38	26.80	7.61	16.13	6.66	5.05	2.06	16.20	0.00	6.39
Subapine fir	0.00	6.96	0.00	5.38	0.00	0.00	4.52	7.73	0.00	3.20
Ponderosa Pine	90.28	40.55	26.70	0.52	30.94	33.75	22.03	63.26	36.32	29.75
nonindustrial	42.29	5.06	2.16	7.41	5.80	14.43	9.94	7.82	2.42	5.61
	BOOST LP RUN									
White Pine	0.81	0.67	0.13	0.00	0.00	0.00	0.04	7.59	2.22	0.23
Western Larch	4.91	12.47	10.35	12.22	6.98	9.08	5.56	12.10	8.77	5.39
Douglas-fir	74.82	70.10	85.08	51.38	60.81	57.03	52.92	55.28	57.73	52.80
Grand fir	20.34	7.70	3.37	16.63	4.85	14.10	14.11	20.65	19.60	29.16
Western Hemlock	0.00	0.00	0.00	0.38	1.74	1.21	0.00	0.00	0.00	3.75
Western Redcedar	2.10	7.03	2.42	5.66	6.59	4.42	7.13	3.52	7.69	3.70
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.02	0.06	0.07	0.00	0.19
Engelman Spruce	19.34	13.05	14.01	23.43	11.08	6.94	13.62	6.89	4.62	7.49
Subapine fir	0.00	0.00	0.00	8.23	3.15	3.38	0.82	2.48	7.08	2.03
Ponderosa Pine	44.40	53.60	35.55	20.23	38.33	30.46	44.67	40.66	37.08	35.33
nonindustrial	10.38	4.13	9.46	12.69	14.57	19.29	8.68	3.60	6.49	8.21

Table 6.4b (continuation): Projections for DNR, Inland Empire and Central Timbersheds, of average annual harvest (MMBF) under different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have constraints of ± 5%.

SPECIES	YEAR 1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	less 15% LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.60	0.00	0.31
Western Larch	16.68	7.78	10.70	8.27	6.16	7.41	5.13	9.63	5.22	5.19
Douglas-fir	69.23	68.81	65.39	41.90	49.70	53.65	55.75	59.03	53.25	52.15
Grand fir	10.26	7.48	5.10	14.07	6.01	11.35	13.35	18.09	15.87	23.64
Western Hemlock	0.00	0.00	0.00	0.00	1.74	1.21	0.00	0.00	0.00	4.48
Western Redcedar	2.04	7.03	2.42	6.01	6.06	4.42	7.00	3.52	7.70	3.82
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.09
Engelman Spruce	16.65	12.06	13.14	21.31	11.83	7.73	13.07	7.80	5.08	4.83
Subapine fir	0.00	0.00	0.00	7.26	3.15	3.38	0.79	2.69	6.96	2.15
Ponderosa Pine	32.62	39.99	34.39	20.71	33.58	17.56	24.16	22.38	30.28	25.06
nonindustrial	7.28	3.77	8.49	11.90	9.61	19.24	8.21	3.52	6.33	6.91
	Boost and less 15% LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.06	7.59	1.39	0.17
Western Larch	9.21	10.06	7.87	9.74	6.68	6.73	5.29	8.37	6.16	3.68
Douglas-fir	69.43	66.52	73.52	43.82	57.36	50.60	49.95	51.49	50.41	49.37
Grand fir	14.77	7.08	4.87	16.78	5.30	12.06	12.67	16.50	19.91	28.65
Western Hemlock	0.00	0.00	0.00	0.23	1.74	1.21	0.00	0.00	0.00	3.97
Western Redcedar	2.33	7.15	2.42	3.08	4.43	2.34	5.02	2.86	6.08	2.36
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
Engelman Spruce	16.20	10.57	12.28	24.39	11.22	7.73	12.82	7.53	4.98	3.21
Subapine fir	0.00	0.00	0.00	8.23	3.15	3.38	0.79	2.48	7.08	1.84
Ponderosa Pine	37.14	45.72	33.59	19.15	33.31	26.02	38.39	36.43	30.38	31.38
nonindustrial	8.89	3.42	8.45	8.93	8.08	19.24	5.87	3.52	6.98	6.60

Table 6.5a: Projections for DNR, Inland Empire Timbershed, of average annual harvest (MMBF) under different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have constraints of ± 5%.

SPECIES	YEAR 1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
					BASE LP RUN					
White Pine	1.08	0.89	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.31
Western Larch	13.57	5.26	7.18	6.54	3.78	3.94	4.85	6.31	3.66	2.81
Douglas-fir	22.83	20.15	16.85	22.52	23.71	22.60	22.27	28.81	30.71	25.06
Grand fir	4.46	5.53	2.54	4.21	0.39	0.53	1.42	1.52	6.64	2.18
Western Hemlock	0.00	0.00	0.00	0.00	1.74	1.21	0.00	0.00	0.00	4.48
Western Redcedar	1.48	7.03	2.42	2.55	3.50	2.34	5.06	2.86	6.08	2.41
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Engelman Spruce	0.00	0.05	0.37	0.43	1.88	0.44	0.00	0.00	0.00	0.00
Subapine fir	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ponderosa Pine	11.94	16.00	21.51	11.65	12.47	13.10	13.89	13.60	7.14	15.45
nonindustrial	3.03	0.47	1.61	2.11	4.64	10.54	4.43	1.54	1.89	1.53
					LOW LP RUN					
White Pine	1.08	0.89	0.18	0.00	0.00	0.00	0.00	0.00	0.00	1.36
Western Larch	1.28	4.26	6.76	6.83	3.12	4.67	5.61	8.38	5.56	3.44
Douglas-fir	21.76	17.35	16.97	22.75	23.85	28.38	21.18	26.07	23.84	22.29
Grand fir	2.48	4.47	4.31	2.59	2.49	1.87	3.27	3.62	2.43	4.29
Western Hemlock	0.00	0.00	0.00	0.00	1.74	1.21	0.00	0.00	0.00	4.48
Western Redcedar	3.31	4.67	3.34	2.87	0.64	5.08	4.95	5.17	5.78	2.27
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Engelman Spruce	0.00	0.00	0.37	2.11	0.00	0.44	0.00	0.00	0.00	0.00
Subapine fir	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ponderosa Pine	11.76	23.23	14.57	14.79	10.90	13.18	9.12	4.87	11.06	8.31
nonindustrial	0.85	0.18	1.99	2.24	3.44	10.59	2.47	1.70	2.13	1.59
					HIGH LP RUN					
White Pine	1.76	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.20	0.00
Western Larch	44.63	14.42	7.39	9.72	0.00	2.77	2.42	3.89	0.60	0.00
Douglas-fir	71.85	16.38	9.18	15.57	11.29	24.67	24.42	12.16	15.51	41.96
Grand fir	10.25	0.17	7.89	1.47	0.00	6.75	3.85	15.92	5.42	12.21
Western Hemlock	2.90	0.00	0.00	0.39	0.00	0.00	0.00	0.27	0.00	0.00
Western Redcedar	12.61	4.53	4.41	1.05	0.00	3.37	3.28	1.74	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.84
Engelman Spruce	0.00	0.87	0.00	0.00	0.00	1.20	0.30	0.06	0.00	0.00
Subapine fir	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ponderosa Pine	22.69	16.93	14.89	0.00	16.36	10.79	9.20	12.31	13.81	7.23
nonindustrial	19.24	1.86	0.16	5.32	4.82	1.51	0.94	4.46	0.20	2.21
					BOOST LP RUN					
White Pine	0.81	0.67	0.13	0.00	0.00	0.00	0.04	0.00	0.09	0.00
Western Larch	4.91	10.00	6.40	6.80	4.38	5.61	5.34	7.26	3.71	3.22
Douglas-fir	24.03	23.65	20.31	23.74	26.69	20.11	24.11	24.47	27.96	24.92
Grand fir	7.68	4.87	1.17	5.05	0.91	3.16	2.64	7.22	6.98	5.04
Western Hemlock	0.00	0.00	0.00	0.38	1.74	1.21	0.00	0.00	0.00	3.75
Western Redcedar	1.48	7.03	2.42	2.39	3.77	2.34	4.97	2.86	6.08	2.32
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.04	0.00	0.00
Engelman Spruce	0.00	0.05	0.37	0.43	1.88	0.44	0.00	0.00	0.00	0.00
Subapine fir	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ponderosa Pine	15.26	10.46	22.03	10.04	9.03	11.58	10.70	11.58	6.90	16.11
nonindustrial	5.48	0.47	1.56	2.82	4.06	10.58	4.45	1.45	1.98	1.40

Table 6.5b (continuation): Projections for DNR, Inland Empire Timbershed, of average annual harvest (MMBF) under different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have constraints of ± 5%.

