COST-EFFECTIVENESS OF FEDERAL PROGRAM OPPORTUNITIES FOR RELIEVING SOFTWOOD TIMBER SUPPLY PROBLEMS

Dissertation for the Degree of Ph. D.

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THOMAS HOWARD ELLIS, JR.

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This is to certify that the

thesis entitled

Cost-Effectiveness of Federal Program Opportunities
for Relieving Softwood Timber Supply Problems

presented by

Thomas Howard Ellis, Jr.

has been accepted towards fulfillment
of the requirements for

Ph.D. degree in Forestry

Robert J. Marty
Major professor

Date July 15, 1976

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Abstract

COST-EFFECTIVENESS OF FEDERAL PROGRAM OPPORTUNITIES FOR RELIEVING SOFTWOOD TIMBER SUPPLY PROBLEMS

By

Thomas Howard Ellis, Jr.

Analyses are made of opportunities for affecting future demand-supply balances for softwood timber supplies through three types of Federal programs:

--National forest reforestation and stand improvement,

--Cost-sharing of reforestation and stand improvement on nonindustrial private forest lands, and

--Technological research and development.

Selected elements in these program areas are evaluated in terms of expected costs and likely impacts on annual timber growth, on annual harvest, or on annual timber product requirements.

Methodology for timber program analysis is discussed. Criteria for ranking of opportunities are suggested, and techniques for evaluating benefits are described.

Examined national forest timber management opportunities include "backlog" reforestation and timber stand improvment. Estimates of potential treatment acreages considered accessible and inaccessible, as of 1972, are compiled by forest type, site-productivity class, and administrative region. Treatment costs and yields are evaluated for each classification. Projections of effects on annual growth and on allowable harvest are estimated for various levels of funding.

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Reforestation and stand improvement opportunities on nonindustrial private land are evaluated in essentially the same way as are national forest opportunities.

Technological opportunities evaluated involve research and/or technical assistance to forest industries in the following areas:

--Genetic improvement of planting stock,

--Control of *Fomes annosus* root rot,

--Improved drying systems for linerboard manufacture, and

--Computerized sawmill control.

Calculations are made of likely costs, including Federal research and development and private investment costs. Projections are made of likely results in terms of timber growth or savings in annual timber requirements.

Conclusions are that technological improvements in certain aspects of processing are the most immediate means of mitigating timber supply problems. The most effective of such opportunities, in the short run, would be ones requiring relatively small capital investments on the part of forest industries. Development of computerized sawmill systems is ranked highest in these terms.

Assuming that harvest regulation policy would allow increased timber sales immediately following silvicultural investment on national forests, such investments there would affect timber supplies sooner than reforestation programs for nonindustrial private lands. Stand improvement measures typically would be more cost-effective than reforestation. Reforestation on nonindustrial private lands should be more cost-effective for long-term improvement in timber supply, however, because these ownerships include large

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include large acreages of southern pine forest types where treatment costs are relatively low and land productivity high.

All of the programs evaluated involve large uncertainties. Technical progress in research may be slower than anticipated and industry may be slow to adapt research findings to actual production. Yield estimates used for reforestation and stand improvement analyses appear conservative, but land-use changes may result in even lower cost-effectiveness than calculated. Uncertainties about land-use may be as great for national forests as for private lands.

Principal recommendations are that:

(1) Future policy decisions on national programs to increase timber supplies should recognize opportunities for technological improvements as well as investments in silviculture;

(2) The technological opportunities evaluated in this study should receive strong support;

(3) Policymakers should note the potentially high cost-effectiveness of increased investment in nonindustrial private opportunities;

(4) Measures should be taken to reduce the high costs of silvicultural treatments on national forests;

(5) Changes in accounting practices should be considered, to allow increased investment in national forest silviculture without directly proportional increases in overhead costs; and

(6) The Forest Service should concentrate its increasingly large budget for silvicultural examinations on those administrative

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regions and national forests where cost-effectiveness of treatment is likely to be high.

Recommendations for further research also are given.

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COST-EFFECTIVENESS OF FEDERAL PROGRAM OPPORTUNITIES FOR RELIEVING SOFTWOOD TIMBER SUPPLY PROBLEMS

By

THOMAS HOWARD ELLIS, JR.

A DISSERTATION

submitted to

Michigan State University

in partial fulfillment of the requirements

for the degree of

DOCTOR OF PHILOSOPHY

Department of Forestry

1976

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The author wishes to acknowledge the encouragement and assistance of many friends and associates within the Forest Service, U.S.D.A., and at Michigan State University. Dr. Adrian M. Gilbert, Director of Program and Policy Analysis for the Forest Service, gave constant support for the analysis which was done largely while I was a staff assistant to him. David Tackle and Charles A. Wellner helped greatly in development of physical yield estimates for national forest silvicultural treatments and for genetic improvement of planting stock. Robert N. Stone gave much advice in establishing the framework for analysis. Thomas J. Mills, Marcus Goforth, and David J. Neebe helped overcome the computational difficulties of handling the large data sets and complicated investment analyses involved.
Professor Robert Marty, my major advisor, gave me my first introduction to public program evaluation and lent patient advice in the preparation of the manuscript. Professor Robert S. Manthy also introduced the author to some basic concepts of resource program analysis, as well as of research planning. Mrs. Norma Jones volunteered many hours deciphering my handwriting and typing a first draft.
Finally, I am most deeply endebted to my wife, Judith, for many years of encouragement toward completing this work.

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I. INTRODUCTION

U Thant remarked on the impact of modern technology upon natural resources:

> The central stupendous truth about developed economies today is that they can have--in anything but the shortest run--the kind and scale of resources they decide to have...It is no longer resources that limit decisions. It is the decision that makes the resources.[1]

While many people today might question U Thant's statement, it seems more likely to be true of timber than of most other resources. Timber inventories could be expanded through use of conventional methods of forestation and timber culture, or through development and application of improved methods for growing and protecting timber. Alternatively, new or improved techniques for harvesting and using timber could extend the usefulness of existing inventories. Congress and the Administration thus face two principal policy questions with regard to timber resources:

--What economic and social objectives are desirable for American forests?

--What kinds of federal programs and policies can best meet those objectives?

The first question is too broad to be analyzed satisfactorily in this study. It suffices to note that, over the past 75 years or more, both Congress and successive administrations have expressed continuing interest in programs for increasing timber

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[1]Quoted in Alvin Toffler. 1970. Future Shock. Random House, New York, p. 15.

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supplies. Recently that concern has been most pronounced during periods of apparent scarcity of softwood lumber and wood products, as evidenced by rapid inflation of lumber and plywood prices. Therefore, we may assume at least a partial answer is that public policymakers want increased assurance that softwood timber supplies will be adequate to meet future demand without dramatic price increases. And we may assume, on the basis of recent experience, that Congress is willing to appropriate substantial sums for programs to provide such assurance. Therefore, the question to which this study is addressed is that of alternative means--which kinds of programs are likely to be most cost-effective for averting or mitigating a presumed trend of increasing economic scarcity of softwood timber?

The Problem and Its Historical Setting

Since its inception, the United States Forest Service has been deeply concerned with means of assuring adequate timber supplies for the Nation. This concern reflects the intent of Congress as expressed in the Organic Act of June 4, 1897:

> No national forest shall be established, except to improve and protect the forest within the boundaries, or for the purpose of securing favorable conditions of water flows, and to furnish a continuous supply of timber for the use and necessities of citizens of the United States.[2]

Long-term adequacy of domestic timber supplies has been a matter of great controversy from the 1800's until today. Whether there is indeed a serious threat of future timber scarcity or not,

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[2] 30 Stat. 35, as supplemented; 16 U.S.C. 475.

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Congress has shown considerable interest in programs designed to expand growth and harvest. For example, between 1965 and 1975 there was a more than threefold increase in appropriations for national forest reforestation and timber stand improvement;[3] in 1973, a forestry incentives program for nonindustrial private land was authorized;[4] and comprehensive planning and analysis was required by the Forest and Rangeland Renewable Resources Planning Act of 1974.[5] Executive attention to timber resources was expressed in the appointment of a Cabinet Task Force on Softwood Lumber and Plywood in March, 1969, in President Nixon's June 1970 response to the recommendations of the Task Force,[6] and in the appointment of a Presidential Advisory Panel on Timber and the Environment in September 1971.

The advent of PPBS (Planning-Programming-Budgeting System) gave emphasis to questions of cost-effectiveness and priority-setting in public forestry programs as in other government activities. An early example of analysis performed in response to PPBS was a study of national forest timber management opportunities.[7] The

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[3]Hearings on Department of the Interior and Related Agencies appropriations before a Subcomm. of the House Comm. on Appropriations, 89th Cong., 2nd Sess., pt. 3, at 18 (1966), and 94th Cong., 1st Sess., pt. 2, at 442 (1975).

[4]Agriculture and Consumer Protection Act of 1973 (87 Stat. 245; 16 U.S.C. 590h).

[5](PL 93-378; 88 Stat. 476).

[6]Statement by the President on findings and recommendations of the Task Force on Softwood Lumber and Plywood, June 19, 1970.

[7]Marty, Robert and Walker Newman. 1967. Opportunities for timber management intensification on the National Forests. USDA-Forest Service Planning-Programming-Budgeting System Special Study. Summarized in Jour. Forestry 67:482-484.

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Office of Management and Budget (OMB) annually specified "Major Program Issues," under PPBS, which required analyses of selected programs. The Issues generally related to specific programs, such as national forest reforestation, but an analysis of unusually broad scope was requested, in 1970, with respect to the National Forest road system:

> Analyze the cost-effectiveness of an accelerated road program and the related up-grading of existing roads in relation to projected demands for National Forest timber, recreation, and other resources. Relate to and compare the opportunities for meeting these demands from areas already roaded and areas that are unroaded.[8]

An even broader analysis was requested, in conjunction with fiscal year 1974 budgeting, in an Issue entitled: Cost-Effective Means of Increasing the Availability of Softwood for Lumber and Plywood Production:

> What combination of Federal decisions and programs over the next five fiscal years will maximize increased softwood sawtimber supply over the ensuing 30 years from various levels of budget input?[9]

Analyses paralleling those required by the Office of Management and Budget were requested by the President's Advisory Panel on Timber and the Environment (PAPTE) in 1972.

Most analyses requested of the Forest Service have focused primarily on land management options. Relatively little analysis of research program opportunities in relation to timber supplies had been requested prior to passage of the Forest and Rangeland Renewable Resources Act of 1974. The report of PAPTE contained

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[8] Excerpt from a letter from Robert Mayo, Director of OMB, to Clifford Hardin, Secretary of Agriculture, February 12, 1970.

[9] Excerpt from a letter from George Shultz, Director of OMB, to Clifford Hardin, Secretary of Agriculture, October 21, 1971.

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discussions of possibilities for improvements in timber utilization practices through research and technical assistance programs. But explicit comparisons between different kinds of research programs or between land management programs and research programs were not made.

The present study compares, in terms of expected effect on timber demand or supply, the following program options:

--National Forest Silvicultural Opportunities

reforestation,

release of immature stands from competing, undesirable vegetation,

precommercial thinning of immature stands;

--Subsidized Silvicultural Investments on Nonindustrial Private Forest Lands

reforestation,

release of immature stands from competing, undesirable vegetation,

precommercial thinning of immature stands;

--Technological Improvement

research to speed the availability of genetically superior tree seed,

research to develop control methods for *Fomes annosus* (a root rot),

research on improved drying methods for producing linerboard (a paperboard material used in container manufacture), and

research on computerization of sawmilling.

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A few other possibilities for similar programs were examined briefly, in preparation for this study, but were not included in this report due to lack of detailed information on likely costs and effects.[10]

Framework for Analysis

A problem of increasing economic scarcity of a natural resource could be countered by measures to increase supply of the resource itself or through changes in the efficiency with which the resource were used in some production process. Programs to improve efficiency of resource use could be considered either as measures to reduce demand for standing timber or as means of increasing supply of products from a given level of timber harvest. For the array of program options considered in this study, several different kinds of effects are explored:

--Increase in expected mean-annual-increment of treated timber stands;

--Increase in expected harvest volumes;

--Reduction in annual growth losses due to insect or disease attack; and

--Reduction in annual timber demand through efficiencies in harvesting, wood processing, or product design.

For comparability, the effects of programs designed to reduce timber demand are calculated first in terms of product, then in terms of roundwood equivalent. For example, in 1970, softwood

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[10] The most obvious means of enlarging timber supply in the next several decades would be increased harvest of old-growth timber on national forests. It is precisely because the issue on national forest harvesting rates and methods is so controversial and unlikely to be resolved soon that alternative programs are evaluated in this study.

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For comparability, the effects of programs designed to reduce timber demand are calculated first in terms of product, then in terms of roundwood equivalent. For example, in 1970, softwood sawmills recovered about 45 percent of the cubic volume of log input in finished lumber. An improvement to a 50 percent recovery rate would have allowed a 10 percent reduction in sawlog requirements for the 1970 lumber output.[11]

Calculations are based on an initial 5-year program with costs and effects projected to the ends of the first and third decades after program initiation. Both Federal and non-Federal costs are calculated for the initial 5 years, second 5 years, and succeeding 20 years.

Estimates of costs and results are based upon interviews and informal reports submitted by staff assistants in various divisions of the U.S. Forest Service Headquarters, Washington, D.C. and at the Forest Products Laboratory, Madison, Wis.

The logic of the study essentially is as follows. Congress has appropriated increasingly large sums of money for forestry investments over the past 10 years, reflecting its concern about timber supplies. The Forest Service and the Department of Agriculture have considerable influence in deciding what mixture of programs should be recommended for inclusion in the President's annual budget proposal to Congress. The nature of the budgeting process

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[11] A minor savings in logging residues also would result, since a reduction in sawlog requirements would lead to a reduction in harvest--including logging residue associated with harvest. The net effect on logging residues would be too small to matter, in most cases.

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Political constraints and administrative problems make large, precipitous changes in funding allocations very difficult; but gradual reallocations over a 5- or 10-year period would be feasible--especially if made in the programming of budget increases. The analysis in this study is designed to suggest which kinds of programs available to the Forest Service are likely to be most cost-effective in relation to timber supply and should be emphasized in funding allocations.

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II. METHODOLOGY FOR TIMBER PROGRAM ANALYSIS

The basic approach to public program analysis under the Planning-Programming-Budgeting System has been:

--Specification of objectives,

--Identification of alternative means of meeting objectives,

--Evaluation of alternatives, and

--Conclusion as to preferred alternative.

Even though the larger objectives of PPB may have been abandoned, as surmised by Schick,[12] or impossible of achievement, as suggested by Wildavsky,[13] the demand for analysis of Forest Service programs has increased, rather than diminished in the past several years. The most outstanding example is the Forest and Rangeland Renewable Resources Planning Act of 1974 (PL 93-378; 88 Stat. 476). The Act requires an assessment of resource demand and supply trends, a detailed inventory and evaluation of opportunities for affecting these trends, and discussion of priorities for public investment. The Act presents a framework for program evaluation almost exactly similar to that required earlier in the USDA PPB System.[14]

Reviews of federal timber programs usually have been concerned either with short-term policies for immediate relief of on-going

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[12] Allen Schick. 1973. A death in the bureaucracy: the demise of federal PPB. Public Administration Review. Vol. XXXIII, No. 2 pp. 146-156.

[13] Aaron Wildavsky. 1969. Rescuing policy analysis from PPBS. Public Adminstration Review. Vol. XXIX, No. 2 pp. 189-202.

[14] A statement of objectives for the U.S.D.A. PPB System was given in Secretary's Memorandum No. 1589, Oct. 27, 1965, by Orville Freeman, Secretary of Agriculture.