SPECIES	YEAR									
	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	less 15% LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31
Western Larch	16.68	5.99	7.46	6.41	3.57	4.05	4.67	6.11	3.42	2.66
Douglas-fir	21.12	20.66	13.08	19.63	18.50	20.58	21.01	25.01	27.60	23.17
Grand fir	3.30	4.95	3.58	3.25	1.63	1.50	2.51	3.17	4.16	3.98
Western Hemlock	0.00	0.00	0.00	0.00	1.74	1.21	0.00	0.00	0.00	4.48
Western Redcedar	1.48	7.03	2.42	2.55	3.5	2.34	5.08	2.86	6.09	2.44
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Engelman Spruce	0.00	0.05	0.37	0.43	1.88	0.44	0.00	0.00	0.00	0.00
Subapine fir	0.00	0.00	0.00	0	0	0.00	0.00	0.00	0.00	0.00
Ponderosa Pine	7.82	11.23	19.37	11.12	11.15	6.63	7.16	8.72	5.52	13.36
nonindustrial	2.70	0.47	1.62	2.11	3.08	10.54	4.43	1.37	1.89	1.03
	Boost and less 15% LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.14	0.03
Western Larch	9.21	8.55	6.79	6.66	4.09	5.47	5.10	7.10	3.60	3.02
Douglas-fir	21.21	22.35	16.03	19.57	23.62	17.10	20.08	22.31	21.88	22.95
Grand fir	7.08	5.34	1.27	5.20	0.37	1.31	3.40	2.99	9.65	4.60
Western Hemlock	0.00	0.00	0.00	0.23	1.74	1.21	0.00	0.00	0.00	3.97
Western Redcedar	1.48	7.03	2.42	2.44	3.31	2.34	5.01	2.86	6.08	2.36
Lodgepole Pine	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Engelman Spruce	0.00	0.05	0.37	0.43	1.88	0.44	0.00	0.00	0.00	0.00
Subapine fir	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ponderosa Pine	10.21	7.74	20.26	9.18	8.09	10.06	9.44	11.79	5.22	13.88
nonindustrial	4.31	0.21	1.58	2.57	3.08	10.54	2.89	1.37	2.03	1.03

Table 6.6a: Projections for DNR, Central Timbershed, of average annual harvest (MMBF) under different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have constraints of ± 5%.

SPECIES	YEAR 1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
BASE LP RUN										
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.56	0.00	0.00
Western Larch	0.22	2.20	4.03	2.67	2.79	4.16	0.52	4.57	3.66	3.08
Douglas-fir	53.42	50.11	59.38	25.40	33.64	36.82	31.44	33.29	32.43	27.44
Grand fir	7.70	2.93	1.13	10.09	4.31	10.54	11.10	15.66	11.32	23.24
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.93	0.15	0.00	4.79	1.36	2.01	1.85	0.64	1.56	1.33
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.15
Engelman Spruce	17.27	14.54	13.23	18.48	10.89	7.29	13.52	8.51	5.18	7.53
Subapine fir	0.00	0.00	0.00	6.34	3.15	3.38	0.79	2.89	6.85	2.47
Ponderosa Pine	28.72	33.76	16.65	16.28	29.02	14.43	28.32	20.09	26.86	15.51
nonindustrial	4.58	3.49	7.41	11.72	6.73	8.71	4.13	2.45	4.79	6.45
LOW LP RUN										
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.13	1.03
Western Larch	0.79	1.51	3.81	1.97	2.90	2.79	0.53	3.02	4.33	2.60
Douglas-fir	58.51	31.86	47.93	30.60	35.82	28.94	43.16	31.34	25.47	51.46
Grand fir	11.12	4.35	3.89	5.63	6.29	10.74	13.52	9.97	7.87	29.02
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.62	0.00	0.00	4.69	1.41	2.08	1.92	0.66	1.61	1.38
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.04	0.94
Engelman Spruce	19.40	15.27	14.92	9.45	12.58	7.29	14.99	10.68	5.56	5.94
Subapine fir	0.00	0.00	0.00	2.85	3.15	3.38	0.79	3.67	6.43	3.24
Ponderosa Pine	18.29	26.64	26.68	20.64	29.52	11.72	22.49	17.33	14.81	15.96
nonindustrial	0.00	4.76	9.22	13.48	5.03	5.85	7.52	5.20	7.33	4.93
HIGH LP RUN										
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.30	0.00	0.00
Western Larch	1.51	0.97	1.59	5.06	2.18	0.07	0.16	3.21	3.25	0.00
Douglas-fir	198.07	43.46	51.10	20.28	26.23	19.89	14.88	17.00	33.10	33.32
Grand fir	16.69	5.06	5.15	13.36	8.20	8.85	6.23	22.82	7.81	12.65
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	9.69	3.60	3.59	0.00	0.00	0.00	5.15	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.41	0.01	0.90
Engelman Spruce	38.38	25.93	7.61	16.13	6.66	3.84	1.76	16.14	0.00	6.39
Subapine fir	0.00	6.96	0.00	5.38	0.00	0.00	4.52	7.73	0.00	3.20
Ponderosa Pine	67.59	23.63	11.81	0.52	14.58	22.97	12.83	50.95	22.51	22.52
nonindustrial	23.04	3.20	2.00	2.09	0.98	12.92	9.00	3.37	2.22	3.40
BOOST LP RUN										
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.59	2.13	0.23
Western Larch	0.00	2.47	3.96	5.42	2.59	3.48	0.22	4.84	5.06	2.16
Douglas-fir	50.79	46.45	64.77	27.64	34.12	36.92	28.82	30.80	29.78	27.89
Grand fir	12.65	2.84	2.20	11.58	3.94	10.94	11.47	13.42	12.63	24.12
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.62	0.00	0.00	3.26	2.83	2.08	2.16	0.66	1.61	1.38
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.02	0.00	0.19
Engelman Spruce	19.34	13.00	13.64	22.99	9.20	6.50	13.62	6.89	4.62	7.49
Subapine fir	0.00	0.00	0.00	8.23	3.15	3.38	0.82	2.48	7.08	2.03
Ponderosa Pine	29.14	43.14	13.52	10.19	29.30	18.88	33.97	29.08	30.18	19.22
nonindustrial	4.90	3.66	7.90	9.87	10.51	8.71	4.23	2.15	4.51	6.81

Table 6.6b (continuation): Projections for DNR, Central Timbershed, of average annual harvest (MMBF) under different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have constraints of ± 5%.

SPECIES	YEAR 1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	less 15% LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.60	0.00	0.00
Western Larch	0.00	1.80	3.24	1.87	2.59	3.36	0.45	3.51	1.80	2.53
Douglas-fir	48.11	48.15	52.32	22.27	31.20	33.07	34.74	34.02	25.66	28.98
Grand fir	6.96	2.53	1.52	10.82	4.38	9.86	10.84	14.92	11.71	19.66
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.56	0.00	0.00	3.46	2.56	2.08	1.92	0.66	1.61	1.38
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.09
Engelman Spruce	16.65	12.01	12.77	20.87	9.95	7.29	13.07	7.80	5.08	4.83
Subapine fir	0.00	0.00	0.00	7.26	3.15	3.38	0.79	2.69	6.96	2.15
Ponderosa Pine	24.80	28.77	15.03	9.59	22.43	10.92	17.00	13.66	24.77	11.70
nonindustrial	4.58	3.31	6.87	9.79	6.53	8.71	3.77	2.15	4.44	5.88
	Boost and less 15% LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.59	1.25	0.13
Western Larch	0.00	1.51	1.08	3.08	2.59	1.26	0.19	1.27	2.56	0.66
Douglas-fir	48.22	44.17	57.49	24.25	33.74	33.50	29.86	29.18	28.53	26.42
Grand fir	7.70	1.73	3.60	11.58	4.93	10.75	9.27	13.51	10.26	24.04
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.85	0.12	0.00	0.64	1.12	0.00	0.01	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
Engelman Spruce	16.20	10.52	11.92	23.96	9.34	7.29	12.82	7.53	4.98	3.21
Subapine fir	0.00	0.00	0.00	8.23	3.15	3.38	0.79	2.48	7.08	1.84
Ponderosa Pine	26.93	37.99	13.33	9.96	25.22	15.96	28.95	24.64	25.16	17.49
nonindustrial	4.58	3.21	6.87	6.37	5.00	8.71	2.98	2.15	4.95	5.58

Table 6.7a: Projections for forest industry, Inland Empire and Central Timbersheds, of average annual harvest (MMBF) under different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have constraints of ± 5%. For Central Timbershed however, the boost run harvest flow constraint is ± 25% in order to obtain a feasible solution.