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surges in lumber and plywood prices[15] or with evaluation of possibilities for mitigating anticipated price rises over periods of one or more decades. The latter interest has been particularly evident in requests by OMB for timber analyses. In any case, recognition that Forest Service programs may have sufficiently large effects to alter price trends for timber and wood products has significant implications for methodology of timber program evaluation. Furthermore, the fact that congressional and executive interest in timber programs generally has ebbed and flowed in concert with lumber and plywood prices suggests that it is the effects of timber-related investments on national economic growth that are of greatest interest.[16]

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[15] Options typically examined for relief of on-going surges in lumber and plywood prices have been increased funding for timber salvage and commercial thinnings on national forests, imposition of controls on log exports, amendment of laws requiring waterborne interstate commerce to use domestic shipping, and steps to alleviate boxcar shortages in lumber and plywood producing regions. See for example Robert Mayo's Memorandum for Cabinet Committee on Economic Policy--fundings and recommendations of Task Force on Softwood Lumber and Plywood, released by the White House, June 19, 1970. See also John T. Dunlop's statement at the opening of public hearings on lumber prices, April 4, 1973, cost of Living Council News, Office of Public Affairs, Washington, D.C.

[16] This is not to suggest that environmental and other aspects of timber programs are unimportant. Rather, it is an assumption that motivation for increased timber investment is primarily economic.

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Basic Concepts of Public Program Evaluation

Economic study of public expenditure programs principally involves two areas of inquiry. The first is consideration of the proper relationship between private enterprise and government, especially the identification of areas where public expenditures are warranted. Welfare economists have examined the theoretical assumtions of free market operation to specify instances of "market failure" under which government intervention would be justifiable. The second area of inquiry concerns the methods by which public expenditures may be allocated so as to maximize social benefits. It is these methods, generally applied in the context of "benefit-cost analysis," which are of particular interest for the present study.

Benefit-Cost Analysis

Benefit-cost analysis essentially involves the quantification and comparison of expected program effects and costs, in pursuit of economic efficiency. Haveman defined economic efficiency succinctly:

> Considered most simply, economic efficiency is achieved when the value of what is produced by any set of resources exceeds by as much as possible the value of the resources used; or when the least valuable set of resources is utilized in producing any particular worthwhile output.[17]

Basic corollaries to the objective of economic efficiency are that public expenditures should not be made unless resultant

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[17] Robert H. Haveman. 1970. Public expenditure and policy analysis: an overview. In Public expenditure and policy analysis. ed. by Robert H. Haveman and Julius Margolis. Markham Publishing Co., Chicago, Ill. p. 7.

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benefits to society were expected to equal or exceed costs and that, for a limited budget, the government should select the set opportunities for public programs expected to yield the maximum possible social gain.

Common features of benefit-cost analysis are: compilation of explicit schedules of program costs and returns, valuation in dollar terms, and use of interest rates to discount or compound costs and returns to a common point in time. The techniques of benefit-cost analysis thus are essentially similar to capital budgeting methods developed for investment planning by business firms. The primary distinction between public program analysis and capital budgeting lies in the scope of evaluation. A private firm presumably attempts to maximize its own profits, after taxes, and thus may ignore costs or benefits associated with its activities but not accruing directly to the firm itself. A government agency, ostensibly attempting to maximize the welfare of society in general, should consider all significant effects of its programs. And, unlike the business firm, the agency would disregard taxes and other "transfers of income" in its calculations of program efficiency.

Although the philosophy of benefit-cost analysis has a long history of development, refinements of technique and practical application have largely occurred since World War II--especially in conjunction with the Planning-Programming-Budgeting System

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inaugurated in the 1960's.[18] In 1962, guidelines for Federal agencies were provided in a Senate Document entitled "Policies, Standards, and Procedures in the Formulation, Evaluation and Review of Plans for Use and Development of Water and Related Land Resources."[19] Subsequently, instructions issued by the Office of Management and Budget and by individual departments in conjunction with program budgeting have guided agency analysts.

Problems in Application of Benefit-Cost Analysis

Analysts making benefit-cost evaluations have encountered many conceptual and practical problems. Some of the more common problems involve:

--lack of useful estimates of project effects;

--variations in scale of projects;

--difficulty in valuing project benefits or disbenefits;

--existence of "externalities" and "secondary benefits;"

--questions as to the appropriate interest rate for discounting;

--choice of criteria for ranking alternative projects;

--risk and uncertainty; and

--institutional problems.

Inadequate information on project effects is perhaps less serious for analysis of timber production opportunities than for many

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[18] A thorough review of the history, theory, and problems of benefit-cost analysis was made by A. R. Prest and R. Turvey. 1965. Cost-benefit analysis: a survey. The Economic Journal. Vol. LXXV (300):683-735.

[19] 87th Cong., 2nd. Sess., Senate Document No. 97.

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other kinds of programs, e.g., public health programs. But even in the case of silvicultural investments, it is difficult to get truly reliable estimates of physical yields. The difficulty is made more acute because the analyst desires to know the marginal effects of potential investments. Thus, in analyzing a reforestation opportunity, he must estimate not only what yields might occur with a given treatment, but also what yields might occur without the treatment. Similarly, in analyzing an investment in controlling a forest pest, he must estimate timber losses, with and without control efforts.

For many projects, there are almost unlimited possibilities for varying the scale of investment. For example, in reforestation projects, the number of seedlings planted on a given acre may vary from just a few to more than a thousand. The quality of seedling, and thus seedling cost, may vary greatly, as may the degree of site preparation done in advance of planting. Ideally, the analyst desires to select the economically efficient level of investment within each program opportunity, as well as for the collective set of available opportunities. In a practical sense, such detailed analysis is nearly impossible when the set of opportunities is large and diverse--as is the case for broad-scale timber program analysis.

Prices applicable to government programs with benefits not ordinarily available in competititve markets are difficult to derive. The problem is most acute for projects involving "intangible benefits" such as scenery. Even for timber programs, however, prices are a problem, because long investment periods are involvec

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are involved and trends in stumpage or wood product prices have been erratic. Furthermore, public timber programs may have large effects on these trends. Principal means of handling uncertainty as to price trends is to analyze program benefits with two or more separate price assumptions. Another common method is cost-effectiveness analysis, employed in this study, to examine the costs of achieving a desired effect through alternative means.

Externalities and Secondary Benefits

Externalities are indirect or "spillover" effects. McKean distinguished between "technological spillovers" and "pecuniary spillovers."[20] Technological spillovers affect the physical production of goods or services outside the project under consideration. An example would be the reduction of anadramous fish production resulting from construction of a high dam. A pecuniary spillover is an effect on prices received by businesses or agencies outside the project. McKean discussed four types of pecuniary spillovers: (1) the bidding up of input prices; (2) the reduction of prices for substitute products; (3) the raising of prices for complementary products; and (4) the lowering of prices for the products of the project. While technological spillovers impose real costs or benefits on society and should be counted among project effects, pecuniary spillovers merely shift income distribution and should not enter the calculation

[20] Roland N. McKean. 1958. Efficiency in government through systems analysis. Wiley and Sons, New York, N.Y.

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of economic efficiency. Pecuniary spillovers, however, may be important determinants of the political and social feasibility of a given project.

Secondary benefits are income effects which occur beyond the stage of delivery of the direct output of a project. An example would be an increase in sales of lumber manufacturers' due to an increase in national forest timber production. Inclusion of secondary benefits in economic efficiency calculations may lead to serious overcounting of benefits, as in the example of increased lumber sales--the value of which includes stumpage costs, logging costs, and manufacturing costs. A case may be made for inclusion of secondary benefits, however, if some of the resources involved would be unemployed without the project.[21] For example, it may be appropriate to consider an increase in sawmill labor income as a real benefit, if that labor were expected to remain unemployed without a particular national forest project.

Interest Rate Problems

Selection of the appropriate interest rate for analysis of public projects is a controversial subject. Some economists have argued that society has a longer time-horizon than a business firm and, therefore, should use lower interest rates in discounting future benefits of long-term projects. Others have argued that use of a lower interest rate for public projects biases investment away from more efficient private projects and thus reduces economic

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[21] See Roland N. McKean, *op. cit.* p. 158-160.

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growth in the long-run. Baumol suggested, "...the correct discount rate for the evaluation of a government project is the percentage rate of return that the resources utilized would otherwise provide in the private sector."[22] The problem lies in determining what that rate would be. For the government analyst, the problem is simplified: specific instructions on the interest rate to be used are issued by the Office of Management and Budget and, frequently, by his own agency.

Criteria for Ranking Program Opportunities

Many criteria have been suggested for ranking alternative investment opportunities:

Present worth.--The sum of all future returns from an investment discounted to the present.

Net present worth.--Present worth minus the sum of discounted costs (including initial investment cost).

Benefit-cost ratio.--Present worth divided by the sum of discounted costs.

Internal rate of return.--The interest rate(s) which would equate present worth and the sum of discounted costs, if used to discount both costs and returns.

Composite internal rate of return.--A variant of internal rate of return in which an *a priori* interest rate first is used to compound intermediate net benefits to the end of the project lifetime and to discount intermediate net costs to the present.

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[22] William J. Baumol. 1970. On the discount rate for public projects. In Public expenditure and policy analysis. Ed. by Robert H. Haveman and Julius Margolis. *Op. cit.* p. 273-290.

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The composite internal rate is then that interest rate which would discount future value of benefits to equal present value of costs.

Equivalent annual income.--Net present worth multiplied by discount rate, i.e., the annual payment which, received each year for a period equal to the project lifetime, would have a discounted value the same as net present worth of the project.

Net future worth.--Value of benefits, compounded to the end of the project lifetime, minus costs compounded similarly.

Choice of criteria depends upon several factors: whether funding available for investment is a fixed amount or limited only by the economic worthiness of program opportunities; whether or not opporunities are mutually exclusive; the existence of interrelationships among opportunities; the extent to which program opportunities are limited or can be carried out at various scales; and the extent of agreement upon explicit interest rates for discounting or reinvestment. McKean recommended maximization of net present worth of whatever level of spending was adopted.[23] He noted that a selection of all projects with internal rates of return greater than a given discount rate would achieve maximum net present worth if the investment budget were large enough to permit such a selection. If the budget were fixed, he suggested the proper procedure was to calculate net present for each opportunity at various discount rates, to find the

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[23] Roland N. McKean, op. cit.

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highest discount rate at which all projects with positive net present worth would just exhaust the budget.

McKean also remarked that proper ranking of alternative investment projects required a two-stage procedure: first, calculation of the optimum level of investment in a given project, then ranking of alternative projects.[24] He opposed the use of benefit-cost ratios on the grounds that they tended to underrate projects with high future costs and returns as compared to projects with low future costs and returns.[25]

Agriculture Handbook 304, widely used by the Forest Service, recommended use of internal rate of return for ranking silvicultural investment opportunities.[26] Various authors[27] have noted shortcomings of internal rate of return, principally:

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[24] Many forestry investment opportunities can be varied in intensity of treatment. A technique for handling this problem, in a fashion similar to that suggested by McKean, was suggested by Allen L. Lundgren. 1971. Ranking investment alternatives--a new look. Journal of Forestry, Vol. 69, No. 9, pp. 568-573.

[25] Similarly, Harold Bierman, Jr., and Seymour Smidt suggested that net present worth was the best measure of profit potential and the benefit-cost ratio (called "present-value index by Bierman and Smidt) was unsuitable for ranking projects. See: The capital budgeting decision. Macmillan, New York, N.Y. 1971.

[26] Robert Marty, Charles Rindt, and John Fedkiw. 1966. A guide for evaluating reforestation and stand improvement projects. U.S. Dept. Agric. Handbook 304.

[27] See, for example, E. J. Mishan. 1971. Economics for Social Decisions. Praeger, New York, N.Y.

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--Possibility of multiple rates of return if periods of net costs are interspersed with periods of net returns, e.g., an initial investment is followed by one or more periods of net returns than one or more of net costs;

--There is an implicit, but oft ignored, assumption that intermediate benefits from a project can be reinvested at the internal rate of return computed for the project;

--If alternative projects differ in scale and in length of time period, ranking by internal rate of return may differ from a ranking by net present worth; and

--If internal rate of return were calculated on the basis of gross costs and gross returns, the answer might be different than one calculated from net cash flows.

Marty proposed use of composite internal rate of return as a solution to the first two problems mentioned above.[28] Teichrow, Robichek, and Montalbano suggested similar criterion for capital budgeting by private firms, but used a different algorithm for its calculation.[29]

In the present study, the principal objective is to compare cost-effectiveness of major program alternatives for affecting timber demand: supply balances. Thus, the primary criteria for comparison are anticipated supply or demand effects, in terms of timber harvest equivalents, per dollar of federal spending.

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[28] Robert Marty. 1970. The composite internal rate of return. Forest Service, Vol. 16, No. 3, pp. 276-279.

[28] Daniel Teichrow, Alexander A. Robichek, and Michael Montalbano. 1965. "Mathematical analysis of rates of return under certainty." Management Science. Vol. 11, No. 3, pp. 395-403.

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Internal rate of return and benefit-cost ratio are compared with cost-effectiveness ratios as ranking criteria for silvicultural programs. Research programs are evaluated entirely on the basis of cost-effectiveness.

Risk and Uncertainty

None of the program opportunities considered in this report would have a completely assured outcome. Yields may vary significantly from projections in both physical volume and economic worth. The problem involves both "risk"--quantifiable, predictable variation in possible outcomes--and "uncertainty"--unmeasurable, unpredictable variability in outcomes.[30]

Silvicultural investments entail risks of loss to natural causes, such as fire, insects, drought, and storms. They also involve uncertainties as to future land management; e.g., an area of commercial forest land treated today may become a part of a campground or a proclaimed wilderness area tomorrow. Another factor of uncertainty is that estimates of treatment yields must be based heavily upon expert opinion rather than empirical data. It is especially difficult to estimate what yields would be in the absence of treatment. Therefore, calculations of marginal effects due to treatment may be quite erroneous. The problem is compounded by the practical necessity of aggregating highly variable treatment situations into a manageable set for analysis. Another element of uncertainty is the difficulty of identifying treatment opportunities correctly on the ground.

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[30] Frank H. Knight. 1921. Risk, uncertainty, and profit. Reprinted by Harper and Row, New York, N.Y. 1965.

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Research projects by their very nature are subject to large uncertainties. Answers to technical problems may be more elusive than anticipated. Solutions which are feasible in a technical sense may not be economically feasible on a commercial scale or may be blocked by institutional problems. Estimates of rates of implementation and ultimate extent of application may be seriously in error. There is also the possibility of parallel or competing developments which may obviate the particular research project in question. Furthermore, benefit-cost analysis of forestry research programs is subject to large errors in estimation of forest products price trends, as is analysis of silvicultural opportunities.

Probably the most common solution to problems of uncertainty is that noted by Knight, hiring people who have a reputation for making good guesses:

> Organized control of nature in a real sense depends less on the possibility of knowing nature than it does on the possibility of knowing the accuracy of other men's knowledge of nature, and their powers of using this knowledge.[31]

Many of the techniques used today for technology assessment concentrate on efficient methods of eliciting other men's knowledge.[32]

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[31] Id., pp. 285-286.

[32] See, for example, Charles H. Kepner and Benjamin B. Tregoe. 1965. The rational manager, McGraw-Hill, New York, N.Y. See also Robert R. Dunford. 1974. Decisions, decisions. Industrial Research. July 1974. pp. 27-30.

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Procedures for treating risk and uncertainty range from simple reductions of project benefits to use of higher or lower discount rates depending upon the degree to which a project is subject to variable outcomes. It is commonly argued that because government undertakes so many investments, no increase in discount rate should be applied to risky projects. An opposing view is that such a procedure introduces a bias toward government and away from private investment opportunities, even though the latter may be equal in risk and superior in economic worth.[33]

In analyses of silvicultural investments, it is common practice to reduce hypothetical yields by some percentage to account for anticipated losses to natural causes. Row proposed a more sophisticated procedure, using a stochastic model for simulating treatment effects and variation in rates of return due to risks of natural losses and wrong estimation of costs.[34] Another technique is that of sensitivity analysis, examining

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[33] A concise summary of various viewpoints on this topic was given in Jack Hirshleifer and David L. Shapiro. 1970. The treatment of risk and uncertainty. In Public expenditure and policy analysis. Ed. by Robert H. Haveman and Julius Margolis. Markham Publishing Co., Chicago, Ill., pp. 291-313.

[34] Clark Row. 1973. Probabilities of financial returns from southern pine timber growing. Unpublished Ph.D. Dissertation. Tulane University, New Orleans, La. A similar approach to investment decisions for private firms was described in Edgar A. Pessemier. 1966. New-product decisions: an anlystical approach. McGraw-Hill, New York, N.Y.

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the effects of changes in analytical assumptions upon predicted economic feasibility.[35]

The approach used in the present study is to reduce silvicultural yields explicitly to account for anticipated losses to natural causes. Deductions are not made for uncertainty over land management trends, etc. Since the major emphasis is on comparison of alternative policies for affecting timber demand: supply balances, uncertainties as to price trends are considered relatively unimportant. Uncertainties about research outcomes can only be discussed. No quantitative corrections for uncertainty are applied to anticipated research program effects.

Institutional Problem

Perhaps the least manageable problem in benefit-cost analysis is its potential incompatibility with political or bureaucratic goals which conflict with economic efficiency goals. Comparing program budgeting versus traditional budgetary procedure, Schultze--a proponent of the former--summarized the principal criticisms of PPB:

--the problem-solving approach of PPB is not suited to the actual decision-making process;

--the efficiency criteria of the problem-solving approach are an inferior substitute for "...the more meaningful criteria of achieving consensus through adjustment of conflicting values."; and

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[35] A computerized, investment analysis program for sensitivity analysis was described in Marcus J. Goforth and Thomas J. Mills. 1975. A financial return program for forestry investments including sensitivity of results to data errors. U.S. Dept. Agric., Agric. Handbook 488.

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--the analytical, quantitative approach of PPB fails when applied to social and institutional problems.[36]

The above criticisms of PPB are directed primarily toward the objectives and methods of efficiency maximization, the distinguishing features of benefit-cost analysis.

Another widely recognized problem is that in establishing the framework for his study, the analyst often must make subjective judgements about program objectives and effects. Unless the terms of the analysis are made abundantly clear to, and accepted by the decisionmaker, the analyst may usurp the perogatives of the decisionmaker. Conversly, the analyst may be forced by decisionmakers to introduce highly optimistic assumptions into his work to prove the worthiness of subject programs. Another likely outcome is that analyses casting doubt on projects which have institutional support may be buried in closed files and ignored.

Despite these problems the demand for benefit-cost analysis is increasing, especially with respect to timber programs. Chapter I already has detailed the background of this trend. The rest of this study proceeds on the assumption that benefit-cost analysis is an aid in policy decisions--not a substitute for policymakers' judgement.

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[36] Charles L. Schultze. 1968. The politics and economics of public spending. The Brookings Institute, Washington, D.C.

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The principal source of funding for reforestation and stand improvement on the national forests has been money collected from purchasers of national forest timber. Authorized by the Knutson-Vandenburg (K-V) Act of 1930,[37] these collections totaled $453,314,322 from 1931 through fiscal year 1974.[38] These funds may be used only for silvicultural treatments on timber sale areas. Forest Service policy has been to collect K-V funds primarily for work to be done within 3 years after timber harvest.[39]

Silvicultural investments for which K-V funds are not available are financed annually through congressional appropriations, under the appropriation item, National Forest Protection and Management (P&M). P&M funds are spent largely for "backlog" reforestation and timber stand improvement. Backlog reforestation opportunities include areas denuded by natural causes, e.g., fires, without substantial timber salvage; old cutover areas not successfully reforested with whatever K-V funds may have been collected; and land which may have been nonstocked when added to national forest holdings. Backlog timber stand improvement includes opportunities for precommercial thinning or release of young stands from competition from unwanted vegetation.

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[37] Knutson-Vandenberg Act of June 9, 1930 (46 Stat. 527; 16 U.S.C. 576-576b).

[38] U.S. Forest Service. 1974. Annual reforestation and timber stand improvement report--fiscal year 1974. Letter from R. E. Worthington, Director of Timber Management, to Regional Foresters and Directors, Nov. 13, 1974.

[39] Collection and Use of Deposits for Sale Area Betterment, Forest Service Manual 2477, June 73, AMEND. 76.

Table 1.--National Forest reforestation and stand improvement funding, 1960-1974

Fiscal year	Appropriated funds (P&M)	Knutson-Vandenburg funds (KV)
	Millions of dollars	
1960	2.6	11.8
1961	3.4	14.0
1962	10.3	12.5
1963	15.4	14.0
1964	15.7	16.1
1965	16.6	16.6
1966	17.2	17.8
1967	17.4	19.7
1968	15.6	21.1
1969	15.8	21.4
1970	16.0	25.1
1971	19.4	28.9
1972	[1] 30.8	30.6
1973	[2] 32.1	32.6
1974	[3] 33.3	37.2

Sources: Annual reforestation and timber stand improvement repots, Director of Timber Management, U.S. Forest Service, Washington, D.C., except as footnoted.

[1] Hearings on Department of Interior and Related Agencies. Appropriations before the Senate Comm. on Appropriations, 93rd Cong., 1st Sess., Pt. 3 at 2199 (1973).

[2] Hearings on Dept. of the Interior and Related Agencies. Appropriations before a Subcomm. of the House Comm. on Appropriations, 93rd Cong., 2nd Sess., Pt. 3 at 165 (1974).

[3] Hearings on Dept. of the Interior and Related Agencies. Appropriations before the Senate Comm. on Appropriations, 94th Cong., 1st Sess., Pt. 2 at 1202 (1974).

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Use of P&M funding for reforestation and timber stand improvement rose from $2.6 million in 1960 to about $33 million in 1973 (Table 1). Substantial increases in 1962 and 1963 appropriations probably were a sympathetic response to "A Development Program for the National Forest."[40] A much larger funding increase occurred in 1972, a time of national concern over lumber and plywood supplies. The point of interest for this study is that increasingly large appropriations for P&M reforestation and timber stand improvement are being made, with the principal objective being to increase timber supplies. Thus it is appropriate to examine the effectiveness of such funding in terms of likely timber supply impacts and in comparison with other kinds of opportunities for achieving similar inputs.

Previous Reports of National Forest Backlog Opportunities

The Anderson-Mansfield Reforestation and Revegetation Act of 1949 (16 U.S.C. 581; 581k) stated that national forest lands contained over 4 million acres of denuded and unsatisfactorily stocked timberlands and authorized a schedule of increasing appropriations, rising to $10 million for FY 1955. Congress did not appropriate the levels authorized, however.

A 1952 survey indicated a total of 4,567,000 acres of "plantable area" on national forests. Plantable area was defined as:

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[40] U.S. Forest Service. 1961. A development program for the national forests (hereinafter cited as 1961 Development Program). Transmitted to Congress by John F. Kennedy, Sept. 21, 1961.

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> Nonstocked or poorly stocked forest land or nonforest land on which, judged by 1952 conditons: (1) the establishment of forest tree cover is desirable and practical, and (2) regeneration will not occur naturally within a reasonable time.

Economic desirability of treatment was not considered:

> This analysis does not attempt to incorporate business aspects, nor does it suggest that it is economically feasible to plant all plantable area.[41]

The 1961 Development Program reported a total of 4.4 million acres of nonstocked and poorly stocked plantable areas, of which 3.8 million acres were recommended for treatment in the next 10 years. The Program also proposed other cultural treatment of 10 million acres of sapling and pole timber sized stands. The long-range timber goal was to increase annual sawtimber harvest to 21.1 billion board feet by the year 2000--a level more than double the 9.6 billion board foot annual allowable cut reported as of January 1, 1961.

Prior to 1966, the principal source of information on national forest treatment opportunities was Forest Survey reports. These reports included estimates of forest acreage by stand-size categories (sawtimber, poletimber, seedling and sapling, and nonstocked) for each timber type, site productivity class, ownership group, and county, state, or region. This information still is provided in current Forest Survey reports,[42] but for

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[41] U.S. Forest Service. 1958. Timber resources for America's future. Forest Resource Report 14. pp. 276-286.

[42] See, for example, U.S. Forest Service. 1972. Forest Statistics for the United States, by State and Region, 1970. U.S. Dept. Agric. unnumbered publication.

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programming purposes, estimates of treatment opportunities, after 1966, were based on the Forest Service Project Work Inventory (PWI). The initial PWI estimates were made, in 1966, on the basis of potential job opportunities in the event of massive public works programs. Each of the Forest Service's several hundred district rangers was asked to estimate the extent of various investment opportunities on his district. Economic feasibility was of no concern.

A comprehensive study of national forest timber management intensification opportunities was concluded in 1967.[43] Rates of return and timber yield additions were calculated for general regimes of management intensification, including increased spending for reforestation and stand improvement, road construction and maintenance, and timber sales administration. Each major timber type and geographic region was investigated. Major findings of the study were that investments in intensified management would yield 4 percent or larger rate of return on 42 percent of national forest timberland and, thus, would result in a sustainable annual harvest 2.2 billion cubic feet greater than that otherwise obtainable. Estimates were not made of economic desirability of single treatments, e.g., forestation, but acreages of reforestation and stand improvement opportunities were reported, from the 1966 Project Work Inventory, for each timber type and region. Reforestation opportunities were estimated at 4,961,000 acres and release and thinning opportunities

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[43] Robert J. Marty. 1967. Opportunities for timber management intensification on the national forests. Unpublished review draft. Forest Service. U.S. Dept. Agric.

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at 9,264,000. About 8.7 million acres of these treatment opportunities was reported for timber types and sites where a 4 percent or higher rate of return to management intensification was anticipated.

The Project Work Inventory was updated in 1968, then adjusted by the Division of Timber Management. The following estimates resulted:

Backlog National Forest Opportunities, 1968[44] by Rate of Return to Timber Management Intensification

Treatment Class	0-6 percent	6 percent and higher	All
	------------Millions of acres------------		
Reforestation	2.5	2.3	4.8
Release	2.1	2.2	4.3
Thinning	7.4	1.7	9.1
	12.0	6.2	18.2

In 1969, a working group of the Cabinet Task Force on Softwood Lumber reported that intensified management could increase national forest timber harvest by 7 billion board feet annually by 1978.[45] It was estimated that the following backlog treatment would be necessary: reforestation, 3.4 million acres; release, 3.4 million acres; and precommercial thinning, 2.5 million acres.

[44] Memorandum from R. G. Florance, Acting Deputy Chief, to Chief of the Forest Service. 1310 Planning. Dec. 2, 1970. Rate of return classes refer to estimated return to general regimes of management intensification as reported by Marty. (See footnote 43.)

[45] U.S. Forest Service. 1969. Possibilities for meeting future demands for softwood timber in the United States. Unpublished report prepared for Working Group of the Cabinet Task Force on Lumber, revised Sept. 29, 1969.

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In 1970, the Chief of the Forest Service ordered an internal review of national forest timber management policies. One of the problems mentioned in the review report was inadequacy of existing procedures for identifying reforestation opportunities and establishing a priority system for allocating funding thereto.[46] A subsequent report, in 1972, recommended development of comprehensive systems for inventorying reforestation opportunities regularly, issuance of standard instructions for use by regional staff in economic analysis and priority setting, and preparation of growth tables for projecting yield of managed stands.[47] Both reports stressed the importance of "inplace, detailed stand information," i.e., information on treatment opportunities based on field mapping and examination rather than the kind of data derived from forest survey plots. The FY 1973 budget included $2.3 million for silvicultural examinations--as compared to $430,000 the previous year.

In September 1972, Congress passed a Supplemental National Forest Reforestation Fund Act (P.L. 92-421, 86 Stat. 678) which authorized appropriations of up to $65 million per year for reforestation. Any moneys appropriated under the Act were to be available until expended, rather than limited to the year in which appropriated. This provision would have allowed greater flexibility in program planning and management than had been possible previously, but no funds were appropriated under

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[46] U.S. Forest Service. 1971. National forests in a quality environment. U.S. Dept. Agric. unnumbered publication.

[47] U.S. Forest Service. 1972. National forests in a quality environment--action plan. U.S. Dept. Agric. unnumbered publication.

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this Act subsequently. The most important result was an increased effort by the Forest Service to develop information on backlog treatment opportunities and a related program plan in response to the Act's requirement for an annual report. The first report pursuant to this Act was made in 1974.

A President's Advisory Panel on Timber and the Environment was appointed in September 1971, to "...advise the President on matters associated with increasing the Nation's supply of timber to meet growing housing needs...."[48] Among other things, the Panel was to make recommendations regarding costs and benefits of alternative forest management programs. Its 1973 report included recommendations:

> 9. The Forest Service carry out an accelerated program of timber growing, stressing immediate regeneration, on national forests....
>
> 10. The Federal Government maintain incentive programs to encourage private landowners to follow forest management programs...to increase future timber supplies....
>
> 17. A better method of more adequate and timely finance of forest management programs on all Federal lands is essential. Such a method must recognize the long-term nature of forestry and be based upon sound economic concepts of intensive forest management; ....[49]

The Panel's report included an analysis by Marty of the economic effectiveness of general management intensification for major timber types in the United States.[50]

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[48] Press release by the Office of the White House, Press Secretary, Sept. 2, 1971, San Clemente, Calif.

[49] Report of the President's Advisory Panel on Timber and the Environment. April 1973. Government Printing Office, Washington, D.C.

[50] Id. pp. 141-147.

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[53] Id. pp. VI-

During 1973, the General Accounting Office (GAO) investigated the Forest Service's management of reforestation and timber stand improvement programs. GAO's report[51] on the subject recommended essentially the same actions as those desired by the Forest Service: increased funding, development of "inplace" inventory data, and work on methods of establishing funding priorities.

The following year, Forest Service planners circulated a Draft Environmental Program for the Future--A Long Term Forestry Plan.[52] The Draft Program posed "low," "moderate," and "high" supply alternatives for programming various forestry activities for fiscal years 1975-79. The high supply alternative for national forest timber management would have included 1.5 million acres of backlog reforestation and 3.0 million acres of timber stand improvement.[53] These measures were expected to increase annual allowable cut by 3.8 billion board feet (International 1/4" log rule) by 1984.

The Present Study

A major problem in analyses of national forest treatment opportunities has been that neither Forest Survey nor Project Work Inventory reports indicated which opportunities were currently accessible or soon to be. Another difficulty has been that some

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[51] Comptroller General of the United States. 1974. More intensive reforestation and lumber stand improvement programs could help meet timber demand. Feb. 14, 1974, report to Congress.

[52] U.S. Forest Service. 1974. Environmental program for the future--A long term forestry plant (draft). U.S. Dept. Agric. unnumbered publication for public review.

[53] Id. pp. VI-12, 13.

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acreages listed as opportunities in the inventory may have been quite unlikely to respond satisfactorily to treatment. The present study is designed to evaluate those backlog acreages considered accessible and treatable at reasonable cost and the maximum feasible 5-year investment program. Major steps in the analysis are:

--Compilation of acreage estimates by administrative region, forest type group, and site productivity class;

--Estimation of anticipated growth and harvest impacts on a per-acre basis for the various treatment costs and stumpage values;

--Ranking of opportunities by several criteria; and

--Compilation of estimated costs and effects for several levels of total investment allocated as considered most desirable by staffmen in the Forest Service Division of Timber Management.