SPECIES	YEAR 1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	BASE LP RUN									
White Pine	3.42	1.55	2.27	1.24	2.12	4.48	1.26	27.74	17.22	9.61
Western Larch	20.42	19.55	7.63	7.33	5.99	7.39	1.44	1.93	4.54	2.82
Douglas-fir	120.41	118.03	120.35	95.45	77.71	79.89	88.98	92.83	89.77	69.48
Grand fir	44.06	44.79	24.10	39.54	30.30	42.63	44.72	40.68	56.80	73.13
Western Hemlock	1.73	0.00	0.00	1.59	0.26	0.67	4.75	3.02	1.74	1.29
Western Redcedar	10.88	4.72	7.41	10.24	21.36	11.64	8.96	5.88	8.38	13.80
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37	5.64	0.16
Engelman Spruce	2.12	3.62	2.22	1.06	1.90	8.76	2.73	4.11	2.85	6.90
Subapine fir	0.91	0.79	3.41	2.44	2.42	3.64	4.43	15.40	2.84	4.15
Ponderosa Pine	48.57	41.13	60.43	60.41	65.95	44.83	56.64	29.77	46.62	52.34
nonindustrial	7.86	13.29	7.58	4.27	4.33	5.12	5.36	7.11	2.56	4.99
	LOW LP RUN									
White Pine	3.42	1.55	2.27	2.12	3.36	2.27	15.78	0.65	5.03	7.45
Western Larch	22.73	9.07	9.98	8.63	7.61	8.28	1.91	2.46	2.31	2.78
Douglas-fir	138.30	90.13	93.42	95.55	79.52	88.02	118.26	89.56	79.13	101.47
Grand fir	28.20	17.29	22.01	33.03	25.64	52.65	36.02	38.21	52.78	45.30
Western Hemlock	1.73	0.00	0.00	1.59	0.26	0.67	4.75	3.02	1.74	1.29
Western Redcedar	8.65	6.34	7.85	7.70	22.10	10.1	9.18	6.76	5.71	9.59
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	1.93
Engelman Spruce	2.12	3.62	2.22	1.06	1.90	8.76	5.69	1.71	2.85	5.75
Subapine fir	0.91	0.79	3.41	2.44	2.42	3.64	12.59	3.85	2.80	3.06
Ponderosa Pine	69.45	39.43	52.17	46.15	60.06	37.55	43.93	42.65	22.86	59.67
nonindustrial	8.18	12.97	8.17	3.39	4.33	5.45	5.45	7.12	2.47	7.76
	HIGH LP RUN									
White Pine	6.73	0.00	0.77	2.52	0.45	1.79	3.35	18.03	35.09	2.32
Western Larch	49.35	4.37	2.90	6.05	6.33	0.45	1.85.	0.00	1.89	3.06
Douglas-fir	332.82	67.58	74.91	42.23	52.67	40.31	69.12	89.85	98.50	78.44
Grand fir	122.74	16.60	24.71	31.74	35.89	40.83	33.11	54.92	87.47	35.91
Western Hemlock	6.44	0.00	0.00	0.46	5.45	0.00	0.00	1.92	2.61	2.37
Western Redcedar	29.90	0.78	4.47	5.15	4.91	4.73	2.04	10.45	11.92	11.28
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.87	1.02
Engelman Spruce	15.91	0.00	3.46	0.00	0.00	0.00	0.00	7.57	0.00	1.15
Subapine fir	10.86	0.00	0.00	3.87	0.00	3.89	0.00	15.69	0.11	18.53
Ponderosa Pine	125.47	7.54	64.32	29.04	22.72	53.20	49.55	97.63	38.27	39.03
nonindustrial	21.85	5.42	0.84	4.86	4.27	4.16	0.30	1.03	4.69	1.05
	BOOST LP RUN									
White Pine	4.93	1.55	1.83	0.89	2.94	1.64	5.67	23.62	17.65	6.91
Western Larch	35.59	7.83	5.65	10.06	4.61	4.66	0.87	2.03	3.97	3.05
Douglas-fir	184.41	103.40	80.66	75.19	83.52	72.65	91.93	100.38	95.68	113.42
Grand fir	87.43	25.13	22.42	48.67	23.21	44.18	34.41	39.40	84.07	53.18
Western Hemlock	1.73	0.00	0.00	1.59	0.26	0.67	4.75	3.02	1.74	1.29
Western Redcedar	10.84	4.72	6.79	10.65	20.22	10.11	8.37	6.35	11.84	14.77
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	5.27	1.54
Engelman Spruce	5.59	3.62	2.22	1.06	1.90	2.05	2.18	4.77	2.85	6.90
Subapine fir	9.47	0.54	4.20	1.51	2.04	0.00	4.33	12.97	1.89	17.48
Ponderosa Pine	80.48	25.43	66.05	42.72	73.29	31.81	59.37	51.36	32.10	74.73
nonindustrial	11.56	13.18	7.01	4.13	6.44	4.22	4.64	5.94	4.09	6.50

Table 6.7b (continuation): Projections for forest industry, Inland Empire and Central Timbersheds, of average annual harvest (MMBF) under different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have constraints of ± 5%. For Central Timbershed however, the boost run harvest flow constraint is ± 25% in order to obtain a feasible solution.

SPECIES	YEAR									
	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	less 15% LP RUN									
White Pine	0.44	1.55	2.27	2.12	3.41	2.32	4.73	22.51	3.92	5.50
Western Larch	12.28	9.68	10.17	7.19	6.87	8.28	1.91	2.46	3.54	2.64
Douglas-fir	71.22	111.44	85.72	77.91	65.19	69.19	87.93	82.39	88.74	75.77
Grand fir	66.30	26.77	18.05	41.88	23.41	47.39	42.41	37.6	74.04	47.89
Western Hemlock	1.73	0.00	0.00	1.59	0.26	0.67	2.92	3.02	1.74	1.29
Western Redcedar	9.31	2.51	4.99	8.31	20.52	11.44	8.72	6.04	7.04	14.10
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	4.09	1.87
Engelman Spruce	2.12	3.62	2.22	1.06	1.90	8.76	2.64	4.22	2.85	6.90
Subapine fir	0.91	0.79	3.41	2.44	2.42	4.52	4.43	15.40	2.95	5.26
Ponderosa Pine	40.87	32.26	58.29	38.74	55.85	32.93	41.35	32.65	29.29	56.22
nonindustrial	5.78	12.33	5.76	2.84	4.21	7.53	5.45	5.88	2.11	4.92
	Boost and less 15% LP RUN									
White Pine	0.66	1.55	2.27	2.12	3.41	3.81	5.83	14.62	4.66	3.61
Western Larch	20.04	9.38	8.52	9.30	5.08	6.33	0.81	2.00	3.17	3.41
Douglas-fir	71.52	113.70	90.55	73.32	66.97	64.47	82.84	89.14	77.12	86.70
Grand fir	69.10	27.47	17.89	44.44	24.17	46.69	35.95	37.39	76.63	46.56
Western Hemlock	0.66	0.00	0.00	1.59	0.26	0.67	2.92	3.02	1.74	1.29
Western Redcedar	7.57	2.64	4.46	9.88	18.67	10.92	8.15	6.79	8.91	12.53
Lodgepole Pine	0	0.00	0.00	0.00	0.00	0.00	0.00	0.01	4.53	1.19
Engelman Spruce	2.12	3.62	2.22	1.06	1.90	8.76	1.99	5.01	2.85	6.90
Subapine fir	0.05	0.28	2.55	1.02	0.49	4.52	1.96	14.61	1.43	5.26
Ponderosa Pine	36.49	33.97	61.57	37.96	58.79	39.06	56.1	33.65	35.31	54.80
nonindustrial	6.27	11.36	3.72	3.31	4.21	6.75	5.16	5.32	2.24	4.58

Table 6.8a: Projections for forest industry, Inland Empire Timbershed, of average annual harvest (MMBF) under different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have constraints of ± 5%.

SPECIES	YEAR									
	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	BASE LP RUN									
White Pine	0.00	1.55	0.00	0.00	0.64	1.64	0.00	15.64	2.41	2.84
Western Larch	17.23	6.73	7.63	6.69	5.49	5.56	1.44	1.93	4.54	2.82
Douglas-fir	23.19	59.14	45.62	37.33	36.01	38.21	40.18	38.51	53.20	42.70
Grand fir	41.65	16.44	10.01	28.86	9.31	18.70	22.93	16.92	19.18	16.20
Western Hemlock	1.73	0.00	0.00	1.59	0.26	0.67	4.75	3.02	1.74	1.29
Western Redcedar	10.88	4.72	7.41	10.24	21.36	11.07	7.63	5.88	8.38	13.80
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.62	0.16
Engelman Spruce	2.12	3.62	2.22	1.06	1.90	2.05	1.99	3.78	2.85	6.90
Subapine fir	0.91	0.54	0.91	1.51	2.04	0.00	2.62	12.97	1.72	0.92
Ponderosa Pine	18.36	13.04	30.41	15.99	20.76	20.68	23.57	10.09	14.24	17.91
nonindustrial	6.08	10.68	6.43	1.80	1.98	2.61	1.08	2.43	0.32	4.25
	LOW LP RUN									
White Pine	0.00	1.55	0.00	0.00	0.64	1.64	11.76	0.00	2.41	3.17
Western Larch	16.49	6.73	8.00	5.89	7.03	5.82	1.72	2.26	2.31	2.64
Douglas-fir	24.54	42.65	50.78	38.83	39.54	44.40	43.27	47.10	33.31	45.47
Grand fir	16.20	10.68	10.75	20.28	10.36	23.24	16.00	12.74	16.16	16.31
Western Hemlock	1.73	0.00	0.00	1.59	0.26	0.67	4.75	3.02	1.74	1.29
Western Redcedar	8.65	6.34	7.85	7.70	22.10	9.53	7.85	6.76	5.71	9.59
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.45
Engelman Spruce	2.12	3.62	2.22	1.06	1.90	2.05	4.68	1.71	2.85	5.75
Subapine fir	0.91	0.54	0.91	1.51	2.04	0.00	10.79	1.42	1.68	0.00
Ponderosa Pine	24.25	15.13	16.64	14.69	21.56	11.25	20.38	12.27	10.64	20.00
nonindustrial	6.08	10.69	6.43	1.51	1.98	2.94	1.17	2.44	0.23	4.25
	HIGH LP RUN									
White Pine	1.63	0.00	0.00	0.80	0.45	1.66	0.00	16.39	5.67	0.00
Western Larch	29.20	3.58	2.90	5.44	6.33	0.45	0.00	0.00	1.89	3.06
Douglas-fir	116.58	36.90	50.73	13.49	35.56	14.63	24.06	45.04	44.59	46.72
Grand fir	70.46	11.26	14.45	16.31	20.79	5.81	16.71	30.38	28.99	1.21
Western Hemlock	6.44	0.00	0.00	0.46	5.45	0.00	0.00	1.92	2.61	2.31
Western Redcedar	29.90	0.78	4.47	5.15	4.91	4.73	2.04	9.87	11.92	11.28
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.13
Engelman Spruce	12.44	0.00	3.46	0.00	0.00	0.00	0.00	6.35	0.00	1.15
Subapine fir	2.17	0.00	0.00	0.00	0.00	3.01	0.00	12.13	0.04	6.92
Ponderosa Pine	40.19	7.54	37.58	8.33	15.04	19.68	13.90	36.50	18.86	26.45
nonindustrial	15.21	1.91	0.29	4.86	2.15	2.01	0.00	1.03	0.28	1.05
	BOOST LP RUN									
White Pine	0.00	1.55	0.00	0.00	0.64	1.64	1.79	13.26	2.16	2.18
Western Larch	18.19	7.83	5.65	8.17	4.12	4.66	0.87	2.03	3.97	2.91
Douglas-fir	21.36	58.52	44.80	33.94	40.87	37.59	39.43	34.87	45.30	54.25
Grand fir	42.33	15.50	11.37	29.62	11.09	18.29	22.52	14.25	21.05	13.94
Western Hemlock	1.73	0.00	0.00	1.59	0.26	0.67	4.75	3.02	1.74	1.29
Western Redcedar	10.84	4.72	6.79	10.65	20.22	10.11	8.37	6.35	11.84	14.77
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.26	0.21
Engelman Spruce	2.12	3.62	2.22	1.06	1.90	2.05	1.99	3.78	2.85	6.90
Subapine fir	0.91	0.54	0.91	1.51	2.04	0.00	2.62	12.97	1.72	0.92
Ponderosa Pine	17.74	12.53	32.92	15.55	16.14	23.11	21.42	17.90	14.98	17.79
nonindustrial	6.08	10.89	5.27	2.25	1.91	1.71	0.88	1.27	1.85	3.84

Table 6.8b (continuation): Projections for forest industry, Inland Empire Timbershed, of average annual harvest (MMBF) under different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have constraints of ± 5%.