Extent of Treatment Opportunities

A summary of estimated treatment acreages is shown in Table 2. Areas considered to be accessible for treatment in the next 5 years, without need of appropriated funding for road construction, total 2,177,000 acres of reforestation opportunities, 1,076,000 acres of release opportunities, and 1,259,000 acres of precommercial thinning opportunities. Total acreages of precommercial thinning and release opportunities are estimated to be the same as indicated by previous estimates of the Division of Timber Management, but reforestation opportunities appear substantially smaller in extent than expected in all regions other than the Rocky Mountains.

Table 2.--National forest backlog treatment opportunities

Treatment class	Region[1]	Present study estimates		Division of Timber Management previous estimates, accessible and inaccessible
		Accessible[2]	Total	

Table 2.--National forest backlog treatment opportunities

Treatment class	Region[1]	Present study estimates: Accessible[2]	Present study estimates: Total	Division of Timber Management previous estimates, accessible and inaccessible
		Thousands of acres		
Reforestation	Rocky Mountains	913	1,028	1,169
	Pacific Coast	459	573	1,270
	South	546	821	1,554
	North	259	406	796
	Total	2,177	2,828	4,788
Release	Rocky Mountains	560	1,244	1,244
	Pacific Coast	367	407	407
	South	109	156	156
	North	360	531	531
	Total	1,396	2,338	2,338
Precommercial thinning	Rocky Mountains	3,486	6,951	6,951
	Pacific Coast	616	1,095	1,095
	South	118	1,374	1,374
	North	78	388	388
	Total	4,298	9,808	9,808

[1] Geographic regions include National Forest administrative regions as follows: Rocky Mountains, Regions 1, 2, 3, 4; Pacific Coast, Regions 5 and 6; South, Region 8; North, Region 9.

[2] Accessible acreages were defined as areas which could be reached at reasonable cost in the next 5 years without need of appropriated funding for road construction.

[3] Estimates adapted from 1968 Project Work Inventory.

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Main reasons for the reduced estimates are occurrence of natural stocking since 1968, and more careful appraisal of areas with marginal levels of stocking. Another important factor is that some previously listed areas have become stocked with species, such as aspen and red alder, formerly considered noncommercial but now marketable. The 1972 estimates are not considered conclusive by the Division of Timber Management, but are assumed to be good enough for use in planning a 5-year program.

Estimated acreages of backlog reforestation opportunities, by forest type group, site productivity class, administrative region, and geographic region, are shown in Appendix B.

Treatment Yields

Yields are estimated for each of 18 basic treatment situations (Table 3),[54] for several site productivity classes. Site productivity is defined as inherent capacity of the land to grow crops of industrial wood, based on fully stocked natural stands and expressed in terms of cubic feet per acre average annual growth. It refers only to main-stem growth, between a stump 1 foot high and a top 4.0 inches in diameter inside bark. Classes used are: 20-50, 50-85, 85-120, and 120+ cubic feet per acre per year.

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[54] Yield estimates for most treatment situations were prepared by a team under the direction of the author. Members were Charles A. Wellner, Clarence Brown, and David Tackle. Estimates for the red pine-eastern white pine type group are adapted from Robert J. Marty, 1967 (see footnote 43). Estimates for the loblolly pine-shortleaf pine type group were provided by R. N. Stone.

Table 3.--Basic treatment situations for backlog reforestation and timber stand improvement

Forest type or situation	Current stand	Indicated treatment

Table 3.--Basic treatment situations for backlog reforestation and timber stand improvement

Forest type or situation	Current stand	Indicated treatment
All western types, except Douglas-fir in Regions 5 & 6, and except spruce-fir in R-6	Nonstocked, adjacent seed source unsatisfactory	Site preparation and complete planting
All types in R-1 with satisfactory seed source	Nonstocked, adjacent seed source satisfactory	Site preparation and natural regeneration or partial planting to improve species mix
Douglas-fir in R-5 and R-6, and spruce-fir in R-6	Nonstocked	Site preparation and complete planting
Longleaf-slash pine	Nonstocked	Site preparation and complete planting
Loblolly-shortleaf pine	Brush and inferior hardwoods	Site preparation and planting
Red pine-eastern white pine	Nonstocked	Site preparation and planting
All western types, except Douglas-fir in R-5 and R-6, and except spruce-fir in R-6	Overstocked sapling stands	Precommercial thinning
All western types, except Douglas-fir in R-5 and R-6, and except spruce-fir in R-6	Overstocked pole timber stands	Precommercial thinning
Douglas-fir in R-5 and R-6 and spruce-fir in R-6	Overstocked sapling stands	Precommercial thinning

(Page 1 of 2)

Table 3 (cont'd.)

Forest type or situation	Current stand	Indicated treatment

Table 3 (cont'd.)

Forest type or situation	Current stand	Indicated treatment
Longleaf slash pine	Overstocked	Precommercial thinning
Loblolly-shortleaf pine	Overstocked	Precommercial thinning
Red pine-eastern white pine	Overstocked	Precommercial thinning
Lodgepole pine and ponderosa pine	Pole timber with aspen overstory	Release by removal of aspen overstory
Spruce-fir	Pole timber with aspen overstory	Release by removal of aspen overstory
Douglas-fir stands in R-5 and R-6 and spruce-fir in R-6	Sapling stands with brush competition	Release by deadening brush
Longleaf-slash pine	Sapling stands with competing hardwoods or brush	Release by deadening hardwoods or brush
Loblolly-shortleaf pine	Sapling stands with competing hardwoods or brush	Release by deadening hardwoods or brush
Red pine-eastern white pine	Sapling stands with competing hardwoods or brush	Release by deadening hardwoods or brush

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In all cases, estimates are made of yields with treatment and of yields without treatments. Yields are estimated on the basis of complete regimes of management which might include any or all of the following: site preparation, natural regeneration, planting, precommerical thinning, release, commercial thinning, and final harvest. Initial estimates are made in terms of cubic feet of net growth. Estimates are made separately for hardwood and softwood growth, since in some cases the primary intent of treatment would be to replace hardwood growth with softwood.

Resulting estimates of treatment response are generally lower than those used by Marty,[55] as illustrated below:

Treatment	Forest type group	Site class	Increase in mean annual increment due to treatment: Reported by Marty	Increase in mean annual increment due to treatment: Reported in this study
			Cu. ft. per acre per yr.	
Reforestation	Douglas-fir	1	235	99
		2	164	62
	Longleaf-slash pine	1	137	95
		2	112	78
Precommerical thinning	Douglas-fir	1	118	51
		2	91	43
	Longleaf-slash pine	1	34	26
		2	31	25

Several factors may explain the differences shown above. One is that the estimates for this study assume that the higher productivity sites ultimately would restock significantly, even

[55] Robert J. Marty. 1967. *op. cit.*

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without artificial reforestation. Secondly, it is assumed that failure rates on the lower productivity sites would be large. The latter factor is considered especially important on backlog treatment areas as compared to the on-going, KV reforestation areas. Marty's estimates were for entire timber type acreages while those in the present study were specifically for backlog acres. Finally, there is a major deficiency in the availability of sound data on the responses of many timber types to treatments. As mentioned earlier, there simply is not truly reliable data on the performance of severely understocked or overstocked natural stands.

Allowable Cut Effects

The Forest Service typically establishes allowable cut limits for national forest units on the basis of volume growth and inventory. When a substantial inventory of overmature timber exists on a unit, investments which increase growth theoretically lead to an increase in allowable cut. This allowable cut effect (ACE) can occur as soon as the Service recognizes the increased growth in its inventory accounting system.[56]

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[56] A vigorous debate over ACE has been carried on for several years. Opponents of its use argue that the basic philosophy of national forest harvest regulation policy is so illogical as to preclude rational economic analysis within that policy framework. Proponents aver that the Forest Service does indeed enforce its harvest regulation policies, however indefensible, and therefore ACE exists and cash revenues from national forests will be higher if funds are allocated on that premise than otherwise. The debate was summarized by Dennis E. Teegarden. 1973. The allowable cut effect: a comment. Jour. Forestry 71:224-226, and Dennis L. Schweitzer, Robert W. Sassaman, and Con H. Schallau. 1973. The allowable cut effect: a reply. Jour. Forestry 71:227.

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For the present study, estimates have been obtained, from the Division of Timber Management, of the allowable cut effect anticipated 10 years after treatment and 30 years after treatment. Separate estimates are made for each forest type group and region. (See Appendix C.) For most western situations, the ACE is assumed to equal the increase in mean annual increment of treated stands, in both tenth and thirtieth years. In some western cases and all eastern cases, inventories of overmature timber are considered too low for full ACE to be taken in the tenth year. For many eastern situations, the expected thirtieth year ACE is projected to be only half or less of the increase in mean annual increment, because of the small proportion of mature inventory.

Allowable cut effects are not considered in calculation of internal rates of return.

Stumpage Prices

Estimated stumpage prices are based on reported bid rates for national forest timber sales in 1971. Table 4 presents estimated values for 1971 and averages assumed for the investment period. The latter exclude increases due to general inflation. Both sets include KV receipts, but exclude credits for road construction and slash disposal.

Commercial thinnings are valued at 75 percent of the final harvest stumpage rates. For eastern situations, current pulpwood prices are assumed to be $0.08 per cubic foot for softwoods and $0.04 for hardwoods. No values are assigned to pulpwood-sized trees in the West. Future prices of softwood pulpwood are projected at $0.17 per cubic foot for softwoods and $0.10 per cubic foot for hardwoods.

Table 4.--Sawtimber stumpage prices for national forest timber sales, by administrative region and species

Table 4.--Sawtimber stumpage prices for national forest timber sales, by administrative region and species

Species	Region 1	2	3	4	5	6	7	8
	Dollars per M bd ft							
CALENDAR YEAR 1971[1]								
Douglas-fir	12	2.50	8	5	20	27	--	--
Ponderosa pine	17	5.50	20	12	24	14	--	--
Lodgepole pine	8.50	3	--	5	3	5	--	--
Fir-spruce	9.50	3	7.50	6.50	14	14	--	--
Larch-western white pine	21	--	--	--	15	14	--	--
Mixed conifers	15	--	--	--	--	--	--	--
Southern pine	--	--	--	--	--	--	52	18
Red pine-eastern white pine	--	--	--	--	--	--	30	25
FUTURE PRICES[2]								
Douglas-fir	32	22.50	28	25	40	47	--	--
Ponderosa pine	37	22.50	28	25	40	47	--	--
Lodgepole pine	20.50	15	--	17	15	17	--	--
Fir-spruce	21.50	15	19.50	18.50	26	26	--	--
Larch-western white pine	41	--	--	--	35	34	--	--
Mixed conifers	27	--	--	--	--	--	--	--
Southern pine	--	--	--	--	--	--	72	38
Red pine-eastern white pine	--	--	--	--	--	--	50	45

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Table 4 (cont'd.)

Table 4 (cont'd.)

Species	Region							
	1	2	3	4	5	6	7	8
	Dollars per M bd ft							

[1]Calendar year 1971 prices as reported by the Forest Service Division of Timber Management, except that prices for Douglas-fir and ponderosa pine in Regions 5 and 6 are reduced to 65 percent of reported rate based on assumption of reduced values for second-growth timber.

[2]Based on 30 percent increase in lumber prices. Stumpage price rises for all species except lodgepole pine are assumed to absorb 75 percent of increase in lumber prices. For lodgepole pine, 50 percent of lumber increase is assumed to be reflected in stumpage prices.

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Table 5.--Direct costs of national forest reforestation and stand improvement, all-species averages

Administrative region	Practice		
	Reforestation	Release	Precommercial thinning
	Dollars per acre		
1	44	16	29
2	72	21	36
3	63	19	13
4	69	27	13
5	67	14	29
6	64	35	13
8	58	21	16
9	48	19	19

Source: U.S. Forest Service, Division of Timber Management, estimates for fiscal year 1972.

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wildl
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Treatment Costs

Estimates are made of "direct" costs--those incurred for materials, labor, transportation, and immediate field supervision--and of "other" costs--those not incurred directly in the treatment activity but charged to silvicultural program accounts.[57] Costs are estimated for each national forest administrative region, on the basis of fiscal year 1972 experience.

Table 5 shows regional average figures for all species combined, direct costs only. More detailed estimates are shown in Appendix B. Typically, "other" costs are nearly as large as direct charges.

Estimated Program Effects

Rankings are made for each of four criteria:

--Internal rate of return (based on direct treatment costs).

--Benefit-cost ratio (using 5 pct discount rate).

--Increase in sawtimber mean-annual-increment.

--Increase in allowable cut 10 years after treatment.

Examples of calculated criteria for several treatment opportunities are shown in Table 6.

Hypothetical investment schedules by region and treatment are compiled and estimates made of program effects, at several levels of funding, in terms of increases in mean annual increment of sawtimber and allowable cut. Figure 1 shows expected increases in softwood sawtimber mean annual increment, for various levels

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[57] "Other" costs include general supervision, planning, and programming expenses at all organization levels, part of the expense of support services such as soil scientists and wildlife biologists, and a share of the expense of work not specifically covered by an appropritation account, e.g., emergency rescues and public hearings.

Table 6.--Calculated ranking criteria for selected national forest reforestation and stand improvement opportunities

Treatment	Administration	Forest type group	Site	M.A.I.[1]	ACE[2]	IRR[3]	B/C[4]

Table 6.--Calculated ranking criteria for selected national forest reforestation and stand improvement opportunities

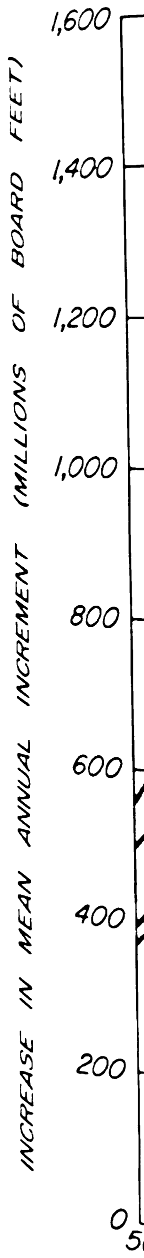
Treatment	Administration region	Forest type group	Site	M.A.I. effect[1]	ACE[2]	IRR[3]	B/C[4] ratio
				Bd ft/$	Cu ft/$	Pct	
Reforestation	6	Douglas-fir	1	3.0	0.8	5.0	1.0
			2	2.0	.5	4.7	.2
	8	Longleaf-slash pine	1	4.7	.1	6.3	1.8
			2	4.1	.1	5.7	1.4
Release	6	Douglas-fir	1	8.8	2.0	16.5	9.1
			2	7.9	1.6	12.2	5.9
	8	Longleaf-slash pine	1	12.4	.3	11.8	2.2
			2	11.1	.3	10.2	2.1
Precommercial thinning	6	Douglas-fir	1	3.2	.7	10.7	3.2
			2	2.9	.6	7.7	2.1
	8	Longleaf-slash pine	1	19.1	.5	13.7	2.3
			2	17.0	.4	11.8	2.2

[1] Mean-annual-increment increase per dollar of total cost.

[2] Allowable cut effect in 10th year per dollar of total cost.

[3] Internal rate of return on direct costs.

[4] Benefit-cost ratio, at 5 percent discount, on direct costs.


INCREASE IN MEAN ANNUAL INCREMENT (MILLIONS OF BOARD FEET)
1,600
1,400
1,200
1,000
800
600
400
200
0

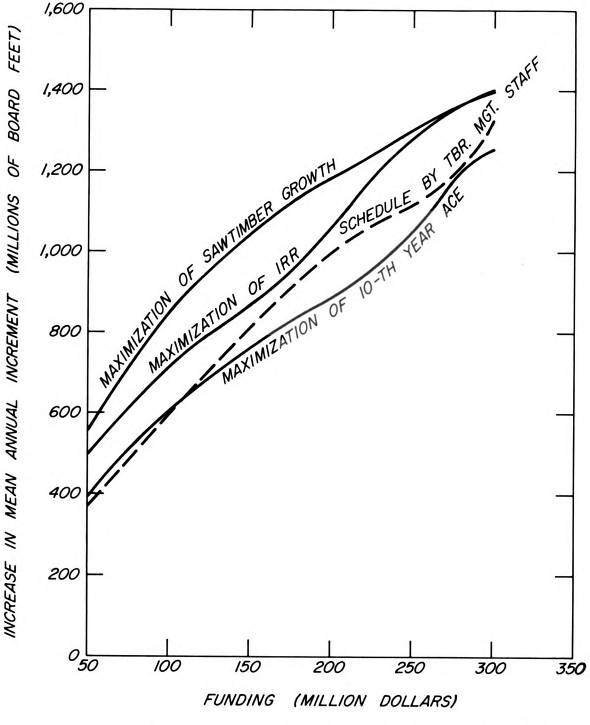


Figure 1. Expected softwood sawtimber growth effects with alternative allocation criteria--national forests.

INCREASE IN ALLOWABLE CUT (MILLIONS OF CUBIC FEET)

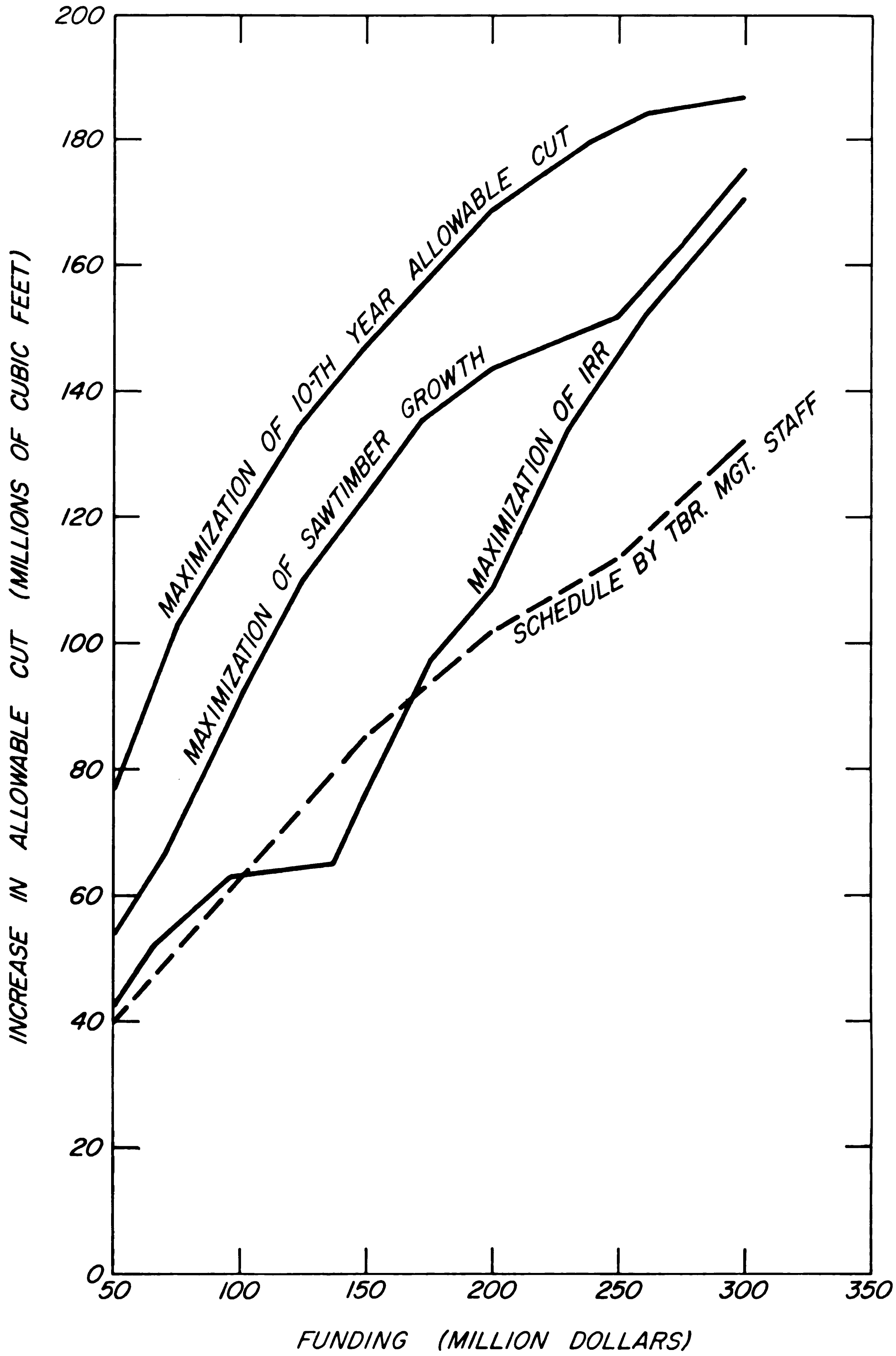


Figure 2. Expected softwood allowable cut effects with alternative allocation criteria--national forests

Table 7.--Schedule of national forest backlog reforestation and stand improvement recommended by staff of Timber Management Division

Funding level[1]	Regional funding distribution				Funding distribution by treatment			Program effects	
	Rocky Mountain	Pacific Coast	South	North	Reforestation	Release	Precommercial thinning	Sawtimber growth[2]	Allowable cut[3]
$ millions	Pct				Pct			MM bd ft	
50	29	30	26	15	75	17	8	380	210
100	29	29	28	14	78	14	8	590	320
150	28	29	29	14	67	15	18	810	450
200	33	27	28	12	62	11	27	1,000	530
250	34	28	27	11	58	11	31	1,120	590
300	36	26	26	11	57	12	31	1,330	680

[1] Funding for direct and indierect costs of treatment.

[2] Softwood sawtimber growth only.

[3] Allowable cut of softwood sawtimber only, 10 years after treatment.

of funding, with different allocation criteria used for scheduling treatments. It indicates little difference in effect between a schedule maximizing sawtimber growth and one based on internal rate of return. Because high-growth-effect opportunities in the East would have little immediate impact on allowable cut, funding allocation based entirely on allowable cut would yield less sawtimber growth than allocation based on internal rate of return or allowable cut effects. Figure 2 compares alternative ranking criteria in terms of 10th-year allowable cut effects.

The Division of Timber Management recommended an investment schedule (Table 7) which would allocate a much higher proportion of funds to reforestation and less to release or thinning, than would be suggested by any of the allocation criteria examined here. One reason is concern over fire hazard associated with precommercial thinning slash. Another is an ethical preference for re-establishing stands on nonstocked commercial forest land as compared to treatment of overstocked stands. A further factor is a concern that a drastic change from current programming--heavily weighted toward reforestation--would cause administrative inefficiencies associated with closing tree nurseries, moving personnel, etc.

At a $300 million funding level, the program recommended by the Division should result in increases of about 1.3 billion board feet of softwood nontimber growth and 0.7 billion board feet of annual allowable cut (within 10 years after completion of the program).

IV. REFORESTATION AND STAND IMPROVEMENT ON NONINDUSTRIAL PRIVATE OWNERSHIPS

Nonindustrial private forest ownerships, including farm and all other private holdings except forest industry, are the largest opportunity for intensification of forest management--both in terms of total acreage and potential for improvement. In 1970, these ownerships held 59 percent of all commercial forest acreage in the United States and 64 percent of all nonstocked acreage.[58] In the East, where 91 percent of all nonindustrial private forest acreage was located, they included over 14 million acres of nonstocked commercial forest; and the Forest Service estimated that these ownerships, in the East, were realizing lower proportions of inherent timber growth potential than were forest industry or public holdings.

Many authors have discussed the promise and problems of programs to encourage nonindustrial private owners to invest in reforestation and stand improvement. Most have concentrated on surveys of landowner attitudes towards forestry and forestry programs; few have evaluated the effectiveness of past public investment in private forestry. Problems typically cited are small average size of tract, lack of technical knowledge, ignorance of stumpage markets, and short planning horizons.

Existing Programs

Programs have been designed to encourage landowners to pool their tracts under management by forestry consultants;

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[58] U.S. Forest Service. 1973. The outlook for timber in the United States. Forest Resource Report No. 20.

cooperative state and federal programs provide technical advice; reports of stumpage prices and log prices are published in some states; and federal support of state nurseries allows landowners to buy seedlings at reduced cost. Subsidies to nonindustrial private landowners for reforestation and stand improvement were authorized by the Soil Conservation and Domestic Allotment Act of 1934 and administered through the Agricultural Conservation Program, now titled the Rural Environmental Assistance Program (REAP). The Forestry Incentives Program, authorized by the Agriculture and Consumer Protection Act of 1973 (87 Stat. 245; 16 U.S.C. 590h.), would continue these subsidies.[59]

Experience in the Agricultural Conservation Program

Cost sharing is frequently considered to be the method of public subsidy most likely to attract landowners to forestry programs. While the Forest Service presumably could have subsidized private landowners through Title IV of the Agricultural Act of 1956, nearly all cost sharing for forestry purposes, through 1972, was conducted by the Agricultural Stabilization and Conservation Service.

Direct payments to farmers and ranchers engaging in afforestation were made through the Agricultural Conservation Program administered by the Agricultural Stabilization and Conservation Service. In 1968, rates of cost sharing were supposed to vary between 50 and 80 percent of average planting

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[59] A comprehensive listing of Forestry Assistance Programs current in 1972 is given in U.S. Forest Service, 1972, Forestry Assistance Programs in Cooperation with State Forestry Agencies. Unnumbered publication issued November 1972.

costs.[60] Average planting cost within a state or subdivision thereof is established by the state ASC Committee. The average cost share rate for planting in the U.S. was $17.34 per acre in 1968. It ranged from a low of $6.50 per acre in Texas to a high of $131.45 per acre in North Dakota.

Federal regulations prohibited, in most instances, cost-share payment of more than $2,500 per year to an individual farmer or rancher. Up to $10,000 could be paid for practices carried out under pooling agreements. These limits applied to total payments for all ACP practices. In actuality, payments for all practices averaged between $185 and $228 per assisted farm in the individual years 1960-68. In 1968, only 1.4 percent of all ACP cost-share funds went for practice A-7, Trees or Shrubs for Forestry Purposes. Cost shares of $2.6 million were granted that year for planting of 148,000 acres on 20,000 farms.[61] The average planting supported by ACP was about 7-1/2 acres.

Additionally, in 1968, 15,282 acres were planted to prevent erosion. Total cost sharing for this practice was $834,266 and averaged $54.59 per acre. About 12,000 farms were involved in this practice.

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[60] Agricultural Stabilization and Conservation Service, 1968. Cost sharing in state handbooks--1968 ACP. Unpublished staff paper.

[61] Agricultural Stabilization and Conservation Service, 1969. 1968 Agricultural Conservation Program accomplishments. Unnumbered report, page 58.

Soil Bank and ACP in the South

The Southern Forest Resource Analysis Committee reported that 4.7 million acres of forest planting in the South had been accomplished through ACP or Soil Bank through 1967.[62] This amounted to 31 percent of all forest planting in that region. Plantings were especially large during 1958-61, under the Soil Bank program. In the subsequent period, 1962-66, subsidized plantings still amounted to 634,000 acres in the South, at a total cost of $6.5 million in ACP cost shares.

Effectiveness of Past Federal Program for Afforestation

Public programs for afforesting private lands have had three general objectives--increasing income of poor rural landowners, soil and water conservation, and increasing the Nation's timber supply. The effectiveness of these programs would depend largely on the following factors: (1) extent of participation in the programs; (2) response of different income groups; (3) productivity of plantations; and (4) values of stumpage and soil-water benefits. A number of studies have been devoted to items 1 and 2. Most studies have indicated that participation in CFM and ACP programs was strongly correlated with size of ownership.

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[62] Southern Forest Resource Analysis Committee. 1969. The South's third forest--how it can meet future demands; a report of the Southern Forest Resource Analysis Committee, New Orleans, La.

Muench studied participation of 2,492 North Carolina landowners in public forestry programs.[63] He found that the most responsive owners were those who had relatively good educations, owned large forested acreages, and were business or professional people. He concluded:

> "If the goal of any of these programs is to redistribute income to the poor landowners or tenants, this goal is not being achieved, judging from the apparent asset position of those who are participating. If soil and water conservation is the goal, the effectiveness of forestry practices in ACP can be questioned. If increased timber production is the objective, the programs can increase effectiveness by addressing their efforts to those owners shown to be most responsive."

Studies in Michigan[64] and Wisconsin[65] found farmers the most interested group of small landowners in forestry. Thus it appears likely that there are regional variations in the response of different classes of landowners to public forestry programs.

Little information is available on the timber yields from federally supported afforestation programs. While annual estimates of acres planted are available for ACP programs, there is little published information on survival, length of existence, or timber production from such plantations. These data are

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[63] John Muench, Jr. 1975. Private forests and public programs in North Carolina. American Forestry Association (distributed by North Carolina Forestry Association, Raleigh, N.C.).

[64] James G. Yoho, Lee M. James, and Dean Quinney. 1957. Private forest land ownership and management in the northern half of Michigan's lower peninsula. Tech. Bul. 261, Mich. Agr. Exp. Sta.

[65] Charles F. Sutherland and Cal H. Tubbs. 1959. Influence of ownership on forestry in small woodlands. Lake States For. Exp. Sta. Pap. No. 77.

crucial to a reliable evaluation of existing programs and to reasonably accurate projections of returns from proposed programs.

Forest Survey data for South Carolina indicate that 77 percent of the forest planting done through 1967 was identifiable in 1968.[66] About 35 percent of the planting done there was under ACP or the Conservation Reserve Soil Bank Program. Thus at least one-third of the subsidized plantations were evident in 1968. This, of course, affords little information on the yield attributable to such plantations.

Studies in New York State indicated that only two-thirds of the acres planted on public and private lands were successful.[67] It seems logical to assume that planting on public lands and industrial lands would have been managed by professional foresters or forestry technicians. Thus the success rate for nonindustrial private ownerships probably would have been much lower than the aggreate two-thirds rate mentioned above.

On the Yazoo-Little Tallahatchie Flood Prevention Project, where public subsidy resulted in 470,000 acres of planting in the years 1948 through 1968, about 10-20 percent of the annual planting was rework. Survival of the FY 1969 planting averaged 79 percent as indicated by a check of 38 farms.[68] For earlier years, survival averaged about 70 percent.

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[66] Herbert A. Knight and Joe P. McClure. 1969. South Carolina's timber, 1968. USDA Forest Service Resource Bul. SE-13.

[67] John Fedkiw. 1959. Preliminary review of 60 years of reforestation in New York State. State University College of Forestry, Syracuse University, New York.

[68] U.S. Forest Service. 1969. The Yazoo Forester. Vol. 8, No. 12, p. 2.

The Yazoo-Little Tallahatchie Project plantings generally were done under close supervision from the U.S. Forest Service. Although much of the land involved was of poor quality, the quality of work probably was considerably better than would have been the case for most ACP planting, and plantation survival probably was better there than in most other cases when landowners did the planting themselves or hired local contractors.

Problems Found in the ACP Program

Past ACP programs, as a stimulus for timber supply, suffered a number of handicaps. The amount of money allotted for tree planting for forestry purposes was determined locally and was generally low, averaging only 1.4 percent of all ACP assistance in 1968. The average size of plantings was small, thus planting costs were perhaps unnecessarily high. Manthy reported that the average size of ACP planting in Pennsylvania, in 1965, was only 1.5 acres.[69] He suggested that such small plantings might lead to timber stands which were relatively expensive to log and thus might bring low stumpage prices--if they were harvested at all.