SPECIES	YEAR									
	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	less 15% LP RUN									
White Pine	0.00	1.55	0.00	0.00	0.64	1.64	0.00	15.64	2.36	2.71
Western Larch	8.51	6.54	8.20	5.89	6.29	5.82	1.72	2.26	3.54	2.64
Douglas-fir	26.21	51.00	44.54	3i.36	30.51	32.84	37.40	33.19	45.02	42.18
Grand fir	46.79	16.37	10.08	28.34	11.74	16.84	24.93	14.08	21.65	15.47
Western Hemlock	1.73	0.00	0.00	1.59	0.26	0.67	2.92	3.02	1.74	1.29
Western Redcedar	9.31	2.51	4.99	8.31	20.52	10.87	7.39	6.04	7.04	14.10
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.09	1.48
Engelman Spruce	2.12	3.62	2.22	1.06	1.90	2.05	1.99	3.78	2.85	6.90
Subapine fir	0.91	0.54	0.91	1.51	2.04	0.00	2.62	12.97	1.72	0.92
Ponderosa Pine	7.95	12.20	21.82	13.51	12.41	18.84	16.73	8.26	13.89	12.63
nonindustrial	4.31	8.53	4.94	1.22	1.86	2.87	1.17	2.44	0.23	4.25
	Boost and less 15% LP RUN									
White Pine	0.00	1.55	0.00	0.00	0.64	2.99	0.96	14.10	3.44	1.75
Western Larch	12.30	6.90	7.43	8.29	4.53	4.15	0.70	1.89	3.17	3.41
Douglas-fir	25.79	53.99	46.48	28.02	33.00	29.77	40.12	31.59	42.24	50.12
Grand fir	46.23	15.64	10.69	27.35	13.36	17.01	19.97	12.01	20.88	14.78
Western Hemlock	0.66	0.00	0.00	1.59	0.26	0.67	2.92	3.02	1.74	1.29
Western Redcedar	7.57	2.64	4.46	9.88	18.67	10.35	6.83	6.79	8.91	12.53
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.52	0.91
Engelman Spruce	2.12	3.62	2.22	1.06	1.90	2.05	1.99	3.78	2.85	6.90
Subapine fir	0.05	0.03	0.05	0.09	0.12	0.00	0.15	12.18	0.13	0.92
Ponderosa Pine	8.91	11.18	23.72	15.01	14.04	22.60	21.88	13.68	14.66	12.33
nonindustrial	4.79	7.56	2.90	1.69	1.86	2.09	0.88	1.89	0.36	4.25

Table 6.9a: Projections for forest industry, Central Timbershed, of average annual harvest (MMBF) under different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have constraints of ± 5%. For Central Timbershed however, the boost run harvest flow constraint is ± 25% in order to obtain a feasible solution.

SPECIES	YEAR 1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	BASE LP RUN									
White Pine	3.42	0.00	2.27	1.24	1.48	2.84	1.26	12.09	14.81	6.78
Western Larch	3.19	12.82	0.00	0.64	0.50	1.83	0.00	0.00	0.00	0.00
Douglas-fir	97.21	58.88	74.72	58.12	41.70	41.68	48.80	54.32	36.57	26.79
Grand fir	2.41	28.35	14.08	10.68	20.99	23.93	21.79	23.76	37.62	56.93
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.57	1.32	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.03	0.00
Engelman Spruce	0.00	0.00	0.00	0.00	0.00	6.71	0.74	0.33	0.00	0.00
Subapine fir	0.00	0.25	2.50	0.93	0.38	3.64	1.81	2.43	1.12	3.23
Ponderosa Pine	30.21	28.09	30.03	44.42	45.19	24.16	33.07	19.67	32.37	34.43
nonindustrial	1.79	2.61	1.15	2.47	2.35	2.51	4.28	4.68	2.24	0.74
	LOW LP RUN									
White Pine	3.42	0.00	2.27	2.12	2.72	0.63	4.02	0.65	2.62	4.28
Western Larch	6.24	2.34	1.98	2.74	0.58	2.46	0.19	0.20	0.00	0.14
Douglas-fir	113.77	47.48	42.64	56.72	39.98	43.62	75.00	42.46	45.82	56.00
Grand fir	12.01	6.61	11.27	12.75	15.28	29.41	20.02	25.47	36.62	28.99
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.57	1.32	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.48
Engelman Spruce	0.00	0.00	0.00	0.00	0.00	6.71	1.01	0.00	0.00	0.00
Subapine fir	0.00	0.25	2.50	0.93	0.38	3.64	1.81	2.43	1.12	3.06
Ponderosa Pine	45.20	24.30	35.53	31.46	38.51	26.30	23.56	30.38	12.22	39.67
nonindustrial	2.11	2.29	1.74	1.88	2.35	2.51	4.28	4.68	2.24	3.51
	HIGH LP RUN									
White Pine	5.10	0.00	0.77	1.72	0.00	0.13	3.35	1.63	29.42	2.32
Western Larch	20.16	0.80	0.00	0.61	0.00	0.00	1.85	0.00	0.00	0.00
Douglas-fir	216.23	30.68	24.18	28.73	17.10	25.68	45.05	44.80	53.91	31.72
Grand fir	52.29	5.33	10.25	15.43	15.10	35.02	16.40	24.54	58.48	34.70
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.48	0.89
Engelman Spruce	3.47	0.00	0.00	0.00	0.00	0.00	0.00	1.23	0.00	0.00
Subapine fir	8.70	0.00	0.00	3.87	0.00	0.88	0.00	3.55	0.07	11.61
Ponderosa Pine	85.28	0.00	26.73	20.71	7.68	33.52	35.65	61.13	19.41	12.58
nonindustrial	6.63	3.51	0.55	0.00	2.12	2.15	0.30	0.00	4.41	0.00
	BOOST LP RUN									
White Pine	4.93	0.00	1.83	0.89	2.30	0.00	3.88	10.36	15.49	4.73
Western Larch	17.40	0.00	0.00	1.89	0.50	0.00	0.00	0.00	0.00	0.14
Douglas-fir	163.04	44.87	35.86	41.25	42.65	35.06	52.50	65.51	50.38	59.17
Grand fir	45.11	9.63	11.05	19.05	12.12	25.89	11.89	25.15	63.02	39.24
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.02	1.32
Engelman Spruce	3.47	0.00	0.00	0.00	0.00	0.00	0.19	0.99	0.00	0.00
Subapine fir	8.55	0.00	3.29	0.00	0.00	0.00	1.71	0.00	0.17	16.56
Ponderosa Pine	62.74	12.90	33.13	27.17	57.15	8.71	37.95	33.46	17.12	56.94
nonindustrial	5.49	2.29	1.74	1.88	4.53	2.51	3.76	4.68	2.24	2.66

Table 6.9b (continuation): Projections for forest industry, Central Timbershed, of average annual harvest (MMBF) under different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have constraints of ± 5%. For Central Timbershed however, the boost run harvest flow constraint is ± 25% in order to obtain a feasible solution.

SPECIES	YEAR									
	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	less 15% LP RUN									
White Pine	0.44	0.00	2.27	2.12	2.77	0.68	4.73	6.87	1.56	2.80
Western Larch	3.77	3.13	1.98	1.30	0.58	2.46	0.19	0.20	0.00	0
Douglas-fir	45.01	60.44	41.18	46.55	34.68	36.35	50.53	49.20	43.72	33.59
Grand fir	19.51	10.41	7.97	13.54	11.67	30.55	17.47	23.52	52.39	32.42
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0	0	0.57	1.32	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.01	0.39
Engelman Spruce	0.00	0.00	0.00	0.00	0.00	6.71	0.65	0.44	0.00	0.00
Subapine fir	0.00	0.25	2.50	0.93	0.38	4.52	1.81	2.43	1.23	4.34
Ponderosa Pine	32.92	20.06	36.46	25.23	43.44	14.08	24.61	24.39	15.40	43.59
nonindustrial	1.48	3.80	0.83	1.62	2.35	4.66	4.28	3.43	1.89	0.68
	Boost and less 15% LP RUN									
White Pine	0.66	0.00	2.27	2.12	2.77	0.83	4.87	0.52	1.22	1.87
Western Larch	7.74	2.48	1.09	1.00	0.54	2.18	0.11	0.11	0.00	0.00
Douglas-fir	45.73	59.72	44.08	45.30	33.97	34.70	42.72	57.55	34.89	36.58
Grand fir	22.87	11.83	7.20	17.09	10.81	29.68	15.98	25.38	55.75	31.78
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.57	1.32	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.28
Engelman Spruce	0.00	0.00	0.00	0.00	0.00	6.71	0.00	1.23	0.00	0.00
Subapine fir	0.00	0.25	2.50	0.93	0.38	4.52	1.81	2.43	1.30	4.34
Ponderosa Pine	27.58	22.79	37.85	22.96	44.75	16.47	34.22	19.96	20.65	42.47
nonindustrial	1.48	3.8	0.83	1.62	2.35	4.66	4.28	3.43	1.89	0.34

Table 6.10a: Projections for Native American, Inland Empire and Central Timbersheds, of average annual harvest (MMBF) under different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have constraints of ± 5%.

SPECIES	YEAR 1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	BASE LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	29.63
Western Larch	12.25	11.33	11.86	8.46	18.25	5.90	7.44	0.51	0.38	0.00
Douglas-fir	76.16	86.39	92.37	92.37	135.54	129.02	127.79	121.98	114.54	96.16
Grand fir	43.75	38.37	57.34	63.09	69.18	63.67	71.42	46.03	64.49	66.48
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.08	0.00	0.00	1.15	3.07	0.00	6.02	3.25	3.17	4.40
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.12	0.13
Engelman Spruce	15.48	10.93	0.00	1.15	2.97	6.33	5.80	13.52	2.07	2.30
Subapine fir	0.00	0.00	4.56	0.00	1.17	3.61	1.44	3.84	3.67	0.00
Ponderosa Pine	155.21	142.97	116.78	133.11	79.95	83.16	62.98	67.18	70.31	72.39
nonindustrial	3.54	15.06	23.97	22.83	21.47	24.27	21.78	33.26	36.16	30.83
	LOW LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Larch	21.67	17.21	13.57	18.47	18.64	12.09	10.69	2.46	0.38	0.00
Douglas-fir	98.10	79.66	76.46	94.05	126.28	123.77	144.46	114.58	124.82	141.42
Grand fir	114.38	42.57	51.74	62.97	68.94	63.61	85.07	47.20	71.03	102.06
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	7.94	0.00	0.00	1.15	31.46	0.00	6.02	3.25	3.17	4.74
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00
Engelman Spruce	15.48	10.93	0.00	1.15	2.97	6.33	6.01	13.52	2.07	2.30
Subapine fir	0.00	0.00	4.56	0.00	1.17	3.61	1.44	3.84	3.67	0.00
Ponderosa Pine	148.09	151.69	105.45	127.40	70.48	76.07	65.62	56.32	72.72	65.67
nonindustrial	6.15	15.06	26.45	26.48	26.85	28.19	25.44	32.54	35.39	33.68
	HIGH LP RUN									
White Pine	4.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Larch	193.17	9.29	0.00	9.82	4.66	0.00	0.00	0.00	0.00	0.00
Douglas-fir	468.75	8.35	75.31	13.03	71.40	48.14	100.26	109.74	63.86	49.44
Grand fir	390.72	0.41	10.72	91.96	56.22	12.16	44.21	43.38	83.81	43.54
Western Hemlock	15.82	6.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	15.13	3.00	0.00	0.00	0.00	11.24	0.00	0.69	0.00	1.38
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.33	0.00
Engelman Spruce	54.74	10.28	0.00	0.00	0.00	0.00	4.34	0.00	0.00	0.00
Subapine fir	16.47	0.00	3.08	0.00	10.72	4.63	0.00	0.97	1.73	11.38
Ponderosa Pine	714.68	79.08	238.29	102.18	47.34	69.18	135.47	67.78	148.00	116.66
nonindustrial	87.54	5.50	17.39	27.98	5.36	7.63	12.02	0.00	5.68	13.47
	BOOST LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.79
Western Larch	19.14	17.34	4.37	9.95	7.09	2.20	5.94	2.41	0.38	0.00
Douglas-fir	84.05	68.85	88.25	79.74	101.45	102.78	107.11	94.56	101.71	101.67
Grand fir	137.13	52.29	38.55	74.63	59.18	58.92	79.53	46.70	58.65	63.82
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.84	0.00	0.00	1.15	5.89	0.00	6.02	3.25	3.61	4.43
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00
Engelman Spruce	15.48	10.93	0.00	1.15	2.97	6.33	6.01	13.52	2.07	2.30
Subapine fir	0.00	0.00	4.56	0.00	1.17	3.61	1.47	3.84	3.67	0.00
Ponderosa Pine	131.96	205.82	198.14	151.01	125.81	113.40	75.33	108.72	112.71	103.07
nonindustrial	3.80	16.93	23.97	21.94	18.94	23.47	20.60	26.75	29.15	30.58

Table 6.10b (continuation): Projections for Native American, Inland Empire and Central Timbersheds, of average annual harvest (MMBF) under different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have constraints of ± 5%.

SPECIES	YEAR 1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	less than 15% LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.33
Western Larch	6.42	6.40	6.50	3.40	14.90	3.40	6.30	0.51	0.38	0.00
Douglas-fir	66.92	65.45	76.56	75.54	99.37	99.57	98.35	94.43	97.28	79.92
Grand fir	38.58	38.37	51.74	62.97	67.98	63.43	69.86	43.57	46.61	60.54
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	1.15	2.84	0.00	6.02	3.25	3.17	4.40
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.12	0.13
Engelman Spruce	15.48	10.93	0.00	1.15	2.97	6.33	6.01	13.52	2.07	2.30
Subapine fir	0.00	0.00	4.56	0.00	1.17	3.61	1.44	3.84	3.67	0.00
Ponderosa Pine	132.61	128.24	98.78	108.45	74.66	71.28	55.73	59.84	63.57	67.81
nonindustrial	3.52	15.06	23.97	22.49	21.42	24.27	21.78	33.26	35.88	30.88
	Boost and less than 15% LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.08
Western Larch	9.24	15.49	4.32	5.86	4.28	2.00	2.25	1.38	0.38	0.00
Douglas-fir	72.61	52.79	66.39	75.38	84.60	87.90	92.41	74.43	82.28	92.89
Grand fir	125.88	44.23	31.26	63.33	44.76	48.23	72.30	38.50	48.41	52.92
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.69	0.00	0.00	1.15	5.32	0.00	6.02	3.25	3.28	4.43
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00
Engelman Spruce	15.48	10.93	0.00	1.15	2.97	6.33	6.01	13.52	2.07	2.30
Subapine fir	0.00	0.00	4.56	0.00	1.17	3.61	1.44	3.84	3.67	0.00
Ponderosa Pine	107.90	177.89	173.40	120.73	111.96	98.91	61.12	97.78	103.95	87.76
nonindustrial	3.75	16.93	23.97	20.82	18.94	22.54	19.75	26.68	28.33	30.48

Table 6.11a: Projections for Native American, Inland Empire Timbershed, of average annual harvest (MMBF) under different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have constraints of ± 5%.

SPECIES	YEAR									
	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	BASE LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	26.91
Western Larch	3.40	6.37	2.46	5.30	15.87	3.40	6.30	0.51	0.38	0.00
Douglas-fir	43.90	56.06	61.49	52.81	88.81	73.11	66.02	75.57	65.41	50.30
Grand fir	22.07	12.88	2.87	3.79	6.48	5.68	21.40	0.00	15.80	12.01
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.08	0.00	0.00	1.15	3.07	0.00	6.02	3.25	3.17	4.40
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
Engelman Spruce	5.17	0.00	0.00	1.15	2.97	5.89	4.86	6.63	2.07	2.30
Subapine fir	0.00	0.00	4.56	0.00	0.00	3.61	0.59	1.18	2.41	0.00
Ponderosa Pine	58.75	51.40	52.58	68.71	24.60	43.34	23.83	27.57	32.31	39.99
nonindustrial	0.03	0.00	9.14	6.86	4.89	5.17	4.02	11.96	11.52	3.17
	LOW LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Larch	6.20	10.85	3.00	6.20	9.47	2.51	6.30	2.46	0.38	0.00
Douglas-fir	71.55	49.92	48.56	57.80	91.88	73.52	82.00	73.24	80.69	96.79
Grand fir	92.70	17.08	2.87	3.79	6.48	5.68	32.38	0.00	15.80	43.90
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	7.94	0.00	0.00	1.15	31.46	0.00	6.02	3.25	3.17	4.74
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Engelman Spruce	5.17	0.00	0.00	1.15	2.97	5.89	5.07	6.63	2.07	2.30
Subapine fir	0.00	0.00	4.56	0.00	0.00	3.61	0.59	1.18	2.41	0.00
Ponderosa Pine	53.09	49.84	45.41	55.76	29.31	35.00	20.74	17.97	32.26	23.68
nonindustrial	2.64	0.00	11.62	10.16	8.24	9.09	7.68	11.24	10.75	6.02
	HIGH LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Larch	61.70	9.29	0.00	5.86	4.66	0.00	0.00	0.00	0.00	0.00
Douglas-fir	212.17	4.66	6.45	12.65	71.40	37.09	47.90	90.75	52.38	43.93
Grand fir	122.62	0.00	0.00	30.90	3.10	11.34	24.58	9.19	42.52	12.98
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	15.13	3.00	0.00	0.00	0.00	11.24	0.00	0.69	0.00	1.38
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00
Engelman Spruce	27.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Subapine fir	14.34	0.00	0.00	0.00	0.00	4.63	0.00	0.00	0.00	6.58
Ponderosa Pine	371.25	30.21	63.49	18.18	18.12	19.64	70.84	19.64	37.25	30.49
nonindustrial	24.40	1.87	14.26	0.00	0.00	7.63	0.38	0.00	5.68	13.47
	BOOST LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.79
Western Larch	16.15	14.85	0.36	5.32	7.09	2.20	5.94	2.41	0.38	0.00
Douglas-fir	57.65	44.85	59.83	48.77	62.75	57.63	68.81	70.09	63.97	66.89
Grand fir	38.27	17.08	2.87	24.32	15.05	5.68	27.52	10.75	16.46	15.16
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.84	0.00	0.00	1.15	5.89	0.00	6.02	3.25	3.61	4.43
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Engelman Spruce	5.17	0.00	0.00	1.15	2.97	5.89	5.07	6.63	2.07	2.30
Subapine fir	0.00	0.00	4.56	0.00	0.00	3.61	0.59	1.18	2.41	0.00
Ponderosa Pine	53.20	83.81	77.98	59.19	43.39	56.93	20.10	43.06	56.60	44.85
nonindustrial	0.28	1.87	9.14	7.12	2.36	4.84	2.84	5.45	4.51	2.92

Table 6.11b (continuation): Projections for Native American, Inland Empire Timbershed, of average annual harvest (MMBF) under different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have constraints of ± 5%.