In 1968, the 11 southern states averaged 12.8 acres per subsidized planting and only $11.30 per acre cost-share. The remaining states, as a group, averaged only 4.3 acres per subsidized planting and $26.20 per acre. Small plantings would have been less likely to be done by trained crews, less likely to be inspected by skilled examiners, and thus more likely to be unsuccessful.

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[69] Robert S. Manthy. 1970. An investment guide for Cooperative Forest Management in Pennsylvania. USDA For. Serv. Res. Pap. NE-156.

Because the cost-share rates were determined on a state-by-state basis, the amount of money spent within a single state for tree planting may not have been related to the economic desirability of planting in that state. For example, the States of Wisconsin and New York got a combined total of $512,000 in 1968, but planted only 18,000 acres. Thus 20 percent of all tree planting cost-share funds went for planting only 12 percent of total acreage, and that acreage was in states with relatively low-quality timberland. Furthermore, most of the plantings in those states were quite small, averaging 3.4 acres in New York and 5.0 acres in Wisconsin.

The Present Study

The intent of the present study is to estimate the potential effectiveness of cost-sharing payments to nonindustrial private forest owners, in comparison with other federal program opportunities for increasing softwood timber supplies. Estimates are made of treatable acres, costs, and growth impacts for reforestation, release, and precommercial thinnings. Forest Survey staff at Forest Service experiment stations have provided estimates of treatable acreages by timber type and site productivity class. They also have provided data on management regimes and yield similar to that developed for national forests.

Reforestation opportunities totaling 11,796,000 acres are evaluated (Table 8). Data are available for only 232,000 acres of release and 293,000 acres of precommercial thinning opportunities. General descriptions and cost estimates are shown in Table 9. Detailed listings of treatment opportunities ranked in order of cost effectiveness are shown in Appendix B.

Table 8.--Distribution of analyzed treatment opportunity acreages on nonindustrial private forest ownerships, 1972

Treatment class	Region	Acreage[1]
Reforestation	Pacific Coast	12
	Rocky Mountains	--
	South	8,989
	North	2,795
Total		11,796
Release	Pacific Coast	--
	Rocky Mountains	--
	South	112
	North	120
Total		232
Precommercial thinning	Pacific Coast	6
	Rocky Mountains	--
	South	187
	North	--
Total		193

Source: *Ad hoc* reports by Forest Service experiment stations.

[1]Thousands of acres assumed to be accessible to a cost-share program.

Table 9.--Treatment situations investigated for reforestation on nonindustrial private ownerships

Stratum identification	Region and situations	Indicated treatment	Costs: Initial treatment	Costs: Associated	Costs: Federal share
			Dollars per acre		
	SOUTHEASTERN STATES EXCEPT ALABAMA AND FLORIDA				
SE-1	Idle cropland	Plant	15.00	6.20	15.50
SE-2	Nonstocked forest land	Site prep. and plant	20.00	6.40	19.40
SE-3	Nonstocked, brush	Heavy site prep. and plant	45.00	6.40	38.10
SE-4	Defective pine plantations	Light site prep. and replant	20.00	6.40	19.40
SE-5	Poorly stocked natural pine stands	Convert to pine plantation	45.00	6.60	38.20
SE-6	Oak-pine, poorly stocked	do	48.00	6.60	40.40
SE-7	Upland hardwoods, poorly stocked	do	53.00	6.60	44.20
	SOUTH CENTRAL AND GULF COAST STATES				
SO-1	Idle cropland	Plant	15.00	6.20	15.50
SO-2	Nonstocked forestland	Light site prep.	20.00	6.40	19.40
SO-3	Nonstocked, brush	Heavy site prep. and plant	45.00	6.40	38.10
SO-4	Defective oak-hickory stands	Convert to pine plantation	45.00	6.60	38.20
SO-5	Defective oak-pine stands	do	45.00	6.60	38.20
SO-7	Poorly stocked natural pine stands	do	45.00	6.60	38.20

(Page 1 of 2)

Table 9 (cont'd.)

Stratum identification	Region and situations	Indicated treatment	Costs: Initial treatment	Costs: Associated	Costs: Federal share
			Dollars per acre		
		NORTHEASTERN STATES			
NE-1	Idle cropland	Plant loblolly or shortleaf pine	15.00	6.20	15.50
NE-2	Nonstocked, forest	Site prep. and plant red or eastern white pine	35.00	3.70	28.60
NE-3 & 4	Defective hardwood or brush	Convert to red or eastern white pine	50.00	3.90	40.00
NE-5	Nonstocked forest	Site prep. and plant loblolly or shortleaf pine	35.00	6.40	30.40
		NORTH CENTRAL STATES			
NC-2	(Nonstocked or poorly stocked	(Heavy site prep., or convert,	57.00	4.10	45.30
NC-4	with varying degrees of	and plant red or eastern	70.00	4.10	55.00
NC-5	hardwood competition)	white pine)	75.00	4.10	58.80
NC-8A	(Nonstocked with little	(Light site prep. and plant	40.00	3.70	32.40
NC-8B	hardwood competition)	red or eastern white pine)	40.00	3.70	32.40
NC-8C	Nonstocked	Plant loblolly or shortleaf pine	25.00	3.70	21.10
		PACIFIC NORTHWEST			
PN-22	Douglas-fir, high site quality	Plant Douglas-fir	32.00	3.90	26.40

(Page 2 of 2)

Table 10.--Schedule of nonindustrial private reforestation opportunities designed to maximize softwood sawtimber growth[1]

Federal cost[2]	Total cost[3]	Regional funding distribution			Softwood growth effects	
		Pacific Coast	South	North	Sawtimber	Growing stock
$ millions		Percent of federal cost			MM bd ft	MM cu ft
50	68	1	30	69	90	190
100	135	*[4]	17	83	1,550	310
150	202	*[4]	47	53	1,960	460
200	270	*[4]	58	42	2,300	620
250	337	*[4]	66	34	2,470	740
300	406	*[4]	72	28	2,610	860

[1] Sawtimber growth is in terms of mean annual increment.

[2] Federal cost is 75 percent of direct treatment cost, plus technical assisatnce and follow-up inspection.

[3] Total cost includes idrect treatment costs, technical assistance, follow-up inspection, and increased protection from fire and insects.

[4] Less than 0.5 percent.

Cost estimates included treatment costs, direct technical assistance, and follow-up inspection. Where successive treatments are considered necessary for maintenance of the stand (e.g., fire protection), such costs are included.

Estimated Program Effects

Treatment opportunities are ranked in terms of board-foot softwood yield per dollar of Federal cost and board-foot softwood yield per dollar of total cost. Table 10 shows expected costs and effects for programs funded at several different levels. Only reforestation acreage is shown because the estimates related to precommercial thinning and stand improvement are considered unrealistic.

Figure 3 compares softwood sawtimber growth increases, expected for different funding levels, for nonindustrial private ownerships as compared to national forests. The strong advantage indicated for private ownerships is due primarily to two factors--the large acreages of inherently productive southern pine sites in private holdings and the much lower costs assumed for treating private lands rather than national forests. Costs for national forests include large expenses for general administration and planning which are not assumed to exist for private owners.

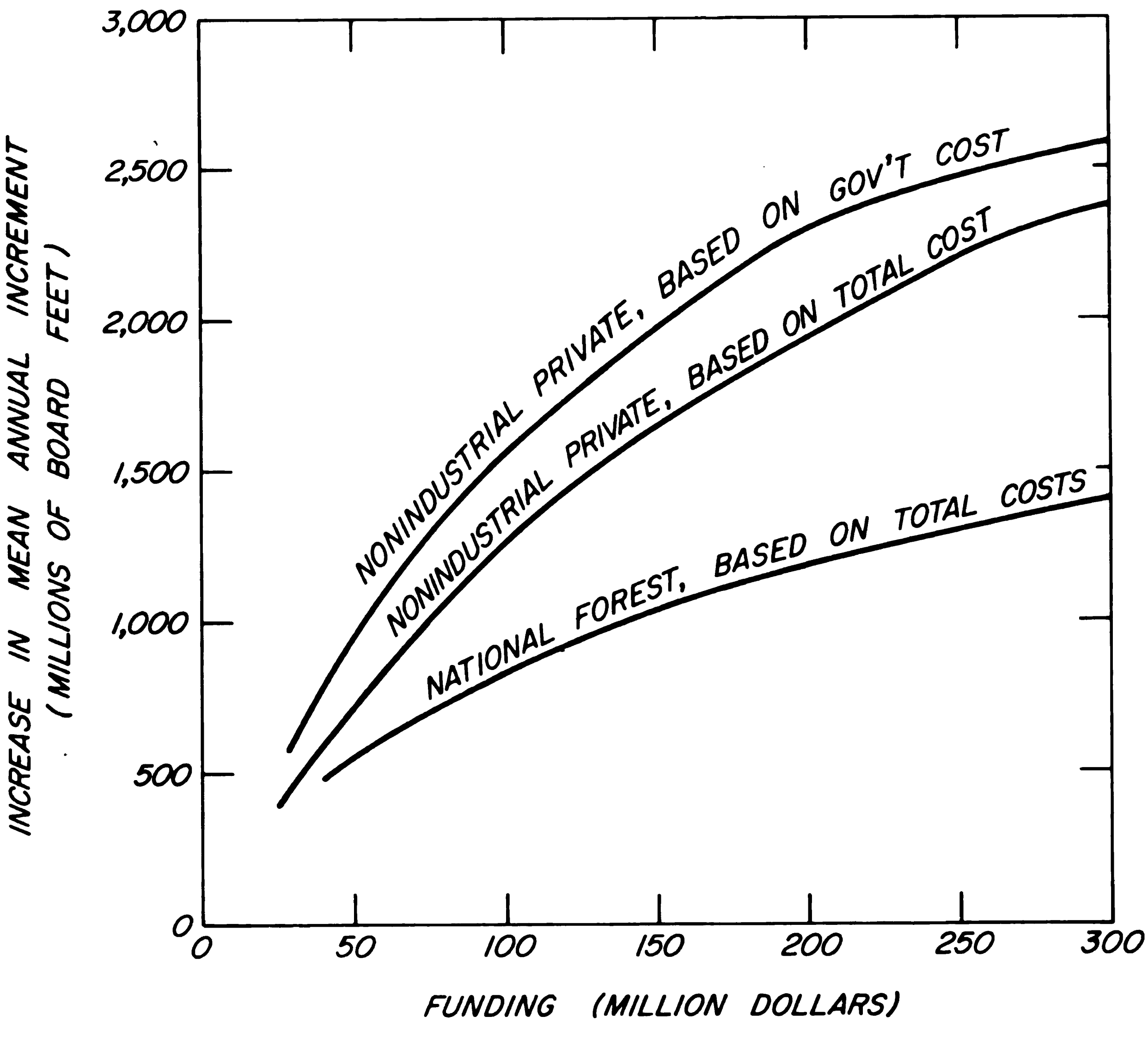

Figure 3. Comparison of softwood sawtimber growth maximization through nonindustrial private reforestation vs. national forest reforestation and stand improvement

V. OPPORTUNITIES FOR TECHNOLOGICAL IMPROVEMENTS

Research and development of improved technology for growing, protecting, and/or utilizing timber is an alternative use of limited forestry program budgets. For the present study, a few specific research opportunities have been selected for analysis. They have been chosen because they are assumed to have the following characteristics:

--High probability of technical development within a decade;

--High probability of commercial application soon after technical development;

--An expectation of important impacts on timber demand or supply; and

--Reasonable susceptibility to quantification.

The opportunities examined are in three program categories: tree improvement, forest pest control, and timber utilization. The general outline followed in each case is as follows:

I. Description of problem/opportunity:

   A. General nature

   B. Size

   C. Ownerships/institutions involved

II. Technical solution:

   A. Description

   B. Susceptible areas, volumes, products, etc.

   C. Probable effectiveness

   D. Application costs

III. Program possibilities:

A. Remaining research to be completed

B. Method of getting technical solution into practice

C. Likelihood of success for each class of owner/institution

D. Timetable for implementation

E. Likely additions to supply (defined in terms of growth, harvest, or product)

IV. Program costs:

A. Research costs

B. Extension costs

C. Federal cost-shares

D. Application cost

In each case, staff assistants in research division of the Forest Service have given their best estimates of incremental costs and effects of expanded research and development programs. The estimates shown in this chapter are for increases over program funding levels for fiscal year 1973.

<u>Tree Improvement</u>

Scientists in the Division of Timber Management Research have assisted the author in defining a potential expanded program of genetics research. Three species or species groups are considered: southern pines, Douglas-fir, and western pines. Intensified efforts involved in the program would include development of methods to stimulate increased flowering of seed orchard trees, improved techniques for grafting scions to root-stocks, better methods of controling cone and seed insects, and

Table 11.--Increases in yield anticipated from an accelerated genetic program for the southern pines

Period	Affected area: Annual	Affected area: Total	Yield increase[1]	Cumulative increase in mean annual increment[2]: MM cu ft	Cumulative increase in mean annual increment[2]: MM bd ft
	M acres		Pct		
2nd 5 years	294	1,470	10	15	75
2nd decade	784	7,840	15	133	665
3rd decade	980	9,800	20	329	1,645
4th decade	980	9,800	20	525	2,625
5th decade	980	9,800	30	819	4,095

[1] Percent yield increase is in addition to percentages expected from current levels of effort.

[2] Calculated from a base yield of 100 cubic feet per acre per year for unimproved stock.

Table 12.--Increases in yield anticipated from an accelerated genetic program for Douglas-fir

Period	Affected area: Annual	Affected area: Total	Yield increase[1]	Cumulative increase in mean annual increment[2]: MM cu ft	Cumulative increase in mean annual increment[2]: MM bd ft
	M acres		Pct		
2nd 5 years	33	165	7	2	10
2nd decade	198	1,980	7	23	115
3rd decade	330	3,300	12	82	410
4th decade	330	3,300	12	141	705
5th decade	330	3,300	15	215	1,075

[1] Percent yield increase is in addition to percentages expected from current levels of effort.

[2] Calculated from a base yield of 150 cubic feet per acre per year for unimproved stock.

Table 13.--Increases in yield anticipated from an accelerated genetic program for western pine

Period	Affected area: Annual	Affected area: Total	Yield increase[1]	Cumulative increase in mean annual increment[2]: MM cu ft	Cumulative increase in mean annual increment[2]: MM bd ft
	----M acres---		Pct		
2nd 5 years	10	50	3	[3]	[3]
2nd decade	30	300	3	[3]	[3]
3rd decade	100	1,000	7	8	40
4th decade	330	3,300	7	31	155
5th decade	330	3,300	10	64	320

[1] Percent yield increase in addition to percentages expected from current levels of effort.

[2] Calculated from a base yield of 100 cubic feet per acre per year for unimproved stock.

[3] Less than 0.5 percent.

procedures for faster testing of parent trees to see if progeny retain desired characteristics.

Expected Costs

Funding required in addition to the current (FY 1973) budget is estimated to be as follows:

Period	Research	Seed orchard establishment	Seed to seedling production	Total
	Millions of dollars			
1st 5 years	2	1	2	5
2nd 5 years	3	2	6	11
2nd decade	3	2	4	9
3rd decade	2	2	4	8

Program Effects

Tables 11, 12, and 13 display estimated yields for the program, in terms of mean-annual-increment of softwood plantations. For southern pines, it is estimated that about 10 percent of the nearly 1 million acres annually planted in 1970-71 was being done with genetically improved seedlings from seed orchards. It is assumed that mean annual increment (m.a.i.) of plantings from unimproved stock averaged 100 cubic feet per acre. It is further assumed that nearly all plantations, by the year 2000, would be made with improved seedlings, but that the degree of improvement would be higher under the accelerated program than otherwise. Thus, an incremental yield of 10 percent, in the 6-10th year of the program, rising to 30 percent in the third decade, is expected. On this basis, in the tenth year after initiation of the program, southern pine m.a.i. is expected to be increased 15 million cubic feet (75 million board feet). By the 30th year, an increase of 329 million cubic feet (1,645 million board feet) should occur (Table 11).

For Douglas-fir it is assumed that 40 percent of the 31 million acres of land in the Douglas-fir type would be planted with improved seedlings, by the end of the 5th decade of the program. Plantations from unimproved stock are assumed to average 150 cubic feet per acre mean annual increment. Projected mean annual increment of areas planted in the first 10 years would be 2 million cubic feet (10 million board feet) higher than otherwise anticipated. By the 30th year, 5,455,000 acres should have been planted with improved stock, with an expected mean annual increment 82 million cubic feet (410 million board feet) higher than expected for unimproved stock (Table 12).

Yields for a western pine program are calculated on the assumption that at least 20 percent of the 42 million acres in these forest types ultimately might be planted with improved stock. Mean annual increment of plantations from unimproved stock on these sites is assumed to be 100 cubic feet per acre. Because relatively little work has been done in genetic improvement of western pines, as compared to southern pines and Douglas-fir, a slow rate of progress would be expected, even with an expanded program (Table 13). Mean annual increment of all areas planted with improved stock in the first 30 years of the program would be expected to be only 8 million cubic feet (40 million board feet) higher than for plantations of unimproved stock.

Combined effects anticipated for all three species or species groups would be:

Year	Cumulative increase in mean annual increment: MM cu ft	Cumulative increase in mean annual increment: MM bd ft
10th	17	85
20th	156	780
30th	419	2,095
40th	697	3,485
50th	1,098	5,490

Fomes annosus Root Rot

Fomes annosus root rot has caused increasingly serious losses of planted pines in the United States during the past 25 years. Although not a significant problem in natural stands, this root rot was found in 59 percent of all loblolly pine plantations and 44 percent of all slash pine plantations examined during a 1960 south-wide survey. It is especially damaging in thinned stands and, therefore, is a major deterrent to intensive management of plantations for sawtimber production.

The fungus enters freshly cut stumps left in thinning operations. Resulting tree mortality in the residual stands begins within 2-3 years after thinning and continues for long periods. Such stands often are decimated before they reach sawtimber size. Average losses in infected stands are estimated to be about 15 percent of the harvest yield otherwise expected. For typical loblolly pine sites managed primarily for sawtimber production, control of *Fomes annosus* is assumed to increase mean-annual-increment about 50 board feet per acre per year.

Past research has indicated three promising avenues of control:

--Restricting thinning operations to the summer season in areas below 34° N. latitude;

--Applying granular borax to freshly cut stump surfaces; and

--Inoculating fresh stump surfaces with a competitive saprophyte, *Peniophora gigantea*.

For areas below 34° N. latitude, *Fomes annosus* is not a serious problem in stands thinned during the summer. Stands thinned at other seasons or in areas above that latitude probably can be protected by borax or *Peniophora* applications. Trial applications of borax have proven 90-95 percent effective. *Peniophora* inoculations appear to be an especially desirable control methods since the saprophyte may provide long-term protection, and is suitable for application in areas where borax should not be applied.

Considering climatic factors, it is estimated that roughly half of all thinned southern pine plantations might warrant treatment for *Fomes annosus* control. Assuming that half of all forest industry, all national forest, and one-fourth of all nonindustrial private southern pine plantations were thinned at age 15, the acreages shown below would be candidates for chemical or biological treatment during a 30-year period. These estimates were based on recorded plantings since 1960, assuming that planting in the period would continue at the 1970-72 levels.

Projected Acreages Suitable for *Fomes Annosus* Control

Period	Forest industry	Other private	National forest
1st 5 years	500,000	300,000	50,000
2nd 5 years	500,000	150,000	60,000
2nd decade	1,500,000	300,000	240,000
3rd decade	1,500,000	300,000	250,000

Expected Costs and Program Effects

A modest amount of research remains to be done in the first 2 years of the assumed program:

--Development of machine applications of chemical or biological agents as an integrated feature of harvesting equipment; and

--Indentification of ecological factors governing susceptibility to the disease.

First priority is evaluation of previously initiated pilot control studies and dissemination of research results. If mechanical applications were perfected, it seems likely that forest industries would adopt them rapidly. A modest subsidy might be necessary to institute the practice on nonindustrial private lands. The Federal government is assumed to bear all costs (roughly $2.50 per acre) on national forest lands and 50 percent of the cost on private lands.

Projected costs for a complete program of research, extension, and application are shown in Table 14. Expected savings in mean annual increment are shown in Table 15. By the end of 30 years, enough area is assumed to have been treated to afford a 282 million board foot savings in mean annual increment.

Table 14.--Projected costs of a program of *Fomes annosus* control in southern pine

Period	Research cost	Technical assistance	Application cost[1]			Total cost	Federal cost[2]
			Forest industry	Other private	National forest		
	Thousands of dollars						
1st 5 years	330	180	1,250	750	125	2,635	1,010
2nd 5 years			1,250	375	150	1,775	338
2nd decade			3,750	750	600	5,100	975
3rd decade			3,750	750	625	5,125	1,000

[1] Based on estimated cost per acre of $2.50.

[2] Assuming Federal government pays 50 percent of cost on other private lands.

Table 15.--Increases in yield anticipated from a *Fomes annosus* control program in southern pine

Period	Cumulative savings in mean annual increment			
	Forest industry	Other private	National forest	Total
	MM bd ft			
1st 5 years	25	15	2	42
2nd 5 years	50	23	5	78
2nd decade	125	38	17	180
3rd decade	200	53	29	282

[1]Based on medium site yields for thinned loblolly pine plantations as shown in Investor's Guide to Converting Southern Oak-Pine Types, by W. C. Anderson and S. Guttenberg, USDA Forest Service Res. Paper SO-72, 1971. Control is assumed to save 15 percent of all sawtimber yields after first thinning.

Table 16.--Approximate physical recovery efficiencies in various forest industries--1970

	Recovery ratio[1]
Sawmilling (dry, finished lumber)	
Douglas-fir region	45-50
Southern pine region	35-45
Plywood manufacturing (dry, finished plywood)	
Douglas-fir region	45-55
Southern pine region	35-45
Hardboard	82
Conventional particleboard	84
Pulping[2]	
Kraft	42-54
Sulfite	44-46
Groundwood	90-95

[1] Calculated as a percent of ovendry weight of wood input.

[2] Yields for pulping ignore losses in debarking and chipping.

Sources:

Sawmilling, Douglas-fir region, adapted from S. E. Corder and T. L. Scroggins. 1972. Wood and bark residues in Oregon--trends in their use. Oregon State Univ., Forest Res. Pap. 11; southern pine region, adapted from M. A. Taras, J. G. Schroeder, and D. R. Phillips. 1974. Predicted green lumber yields from the merchantable stem of loblolly pine. USDA Forest Service Research Pap. SE-121.

Plywood, Douglas-fir region, adapted from S. E. Corder and T. L. Scroggins (op cit); southern pine region, adapted from David L. Williams and William C. Hopkins. 1969. Converting factors for southern pine products. Louisiana State Univ. Agricultural Experiment Sta. Bul. No. 626.

Hardboard and particleboard, adapted from Peter Vajda. 1975. A comparative evaluation of the economics of wood-based panel industries. Paper presented at the FAO World Consultation on Wood-Based Panels, New Dehli, Feb. 1975.

Pulping, Forest Products Laboratory, Madison, Wis.

Timber Utilization

In 1970, about 55 percent of softwood growing stock volume harvested for industrial uses was recovered in products such as lumber, plywood, or woodpulp. Another 35 percent, in the form of manufacturing residues, was used for fuel or was disposed as waste, while about 10 percent was left on the ground as logging residues.[70] Primary product recoveries, excluding byproducts, typically were lower than 55 percent (Table 16).

Increased materials recovery efficiency in timber harvesting and wood products manufacture and use would affect national timber consumption in several ways. For a given level of total demand for forest products, an increase in harvesting efficiency (e.g., through reduction of breakage in tree felling) would decrease required total removals from growing stock inventory. Improved recovery of products from roundwood (e.g., through lessened trimming loss in sawmilling) would tend to decrease total log requirements and thus removals from inventory. New kinds of products, performing a specific function equally well but with less material weight or with lower quality raw material than required for conventional products, similarly could result in reduced total log requirements. Finally, improvements in engineering

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[70] Estimated recovery percentages are adapted from U.S. Forest Service. 1973. op. cit. The 55 percent estimate includes recovery of woodpulp and other industrial products from lumber wood products manufacturing but ignores losses in secondary manufacturing (e.g., residue formation in conversion of lumber to furniture parts). The estimate of logging residue excludes stumps, tops, branches, and nongrowing-stock trees. Thus the foregoing figures overestimate product recovery and underestimate residue proportions, in terms of total wood fiber harvest.

of structures or other end-use applications could reduce wood product, and hence log requirements.

Program Possibilities Evaluated

Estimates are made of likely costs and results of expansions in two projects:

--New technique for drying linerboard; and

--Computerized decisionmaking in sawmills

Of the many Forest Service projects in this general area of timber utilization programs, these are ones considered to hold high promise for successful completion and implementation in the next 5 to 10 years. Work in these two projects is already underway, but at relatively low levels of funding.

Linerboard Drying Technique

In 1970, about 11.5 million tons of linerboard were produced in the United States.[71] Its manufacture consumed roughly 24 percent of all woodpulp produced that year and required approximately 1.3 billion cubic feet of roundwood. Most linerboard is made from unbleached kraft woodpulp of softwood origin, with about 54 percent recovery of wood fiber in the final product.

Currently, most linerboard manufacturing processes involve drying a continuously moving mat of wet fibers, without pressure. To achieve the interfiber bonding necessary for a satisfactory linerboard, existing processes use woodpulp which has been beaten or refined. Wood fiber recovery is inversely proportional to the

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[71] Linerboard is the material normally used for the outer and interior walls of paperboard boxes.

extent of refining. The Forest Products Laboratory, Madison, Wis., has proposed another technique for improving interfiber bonding and thereby lessening the required duration of refining. This technique (called "Z-Direction Restraint") would involve drying the wet fiber mat under pressure.

Advantages indicated for the Z-Direction Restraint would be:

--Use of less refined, higher yield pulp;

--Capability for much greater use of hardwood pulp; and

--Reduced energy requirements since removal of water by pressing takes less energy than removal by evaporation.

Laboratory scientists consider it possible that the technique also would reduce water pollution problems.

Expected Costs

Work to date has been done with very small specimens (called "hand sheets") which have been made essentially piece by piece. Major work required to develop the technique enough to assure industrial adoption would include the following:

--Design and testing of a laboratory-scale, continuous process; and

--Construction and testing of prototype machinery.

Additional funding would be required for a chemical engineer, a mechanical engineer, and a materials engineer during a 5-year period.[72] Cost of laboratory-scale equipment is estimated at

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[72]Within the 5-year period, employment for these people is expected to be the equivalent of 3.5 years for the chemical engineer, 4 years for the mechanical engineer, and 3 years for the materials engineer.

Table 17.--Projected cost increases for accelerated development of Z-direction-restraint techniques

Item	1st 5 years	2nd 5 years	2nd decade	3rd decade
	Millions of dollars			
Federal costs				
Additional research engineers	1.05	0	0	0
Equipment	.10	0	0	0
Industry costs				
Prototype machine assembly and testing	0	2.0	0	0
Replacement of dryers in existing mills	0	1.5	10.0	6.0

$100,000 and cost of building and testing the prototype machine is estimated to be $2 million (assumed to be borne by industry). The new system, once developed is not expected to be more expensive than current equipment when installed as part of a new mill. But conversion of existing mills to the new system is assumed to cost $250,000 each. Table 17 shows expected costs by time period.

Program Effects

With the new technique, it should be possible to use hardwood pulp with an effective yield of 65 percent, as compared to 54 percent yield for the pulp normally used. Only 20 percent of the furnish used in linerboard manufacture in 1970 is estimated to have been hardwood pulp. Without Z-Direction Restraint, by the year 2000, hardwood proportions should have risen to about 30 percent; but with the new technique, 85 percent of furnish by that year might be hardwood. Table 18 summarizes effects on pulpwood requirements. Rate of implementation is assumed to be slow until the technique has been proven in several commercial plants; then to increase rapidly. It is assumed that implementation would never exceed 80 percent of all linerboard production.

In 1970, an estimated 8 billion board feet of softwood sawtimber was used in pulping. This was about 30 percent of all softwood pulpwood. Savings in softwood sawtimber shown in Table 18 are based on the assumption that 25 percent of the softwood pulpwood used in future years would be from sawtimber. On this basis, savings in softwood sawtimber removals are estimated to be 50 million board feet in 1985, rising to 2.7 billion board feet by the year 2000.

Table 18.--Anticipated effects of an accelerated research program in Z-direction restraint

	1970	1980	1985	1990	1995	2000
Linerboard production . . . . MM tons[1]	11,500	17,400	20,900	25,000	29,400	34,600
Pulpwood requirements without program[2]						
Hardwood. . . . . .Pct by weight	20	23	24	26	28	30
Hardwood. . . . . MM cu ft	230	400	500	650	820	1,040
Softwood. . . . . .Pct by weight	80	77	76	74	72	70
Softwood. . . . . MM cu ft	1,040	1,510	1,790	2,090	2,390	2,740
Linerboard production with new technique						
Using new technique and hardwoods . . . . . .Pct	0	0	6	30	60	80
Using old technique and hardwoods . . . . . .Pct	20	23	20	15	10	5
Using old technique and softwoods . . . . . .Pct	80	77	74	55	30	15
Effect on pulpwood requirement						
Hardwood. . . . . .MM cu ft[3]	0	0	+20	+350	+940	+1,430
Softwood. . . . . .MM cu ft[3]	0	0	-40	-540	-1,390	-2,150
Effect on soft sawtbr. req'ment . . . . .MM bd ft[4]	0	0	-50	-680	-1,740	-2,690

[1]Assumes linerboard production increasing at the same rate as indicated for total paperboard in U.S. Forest Service. 1973. The outlook for timber in the United States. Forest Resource Report No. 20, p. 189, "medium projections."

[2]Based on 0.92 ton of woodpulp per ton of linerboard, 54 percent yield, and wood densities of 34 and 30 lb per cu ft for hardwoods and softwoods, respectively.

[3]Based on 65 percent yield for new technique.

[4]Based on assumption that 40 percent of softwood pulpwood would come from sawtimber trees.

Computerized Decisionmaking in Sawmills

Sawmills typically have recovered about 40 to 50 percent of the wood fiber from softwood sawlogs in finished lumber (Table 16). The remainder essentially has been sawdust, planer shavings, slabs, and edgings. The majority of these residuals has been used for pulp or particleboard furnish or fuel, but significant quantities have remained unused, causing waste disposal problems. Furthermore, pulp chips and other sawmill byproducts usually have been less valuable, on a dry-weight basis, than lumber.

One means of increasing lumber recovery is through computer control of sawing. Lewis and Hallock showed that human error in positioning logs properly, with respect to saw blade, in the first cut (opening face) could reduce lumber recovery as much as 27 percent.[73] They proposed a computerized system (Best Opening Face) to ensure optimum log positioning for sound, straight logs.

Another means proposed for improving lumber recovery is Edge Gluing and Ripping (EGAR). As conceived by Forest Products Laboratory scientists, EGAR would involve sawing logs into flitches (pieces as wide as the log). The flitches would be edged full width, dried, and then glued into panels. Panels then would be resawn to whatever widths were desired. The

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[73] David W. Lewis and Hiram Hallock. 1973. Using computers to increase lumber yield--Best Opening Face Program. Paper presented at the 4th Wood Machining Seminar, Dec. 4-6, 1973, Richmond, Calif.

system thus would avoid most of the losses normally caused in edging softwood dimension lumber into nominal widths.