SPECIES	YEAR									
	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	less 15% LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.30
Western Larch	3.40	6.37	2.46	3.40	14.90	3.40	6.30	0.51	0.38	0.00
Douglas-fir	40.35	41.63	48.64	42.73	67.81	58.93	51.58	63.87	60.42	44.70
Grand fir	16.90	12.88	2.87	3.79	6.48	5.68	21.63	0.00	5.94	11.72
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	1.15	2.84	0.00	6.02	3.25	3.17	4.40
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
Engelman Spruce	5.17	0.00	0.00	1.15	2.97	5.89	5.07	6.63	2.07	2.30
Subapine fir	0.00	0.00	4.56	0.00	0.00	3.61	0.59	1.18	2.41	0.00
Ponderosa Pine	48.87	48.10	46.77	61.13	26.34	37.96	19.46	21.61	28.85	35.00
nonindustrial	0.00	0.00	9.14	6.81	4.84	5.17	4.02	11.96	11.24	3.23
	Boost and less 15% LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.08
Western Larch	6.25	14.85	0.31	4.68	4.28	2.00	2.25	1.38	0.38	0.00
Douglas-fir	46.59	30.05	42.21	45.70	50.61	44.80	60.21	51.40	50.66	60.36
Grand fir	36.84	15.90	2.87	26.24	8.40	5.68	26.85	11.75	15.95	14.54
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.69	0.00	0.00	1.15	5.32	0.00	6.02	3.25	3.28	4.43
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Engelman Spruce	5.17	0.00	0.00	1.15	2.97	5.89	5.07	6.63	2.07	2.30
Subapine fir	0.00	0.00	4.56	0.00	0.00	3.61	0.59	1.18	2.41	0.00
Ponderosa Pine	48.51	73.93	71.14	38.02	43.55	53.96	17.05	44.16	53.96	42.50
nonindustrial	0.23	1.87	9.14	6.78	2.36	4.84	2.05	5.38	3.69	2.82

Table 6.12a: Projections for Native American, Central Timbershed, of average annual harvest (MMBF) under different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have constraints of ± 5%.

SPECIES	YEAR 1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	BASE LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	2.72
Western Larch	8.85	4.95	9.41	3.16	2.37	2.49	1.14	0.00	0.00	0.00
Douglas-fir	32.26	30.33	30.88	39.56	46.73	55.90	61.76	46.41	49.14	45.85
Grand fir	21.68	25.49	54.47	59.30	62.70	57.98	50.02	46.03	48.70	54.47
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.12	0.00
Engelman Spruce	10.31	10.93	0.00	0.00	0.00	0.44	0.94	6.89	0.00	0.00
Subapine fir	0.00	0.00	0.00	0.00	1.17	0.00	0.85	2.67	1.26	0.00
Ponderosa Pine	96.46	91.56	64.20	64.40	55.35	39.82	39.14	39.61	38.00	32.41
nonindustrial	3.52	15.06	14.83	15.97	16.58	19.10	17.76	21.30	24.64	27.66
	LOW LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Larch	15.47	6.36	10.58	12.28	9.17	9.58	4.40	0.00	0.00	0.00
Douglas-fir	26.55	29.74	27.89	36.24	34.40	50.25	62.47	41.34	44.13	44.62
Grand fir	21.68	25.49	48.87	59.19	62.47	57.93	52.68	47.20	55.23	58.16
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00
Engelman Spruce	10.31	10.93	0.00	0.00	0.00	0.44	0.94	6.89	0.00	0.00
Subapine fir	0.00	0.00	0.00	0.00	1.17	0.00	0.85	2.67	1.26	0.00
Ponderosa Pine	94.99	101.85	60.04	71.64	41.17	41.08	44.89	38.35	40.46	41.99
nonindustrial	3.52	15.06	14.83	16.32	18.61	19.10	17.76	21.30	24.64	27.66
	HIGH LP RUN									
White Pine	4.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Larch	131.47	0.00	0.00	3.96	0.00	0.00	0.00	0.00	0.00	0.00
Douglas-fir	256.58	3.69	68.86	0.38	0.00	11.05	52.36	18.99	11.49	5.51
Grand fir	268.10	0.41	10.72	61.06	53.12	0.82	19.63	34.19	41.28	30.56
Western Hemlock	15.82	6.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00
Engelman Spruce	27.25	10.28	0.00	0.00	0.00	0.00	4.34	0.00	0.00	0.00
Subapine fir	2.14	0.00	3.08	0.00	10.72	0.00	0.00	0.97	1.73	4.81
Ponderosa Pine	343.43	48.87	174.80	84.00	29.21	49.55	64.64	48.14	110.75	86.17
nonindustrial	63.14	3.63	3.14	27.98	5.36	0.00	11.63	0.00	0.00	0.00
	BOOST LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Larch	2.99	2.49	4.01	4.63	0.00	0.00	0.00	0.00	0.00	0.00
Douglas-fir	26.40	24.00	28.42	30.97	38.71	45.15	38.30	24.47	37.74	34.78
Grand fir	98.86	35.22	35.69	50.31	44.13	53.24	52.01	35.95	42.19	48.67
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00
Engelman Spruce	10.31	10.93	0.00	0.00	0.00	0.44	0.94	6.89	0.00	0.00
Subapine fir	0.00	0.00	0.00	0.00	1.17	0.00	0.88	2.67	1.26	0.00
Ponderosa Pine	78.76	122.01	120.16	91.83	82.42	56.46	55.23	65.66	56.11	58.22
nonindustrial	3.52	15.06	14.83	14.83	16.58	18.63	17.76	21.30	24.64	27.66

Table 6.12b (continuation): Projections for Native American, Central Timbershed, of average annual harvest (MMBF) under different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have constraints of ± 5%.

SPECIES	YEAR 1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	less than 15% LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
Western Larch	3.02	0.03	4.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Douglas-fir	26.58	23.82	27.92	32.82	31.56	40.64	46.76	30.56	36.86	35.22
Grand fir	21.68	25.49	48.87	59.19	61.50	57.75	48.23	43.57	40.67	48.81
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.12	0.00
Engelman Spruce	10.31	10.93	0.00	0.00	0.00	0.44	0.94	6.89	0.00	0.00
Subapine fir	0.00	0.00	0.00	0.00	1.17	0.00	0.85	2.67	1.26	0.00
Ponderosa Pine	83.74	80.14	52.01	47.32	48.32	33.31	36.27	38.24	34.72	32.82
nonindustrial	3.52	15.06	14.83	15.68	16.58	19.10	17.76	21.30	24.64	27.66
	Boost and less than 15% LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Larch	2.99	0.64	4.01	1.17	0.00	0.00	0.00	0.00	0.00	0.00
Douglas-fir	26.02	22.74	24.17	29.68	33.99	43.10	32.20	23.03	31.61	32.52
Grand fir	89.04	28.33	28.39	37.09	36.36	42.54	45.44	26.75	32.46	38.38
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00
Engelman Spruce	10.31	10.93	0.00	0.00	0.00	0.44	0.94	6.89	0.00	0.00
Subapine fir	0.00	0.00	0.00	0.00	1.17	0.00	0.85	2.67	1.26	0.00
Ponderosa Pine	59.39	103.96	102.26	82.71	68.42	44.95	44.07	53.62	49.99	45.27
nonindustrial	3.52	15.06	14.83	14.03	16.58	17.70	17.70	21.30	24.64	27.66

Table 6.13a: Projections for nonindustrial, Inland Empire and Central Timbersheds, of average annual harvest (MMBF) under different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have constraints of ± 5%. For the LESS 15% LP run in the Inland Empire Timbershed the ±25% harvest flow constraint was used to obtain a feasible solution.

SPECIES	YEAR									
	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	BASE LP RUN									
White Pine	3.03	2.04	0.00	1.81	0.00	0.00	0.00	3.92	15.86	10.84
Western Larch	12.71	17.75	21.37	8.04	17.36	9.33	10.96	16.45	15.57	9.32
Douglas-fir	116.13	122.03	114.22	143.95	140.49	158.53	156.02	154.17	151.46	175.29
Grand fir	37.91	26.23	35.62	29.78	38.09	31.81	35.76	38.51	23.07	26.89
Western Hemlock	0.00	0.00	0.85	3.01	2.49	1.98	0.00	0.12	1.67	0.76
Western Redcedar	8.82	1.56	8.68	9.84	11.24	7.89	6.98	10.72	7.82	6.48
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	1.50	9.51
Engelman Spruce	0.00	1.10	1.14	0.75	0.00	0.23	0.82	1.89	1.23	2.61
Subapine fir	1.61	2.69	3.11	2.65	0.45	1.59	2.94	2.66	3.86	2.40
Ponderosa Pine	113.38	104.66	110.05	108.50	112.62	119.12	132.99	102.43	116.40	125.91
nonindustrial	37.77	40.15	29.63	23.64	17.32	21.34	22.77	27.66	28.81	14.96
	LOW LP RUN									
White Pine	3.03	2.04	0.00	1.81	0.00	0.00	0.00	3.92	4.24	12.74
Western Larch	14.14	16.32	22.20	7.61	17.81	9.07	14.59	12.72	16.05	8.38
Douglas-fir	126.70	111.84	152.28	138.13	148.00	153.63	143.72	158.02	153.25	188.92
Grand fir	37.91	26.23	38.30	31.75	35.75	33.11	32.46	41.36	24.01	25.54
Western Hemlock	0.00	0.00	0.85	3.01	2.49	1.98	0.00	0.15	1.65	0.76
Western Redcedar	8.82	1.56	8.94	9.57	11.24	7.89	6.98	10.78	7.77	6.48
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	1.08	7.30
Engelman Spruce	0.00	1.10	1.14	0.75	0.00	0.23	0.82	1.89	1.23	2.61
Subapine fir	1.61	2.69	3.11	2.65	0.45	1.59	2.94	2.66	3.86	2.42
Ponderosa Pine	122.02	106.90	136.57	110.37	130.08	134.83	99.03	116.79	101.79	128.67
nonindustrial	38.18	44.58	28.21	21.39	16.92	24.56	22.22	27.53	25.61	20.40
	HIGH LP RUN									
White Pine	6.16	0.00	0.00	4.77	0.00	0.35	1.76	27.31	9.14	0.00
Western Larch	46.50	9.66	8.02	2.62	16.87	12.37	11.38	1.93	6.37	2.42
Douglas-fir	291.09	56.72	117.57	90.79	108.43	105.15	163.48	109.26	213.48	109.41
Grand fir	67.40	17.68	21.98	23.57	23.16	25.69	29.93	68.97	51.76	26.46
Western Hemlock	3.43	0.00	0.00	0.00	1.67	0.00	0.00	0.11	0.00	0.00
Western Redcedar	25.13	0.00	3.17	2.76	9.05	6.89	4.92	0.34	8.41	3.02
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.01	0.07	1.78	0.87	5.64
Engelman Spruce	2.32	0.00	0.00	0.00	1.32	0.38	0.18	0.00	0.00	0.54
Subapine fir	9.09	0.00	0.00	0.00	1.44	5.67	0.00	0.36	7.43	0.10
Ponderosa Pine	180.30	68.71	94.07	77.08	133.70	116.60	165.01	112.62	183.41	130.15
nonindustrial	102.92	6.82	17.24	23.30	34.27	8.59	28.98	2.59	12.92	21.01
	BOOST LP RUN									
White Pine	4.09	1.55	0.00	4.71	0.00	0.00	6.96	8.02	18.38	15.19
Western Larch	15.32	16.53	20.07	7.50	20.45	8.70	14.59	12.72	16.59	8.37
Douglas-fir	141.95	112.42	160.16	149.13	131.66	149.57	136.11	157.41	170.44	189.68
Grand fir	40.63	35.64	30.59	30.65	30.49	35.97	53.52	49.90	35.51	35.02
Western Hemlock	1.50	0.00	0.00	0.37	3.53	0.03	0.00	0.17	1.65	0.76
Western Redcedar	13.19	1.07	6.80	10.41	8.80	7.53	5.25	10.28	5.86	6.39
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.46	0.14	8.97	7.96
Engelman Spruce	0.00	1.10	1.14	0.75	0.00	0.23	0.82	1.89	1.23	2.61
Subapine fir	1.61	2.69	3.11	2.65	0.45	1.59	2.94	2.66	3.86	2.42
Ponderosa Pine	118.11	140.67	117.56	106.72	139.73	141.36	131.69	127.75	119.55	144.11
nonindustrial	38.88	45.18	25.71	33.97	19.72	19.68	23.10	22.13	25.34	18.09

Table 6.13b (continuation): Projections for nonindustrial, Inland Empire and Central Timbersheds, of average annual harvest (MMBF) under different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have constraints of ± 5%. For the LESS 15% LP run in the Inland Empire Timbershed the ±25% harvest flow constraint was used to obtain a feasible solution.

SPECIES	YEAR 1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	less 15% LP RUN									
White Pine	3.03	2.04	0.00	1.81	0.00	0.00	5.95	4.04	6.72	17.59
Western Larch	12.71	16.32	16.79	7.61	17.59	9.07	12.78	11.43	16.05	6.28
Douglas-fir	116.09	105.75	137.93	128.66	131.69	139.42	128.82	147.76	140.30	160.73
Grand fir	35.46	26.23	38.30	31.75	33.79	33.11	32.46	41.36	23.97	24.16
Western Hemlock	0.00	0.00	0.85	3.01	2.49	1.98	0.00	0.15	1.65	0.76
Western Redcedar	8.82	1.56	8.94	9.57	11.24	7.89	6.98	10.78	7.77	6.48
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.09	8.66	4.67
Engelman Spruce	0.00	1.10	1.14	0.75	0.00	0.23	0.82	1.89	1.23	2.61
Subapine fir	1.61	2.69	2.21	2.65	0.45	1.59	2.94	2.66	3.86	2.40
Ponderosa Pine	116.07	102.88	122.52	100.19	115.34	121.18	88.81	99.22	94.81	111.31
nonindustrial	30.59	39.52	18.18	18.79	11.28	19.69	15.65	19.22	22.62	12.42
	Boost and less 15% LP RUN									
White Pine	4.35	1.55	0.00	4.31	0.00	0.00	4.64	9.62	17.80	14.44
Western Larch	15.32	16.53	17.34	7.50	19.86	8.70	11.54	10.93	16.38	5.99
Douglas-fir	133.06	111.45	156.57	138.66	122.37	133.75	121.64	140.45	157.39	160.26
Grand fir	39.12	34.56	30.61	30.72	30.20	37.69	55.54	49.19	35.35	35.31
Western Hemlock	1.50	0.00	0.00	0.37	3.53	0.03	0.00	0.15	1.65	0.76
Western Redcedar	13.33	1.07	6.80	10.25	8.80	7.53	5.71	9.61	5.86	6.39
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.21	8.68	8.28
Engelman Spruce	0.00	1.10	1.14	0.75	0.00	0.23	0.82	1.89	1.23	2.61
Subapine fir	1.61	2.69	3.11	2.65	0.45	1.59	2.94	2.66	3.86	2.40
Ponderosa Pine	117.00	132.13	112.05	102.09	120.43	127.10	116.56	112.10	98.52	139.38
nonindustrial	30.43	37.17	18.86	31.80	10.31	15.72	19.13	17.87	20.95	12.63

Table 6.14a: Projections for nonindustrial, Inland Empire Timbershed, of average annual harvest (MMBF) under different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have constraints of ± 5%. For the LESS 15% LP run in the Inland Empire Timbershed the ±25% harvest flow constraint was used to obtain a feasible solution.

SPECIES	YEAR 1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	BASE LP RUN									
White Pine	3.03	2.04	0.00	1.81	0.00	0.00	0.00	2.62	5.19	4.04
Western Larch	10.09	15.36	19.39	6.88	14.13	8.82	10.85	14.54	14.95	7.44
Douglas-fir	70.31	85.01	85.14	108.36	107.93	119.81	120.91	100.81	114.68	128.68
Grand fir	21.91	16.11	22.80	18.42	26.65	19.62	24.79	31.74	14.93	24.24
Western Hemlock	0.00	0.00	0.85	3.01	2.49	1.98	0.00	0.12	1.67	0.76
Western Redcedar	8.82	1.56	8.68	9.84	11.24	7.89	6.98	10.72	7.82	6.48
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	1.05	5.92
Engelman Spruce	0.00	1.10	1.14	0.00	0.00	0.00	0.82	1.89	1.23	2.61
Subapine fir	0.00	0.00	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ponderosa Pine	89.26	80.85	79.21	82.79	84.03	98.08	110.26	88.84	97.90	100.07
nonindustrial	28.45	21.93	17.04	15.80	12.75	15.93	11.08	19.62	16.13	8.87
	LOW LP RUN									
White Pine	3.03	2.04	0.00	1.81	0.00	0.00	0.00	2.62	0.61	5.95
Western Larch	11.52	13.93	20.22	6.45	14.58	8.56	14.48	10.81	15.42	6.46
Douglas-fir	75.60	79.71	119.46	105.16	116.94	109.84	111.04	104.54	116.25	128.62
Grand fir	21.91	16.11	24.17	21.68	24.31	20.92	21.50	34.59	15.86	22.89
Western Hemlock	0.00	0.00	0.85	3.01	2.49	1.98	0.00	0.15	1.65	0.76
Western Redcedar	8.82	1.56	8.94	9.57	11.24	7.89	6.98	10.78	7.77	6.48
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.64	2.58
Engelman Spruce	0.00	1.10	1.14	0.00	0.00	0.00	0.82	1.89	1.23	2.61
Subapine fir	0.00	0.00	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.02
Ponderosa Pine	92.12	78.00	109.87	81.25	105.10	113.05	82.77	99.62	82.78	94.82
nonindustrial	28.45	21.93	19.43	13.41	13.53	17.77	11.02	19.10	14.16	13.24
	HIGH LP RUN									
White Pine	6.16	0.00	0.00	4.77	0.00	0.35	1.76	5.59	9.14	0.00
Western Larch	44.53	5.22	8.02	2.24	10.60	10.59	10.26	0.15	3.96	2.42
Douglas-fir	209.13	29.97	73.87	87.89	69.21	82.10	129.32	91.73	154.23	76.31
Grand fir	45.71	11.33	16.02	17.73	10.42	13.18	9.13	57.39	26.66	22.07
Western Hemlock	3.43	0.00	0.00	0.00	1.67	0.00	0.00	0.11	0.00	0.00
Western Redcedar	25.13	0.00	3.17	2.76	9.05	6.89	4.92	0.34	8.41	3.02
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.01	0.07	0.41	0.75	3.23
Engelman Spruce	2.02	0.00	0.00	0.00	1.32	0.00	0.18	0.00	0.00	0.00
Subapine fir	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
Ponderosa Pine	132.86	51.03	83.07	60.71	117.96	112.23	126.99	85.42	148.82	98.57
nonindustrial	74.69	6.45	17.24	22.77	17.64	3.03	18.61	2.59	3.29	13.13
	BOOST LP RUN									
White Pine	4.09	1.55	0.00	4.71	0.00	0.00	0.00	7.59	7.69	10.8
Western Larch	12.71	14.14	18.08	6.34	17.22	8.19	14.48	10.81	15.96	6.46
Douglas-fir	94.95	83.61	114.94	111.49	100.59	104.41	110.90	105.21	134.60	135.03
Grand fir	27.34	23.09	18.36	23.02	17.51	22.34	35.79	38.35	25.01	31.28
Western Hemlock	1.50	0.00	0.00	0.37	3.53	0.03	0.00	0.17	1.65	0.76
Western Redcedar	13.19	1.07	6.80	10.41	8.80	7.53	5.25	10.28	5.86	6.39
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.14	8.35	4.63
Engelman Spruce	0.00	1.10	1.14	0.00	0.00	0.00	0.82	1.89	1.23	2.61
Subapine fir	0.00	0.00	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.02
Ponderosa Pine	89.39	111.03	94.26	76.48	111.56	121.41	108.35	109.84	93.77	118.95
nonindustrial	29.16	23.70	17.96	25.98	11.93	15.06	9.98	14.38	15.20	10.99

Table 6.14b (continuation): Projections for nonindustrial, Inland Empire Timbershed, of average annual harvest (MMBF) under different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have constraints of ± 5%. For the LESS 15% LP run in the Inland Empire Timbershed the ±25% harvest flow constraint was used to obtain a feasible solution.

SPECIES	YEAR 1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	less 15% LP RUN									
White Pine	3.03	2.04	0.00	1.81	0.00	0.00	0.00	2.62	3.08	10.80
Western Larch	10.09	13.93	14.81	6.45	14.36	8.56	12.68	10.02	15.42	4.74
Douglas-fir	74.33	78.20	105.23	97.51	100.64	102.25	97.29	101.30	104.82	117.55
Grand fir	21.91	16.11	24.17	21.68	22.35	20.92	21.50	34.59	15.82	21.50
Western Hemlock	0.00	0.00	0.85	3.01	2.49	1.98	0.00	0.15	1.65	0.76
Western Redcedar	8.82	1.56	8.94	9.57	11.24	7.89	6.98	-10.78	7.77	6.48
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	8.21	2.26
Engelman Spruce	0.00	1.10	1.14	0.00	0.00	0.00	0.82	1.89	1.23	2.61
Subapine fir	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ponderosa Pine	92.12	77.44	97.84	73.91	90.91	100.93	72.41	84.76	75.79	88.51
nonindustrial	23.64	21.93	12.38	13.41	8.31	14.40	8.84	13.66	11.30	7.62
	Boost and less 15% LP RUN									
White Pine	4.35	1.55	0.00	4.31	0.00	0.00	0.00	7.59	7.35	10.46
Western Larch	12.70	14.14	15.36	6.34	16.63	8.19	11.43	9.98	15.76	4.74
Douglas-fir	89.26	82.19	114.58	104.49	91.83	91.31	100.13	96.74	122.05	113.49
Grand fir	26.69	22.15	18.73	23.66	17.92	22.79	35.59	37.69	24.94	31.50
Western Hemlock	1.50	0.00	0.00	0.37	3.53	0.03	0.00	0.15	1.65	0.76
Western Redcedar	13.33	1.07	6.80	10.25	8.80	7.53	5.71	9.61	5.86	6.39
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.09	8.33	4.68
Engelman Spruce	0.00	1.10	1.14	0.00	0.00	0.00	0.82	1.89	1.23	2.61
Subapine fir	0.00	0.00	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ponderosa Pine	89.98	103.42	90.91	75.55	92.71	109.05	92.00	91.01	75.14	111.08
nonindustrial	23.96	23.63	13.52	23.82	7.14	12.22	7.98	10.45	12.31	5.62

Table 6.15a: Projections for nonindustrial, Central Timbershed, of average annual harvest (MMBF) under different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have constraints of ± 5%.

SPECIES	YEAR 1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	BASE LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.30	10.67	6.79
Western Larch	2.62	2.39	1.98	1.16	3.23	0.51	0.10	1.91	0.63	1.88
Douglas-fir	45.82	37.02	29.08	35.59	32.56	38.72	35.11	53.35	36.78	46.61
Grand fir	16.00	10.12	12.83	11.36	11.44	12.19	10.97	6.76	8.15	2.65
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45	3.59
Engelman Spruce	0.00	0.00	0.00	0.75	0.00	0.23	0.00	0.00	0.00	0.00
Subapine fir	1.61	2.69	2.21	2.65	0.45	1.59	2.94	2.66	3.86	2.40
Ponderosa Pine	24.12	23.81	30.85	25.71	28.60	21.04	22.73	13.59	18.50	25.84
nonindustrial	9.32	18.22	12.59	7.84	4.57	5.40	11.68	8.04	12.68	6.10
	LOW LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.30	3.64	6.79
Western Larch	2.62	2.39	1.98	1.16	3.23	0.51	0.10	1.91	0.63	1.92
Douglas-fir	51.09	32.12	32.82	32.97	31.06	43.79	32.68	53.48	37.00	60.30
Grand fir	16.00	10.12	14.13	10.06	11.44	12.19	10.97	6.76	8.15	2.65
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45	4.72
Engelman Spruce	0.00	0.00	0.00	0.75	0.00	0.23	0.00	0.00	0.00	0.00
Subapine fir	1.61	2.69	2.21	2.65	0.45	1.59	2.94	2.66	3.86	2.40
Ponderosa Pine	29.90	28.90	26.71	29.12	24.99	21.78	16.26	17.17	19.01	33.85
nonindustrial	9.72	22.66	8.78	7.99	3.40	6.79	11.20	8.43	11.45	7.16
	HIGH LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.72	0.00	0.00
Western Larch	1.97	4.44	0.00	0.39	6.26	1.78	1.12	1.78	2.41	0.00
Douglas-fir	81.96	26.75	43.70	2.90	39.22	23.05	34.16	17.53	59.24	33.10
Grand fir	21.69	6.35	5.96	5.84	12.74	12.51	20.80	11.58	25.10	4.39
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.36	0.12	2.41
Engelman Spruce	0.30	0.00	0.00	0.00	0.00	0.38	0.00	0.00	0.00	0.54
Subapine fir	8.70	0.00	0.00	0.00	1.44	5.67	0.00	0.36	7.43	0.00
Ponderosa Pine	47.44	17.68	10.99	16.37	15.74	4.37	38.02	27.21	34.59	31.58
nonindustrial	28.23	0.37	0.00	0.53	16.63	5.57	10.38	0.00	9.62	7.88
	BOOST LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	6.96	0.44	10.68	4.39
Western Larch	2.62	2.39	1.98	1.16	3.23	0.51	0.10	1.91	0.63	1.92
Douglas-fir	47.00	28.81	45.21	37.64	31.08	45.16	25.20	52.20	35.83	54.65
Grand fir	13.30	12.55	12.22	7.64	12.98	13.62	17.73	11.55	10.50	3.74
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.00	0.63	3.33
Engelman Spruce	0.00	0.00	0.00	0.75	0.00	0.23	0.00	0.00	0.00	0.00
Subapine fir	1.61	2.69	2.21	2.65	0.45	1.59	2.94	2.66	3.86	2.40
Ponderosa Pine	28.72	29.64	23.30	30.23	28.16	19.95	23.34	17.92	25.78	25.16
nonindustrial	9.72	21.48	7.76	7.99	7.79	4.62	13.12	7.76	10.14	7.10

Table 6.15b (continuation): Projections for nonindustrial, Central Timbershed, of average annual harvest (MMBF) under different LP runs. The harvest flow constraint varies among LP runs; the LOW and HIGH runs have no constraints, while the others have constraints of ± 5%.

SPECIES	YEAR 1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
	less 15% LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	5.95	1.41	3.64	6.79
Western Larch	2.62	2.39	1.98	1.16	3.23	0.51	0.10	1.41	0.63	1.54
Douglas-fir	41.76	27.55	32.70	31.15	31.06	37.18	31.53	46.46	35.49	43.17
Grand fir	13.55	10.12	14.13	10.06	11.44	12.19	10.97	6.76	8.15	2.65
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.45	2.42
Engelman Spruce	0.00	0.00	0.00	0.75	0.00	0.23	0.00	0.00	0.00	0.00
Subapine fir	1.61	2.69	2.21	2.65	0.45	1.59	2.94	2.66	3.86	2.40
Ponderosa Pine	23.95	25.44	24.68	26.28	24.43	20.24	16.39	14.46	19.01	22.80
nonindustrial	6.95	17.59	5.80	5.38	2.98	5.29	6.81	5.56	11.32	4.81
	Boost and less 15% LP RUN									
White Pine	0.00	0.00	0.00	0.00	0.00	0.00	4.64	2.04	10.44	3.99
Western Larch	2.62	2.39	1.98	1.16	3.23	0.51	0.10	0.95	0.63	1.25
Douglas-fir	43.80	29.25	41.98	34.17	30.54	42.44	21.52	43.71	35.34	46.77
Grand fir	12.43	12.41	11.88	7.05	12.28	14.90	19.95	11.50	10.41	3.81
Western Hemlock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western Redcedar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lodgepole Pine	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.11	0.35	3.61
Engelman Spruce	0.00	0.00	0.00	0.75	0.00	0.23	0.00	0.00	0.00	0.00
Subapine fir	1.61	2.69	2.21	2.65	0.45	1.59	2.94	2.66	3.86	2.40
Ponderosa Pine	27.01	28.70	21.14	26.54	27.72	18.05	24.56	21.08	23.38	28.30
nonindustrial	6.47	13.54	5.34	7.99	3.17	3.50	11.16	7.42	8.64	7.01