Yield of highest value in EGAR would require an electronic defect-sensing system for locating knots and other defects. Coupled with a computer-controlled rip saw, the system would allow resawing so as to minimize the downgrading effects of defects. Electronic scanning and defect sensing also would be an important element of BOF.

Program Costs

A combined program is proposed, involving BOF, EGAR, and improved defect-sensing techniques. Refinements to existing BOF procedures would include development of capability to sense and locate defects in logs, improvements in the system to allow adjustments for log taper and crook, and increased flexibility in specifying desired product dimensions. Relatively little work has been done on EGAR; proposed research would include further evaluation of yields, product testing, and development of an integrated defect-sensing and automated ripping system.

Implementation costs for BOF and EGAR, once developed, are expected to be about $100,000 and $730,000 per mill, respectively. An integrated defect-sensing system for either BOF and EGAR is expected to cost $150,000 per mill. Expected costs for all elements combined would be as follows:

	Research	Technical assistance	Industry investment
	----------Millions of dollars------------		
1st 5 years	4.7	0.8	7.5
2nd 5 years	0	.8	10.2
2nd decade	0	0	20.4
3rd decade	0	0	13.9

Industry costs are based on the numbers of mills assumed to be using BOF and EGAR techniques (Table 19).

Program Effects

It is assumed that improved BOF systems would be employed first in the largest mills. Within 5 years after start of the expanded program, it is estimated that 53 mills might have operational systems. Three EGAR mills are assumed to be in operation 5 years after initiation of the program. Yield increases of 10 percent for BOF and 15 percent for EGAR are anticipated. Table 19 shows expected trends in mill installations and product yields. By the 10th year, combined yield increases should be about 710 million board feet (lumber tally) per year. By the 30th year, this should rise to about 1,010 million board feet. These increases in lumber recovery would be equivalent to 780 million board feet and 1,110 million board feet savings in sawtimber harvest requirements, since about 10 percent of the harvest normally has been left as logging residue.

Table 19.--Projected effects of accelerated research and development of computerized sawmill systems

Year	BOF implementation			EGAR implementation			Combined effect	
	Number of mills	Lumber production without BOF	Increase with BOF[1]	Number of mills	Lumber production without EGAR	Increase with EGAR[2]	Lumber recovery increase	Sawtimber harvest savings[3]
		MM bd ft			MM bd ft			
5	53	4,200	420	3	150	20	440	480
10	119	6,500	650	8	400	60	710	780
15	190	7,100	710	13	650	100	810	890
20	265	7,700	770	16	800	120	890	' 980
25	344	8,400	840	19	950	140	980	1,080
30	375	8,600	860	20	1,000	150	1,010	1,110

[1] Yield increases for BOF calculated as 10 percent of production without BOF.

[2] Yield increases for EGAR calculated as 15 percent of production without BOF.

[3] Sawtimber harvest savings calculated on assumption that 10 percent of sawtimber harvest would be lost to logging residue; therefore, an increase in lumber recovery would be equivalent to a 10 percent greater savings in sawtimber removals.

VI. SUMMARY AND RECOMMENDATIONS

This study was designed to evaluate potential projects in several major categories of Forest Service programs. It has been predicted on the assumption that public policymakers desire increased assurance as to adequacy of softwood sawtimber supplies. Budget increases and legislation for national forest reforestation and stand improvement are taken as substantial evidence of this desire.

It is argued that policymakers are particularly concerned with timber supply problems which might occur within the next 10 to 30 years and that the Forest Service has substantial influence over the allocation of funding among programs addressed to that concern. On this basis, evaluations have been made of the cost effectiveness of funding for backlog national forest reforestation and stand improvement, subsidies to nonindustrial private landowners for forestation, and spending for technological improvements in timber production and forest products manufacture.

Summary Comparisons of Program Effectiveness

Table 20 summarizes estimated softwood sawtimber effects and initial program costs for the various projects anlyzed. Comparisons among the projects are complicated because the cost estimates are not all on the same basis nor are the estimates of sawtimber effects. But a number of conclusions can be drawn.

Table 20.--Summary comparisons of estimated program costs and effects

	Federal costs		Other costs	Growth effect[1]		Harvest effect[2]	
	1st 5 years	Next 25 years		10th year	30th year	10th year	30th year
	Millions of dollars			Millions of board feet			
National forest reforestation	50	Unestimated	0	550	550	260	410
and stand improvement	100	......do......	0	840	840	430	640
(schedule designed to	150	......do......	0	1,050	1,050	580	840
maximize softwood sawtimber	200	......do......	0	1,180	1,180	670	950
mean annual increment)	250	......do......	0	1,300	1,300	700	1,020
	300	......do......	0	1,400	1,400	800	1,110
Cost-sharing nonindustrial	50	......do......	18	850	950	Unestimated	
private reforestation	100	......do......	35	1,350	1,350	...........do............	
(schedule designed to	150	......do......	52	1,960	1,960	...........do............	
maximize softwood sawtimber	200	......do......	70	2,300	2,300	...........do............	
mean annual increment)	250	......do......	87	2,470	2,470	...........do............	
	300	......do......	106	2,610	2,610	...........do............	
Tree improvement program							
Douglas-fir)				115	410	...........do............	
Southern pine)	5	28	0	75	1,645	...........do............	
Western pines)				0	40	...........do............	
<u>Fomes annosus</u> control	1.0	2.3	11.3	180	280	...........do............	
8-direction restraint	1.15	0	19.5	0	0	50	2,690
Computerized decisionmaking	5.5	0.8	52.0	0	0	780	1,110

[1]Increased softwood sawtimber mean annual increment expected for treated stands.

[2]Allowable cut effects for national forests and reductions in sawtimber harvest requirements. for improved utilization techniques.

Effect on 10th-Year Harvest

First, as a means of affecting supply-demand balances within 10 years, development of computerized decisionmaking techniques for sawmills appears most cost-effective by far. For an estimated Federal cost of $5.5 million, a decrease in harvest requirements totaling 780 million board feet per year should result. To achieve a 780-million-board-foot increase in national forest allowable cut through reforestation and stand improvement, nearly $300 million would be required. Even if the yield from national forest treatments were twice as high as expected, and that from computerized decisionmaking only one-fifth the estimated amount, the latter project would appear more cost-effective.

Projects other than the two mentioned above would be unlikely to affect softwood sawtimber harvests significantly within 10 years.

Effect on 30th-Year Harvest

Successful development of Z-direction restraint should be more cost effective than computerized sawmilling in reducing softwood timber harvest requirements. For a Federal expenditure of $1.15 million, the former project is expected to lead to a reduction of 2.7 billion board feet in the 30th year. Even considering the $19.5 million assumed to be required for industrial adoption in the first 30 years, this project would appear to have very high cost-effectiveness.

Computerized decisionmaking appears highly cost-effective in terms of 30th-year as well as 10th-year effects. Although requiring an estimated $52 million industry investment over the 30-year period, its impact per dollar spent appears much higher than would be expected for silvicultural investments.

Harvest effects have not been estimated, in this study, for cost-sharing on nonindustrial private lands. By the 30th year of the program, however, it seems likely that a large proportion of the expected increase in mean annual increment might be harvestable directly or through an indirect effect on forest industry planning. But it is not clear whether the 30th-year sawtimber harvest effect per dollar from nonindustrial private lands would be as great as that expected from allowable cut effects on national forests.

Harvest impacts from *Fomes annosus* control and tree improvement probably would be noticeable by the 30th year, but the bulk of the increased growth probably would still be in stands of less than sawtimber size.

Effect on Softwood Sawtimber Growth

Tree improvement programs appear more cost-effective in terms of long-run growth improvement than all other programs evaluated. For a total cost of about $33 million, softwood sawtimber growth rates should be increased by nearly 200 million board feet at the end of 10 years and 2.1 billion board feet by the 30th year of an accelerated program. Even if the yield of the program were only one-tenth as great as expected, cost-effectiveness still would be high.

The *Fomes annosus* project also appears highly cost-effective in avoiding growth losses. Savings of 180 million board feet and 280 million board feet per year were anticipated for the 10th and 30th years, respectively. Total cost would be about 2.6 million in the first 5 years and $12 million in the next 25.

Subsidies to nonindustrial private landowners should be more cost-effective in increasing softwood sawtimber growth than investments in backlog national forest treatments. This superiority is largely due to the relatively low costs and high site productivity typical of nonindustrial private ownerships. The large acreages of nonindustrial private ownership in southern pine timber types accentuate this advantage. Furthermore, the current level of investment in national forests is at a rate of more than $150 million per 5 years, while relatively little subsidy is being provided for nonindustrial private silviculture. The marginal effect of a given increase in spending appears much more cost-effective for the latter than for national forest investments.

Uncertainties in Silvicultural Investments

All of the projects evaluted in this study entail large uncertainties as to outcome. In analyses of silvicultural opportunities, principal uncertainties involve treatment-yield estimates, land-use changes, and budget allocation procedures.

Treatment-yield estimation involves projections for both treated and untreated stands. Projection of yields for untreated stands is particularly difficult since there is little published data available as to the performance of seriously overstocked or understocked stands. The problem is exacerbated by the dearth of information on the degree of over- or understocking typical of any class of backlog treatment areas. The analysis therefore relies on expert, subjective opinions. By comparison with previously reported estimates, the projections used in this study appear conservative. However, it is unlikely that more accurate estimates, if available, would alter the conclusion that subsidies to nonindustrial private landowners are potentially more cost effective than further increases in national forest funding in increasing growth rates. The advantages of low costs and relatively high site productivity typical of much nonindustrial private land would remain.

Land-use changes could significantly reduce the effectiveness of silvicultural investments. It is by no means certain that the probability of such changes would be greater for nonindustrial private forests than for national forests. On both classes of ownerships, silvicultural investments could be lost or diminished in effectiveness, not only through withdrawals of land from timber production, but also through restrictions on harvesting for various reasons. For example, on national forests, some treated areas might ultimately be included in areas zoned as "sensitive" due to threat of watershed damage, or as habitat for "endangered" species of plants or animals, or as areas where aesthetic impacts of normal harvesting methods were intolerable. And continued fractionation of private holdings may split treated stands into units too small for economic harvesting.

It frequently has been suggested that private landowners were becoming less and less willing to sell timber and that many treated stands might be withheld from harvest. However, comparing stated intentions of landowners with actual practices, Stone[74] concluded: "Although small owners display indifference to timber production most of the time they are not indifferent to economic opportunities to market ripe timber and react in a predictable way." He suggested further that changes in land tenure occurred often and that even if one owner planned to withhold his timber, the next one might well have different intentions. Fractionation of ownerships into smaller and smaller holdings appears a more significant problem, however. Between 1952 and 1970, farm ownerships dropped about 42.5 million acres while other nonindustrial private ownerships increased about the same amount[75]--probably with a large increase in numbers of individual ownerships.

It now appears unlikely that the 2.4 million acres of idle cropland included in potential treatment opportunities for nonindustrial private lands would indeed be available. Rising farm crop prices probably have preempted that land for farming instead. While this would eliminate 20 percent of the acreage evaluated for nonindustrial private lands, including some of the least cost, most productive planting sites, it still would not change the general comparison between national forests and nonindustrial private opportunities.

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[74] Robert N. Stone. 1970. A comparison of woodland owner intent with woodland practice in Michigan's Upper Peninsula. Unpublished Ph.D. dissertation. University of Minnesota.

[75] U.S. Forest Service. 1973 *op. cit.* p. 11.

Funding allocations would affect cost-effectiveness of programs significantly. As indicated in chapter 3, the allocation preferred by Forest Service staffmen would not maximize softwood sawtimber growth--for practical reasons. Further, the problem of identifying treatment opportunities properly in the field would be large for both national forest and private lands. And political factors in allocation of subsidies among states and among landowners well might result in less-than-optimal distribution of investment.

Uncertainties in Research Investments

There are significant, unquantifiable chances of error in calculations of research program effectiveness. The most important elements are rate of technical progress and rate of commercial adoption. The projects evaluated in this analysis have been selected, in part, because they have progressed far enough that technical success appeared relatively certain. Commercial adoption might be much slower than anticipated, especially for improved wood processing technology. Industrial adoption of the latter would depend largely on anticipated rates of return on investment in capital equipment. Although the estimated investment costs appear relatively small in relation to projected yields, explicit investment analyses would be needed to reduce uncertainty about industrial application.

Another factor not quantified in these anlyses is the possibility that parallel developments in technology could lessen the impact of Forest Service research and development projects. It is highly likely that technological progress in these areas will result from past and present Forest Service research efforts, without increased funding, or from other institutional or industry-financed research.

Only a few of the many Forest Service research programs related to timber production are evaluated in this study. In fiscal year 1973, appropriations for Forest Service research amounted to about $59 million, including $12.8 million for Timber Management Research, $10.7 million for Forest Insect and Disease Research, and $9.4 million for Forest Products Utilization Research. It would not be fair to assume that all of the projects which could be funded with Research appropriations were more cost-effective than investments in silvicultural treatments.

Recommendations

On the basis of the analyses presented here, the following recommendations are made:

(1) Future policy decisions on national programs to increase timber supply should recognize opportunities for technological improvements as well as investments in silviculture;

(2) Tree improvement, Fomes annosus control, computerized decisionmaking, and Z-direction restraint projects should be supported strongly, because of their expected high cost-effectiveness;

(3) Policymakers should note the potentially high cost-effectiveness of increased public investment in nonindustrial private forest lands as compared to increases in present levels of spending for national forest backlog treatments;

(4) Forest Service administrators should take measures to reduce the high costs of national forest silvicultural treatments, especially reforestation;

(5) Forest Service officials should consider changing current accounting practices to allow increased investment in silvicultural treatments without directly proportional increases in overhead costs (these costs are the largest single factor reducing the apparent cost-effectiveness of national forest treatments); and

(6) The Service should take steps to insure that the increasingly large amounts of money it spends on silvicultural examinations, to find treatment opportunities, are concentrated in those administrative regions and national forests where cost-effectiveness of treatment is likely to be high. Conversely, it should spend little money searching for backlog treatment opportunities in those regions and forests where low stumpage prices, high treatment costs, and low site productivity combine to make such opportunities poor public investments.

Additionally, the following recommendations are made for further research:

(1) The Forest Service should undertake a major effort to evaluate its timber-related research and technical assistance programs to identify the most cost-effective opportunities for affecting timber supply-demand balances;

(2) The Service should place high priority on research aimed at reducing the high costs of silvicultural treatments;

(3) A detailed set of treatment opportunity acreages and physical yield estimates should be established, using either the

ones presented in this study or those developed for previous analyses as an initial basis, and improving the estimates of both acreages and yields continuously as new information becomes available; and

(4) The Service should evaluate various ways of insuring that subsidies for investment on nonindustrial private forest lands are allocated to the most cost-effective opportunities. Further research should be done to examine possible ways of organizing cost-sharing programs to increase cost-effectiveness: concentration of investment, as in the case of the Yazoo-Little Tallahatchie Project, offers economies of scale in both treatment and subsequent timber management and should receive serious consideration.

Finally, both adminstrators and economists should recognize the need for practical application of economic analysis in programming Forest Service budgets. Economists may quibble about the appropriate discount rate (should it be 5 percent or 10 percent or what?) and the theoretically most sound criterion for ranking projects (benefit-cost ratio, net present worth or internal rate of return or what?). Administrators and their staffmen rightly may feel that the analyst has ignored, or been unable to quantify, important benefits from forestry programs. The real opportunity, however, is to use economic analysis in making marginal improvements in budget allocation and to identify major obstacles to improved cost-effectiveness of programs. The Forest Service should expect continued emphasis by the Office of Management and Budget on economic justification of Federal programs. Increasing scrutiny of Forest Service programs by Congress and public interest groups may be expected as a result of the Forest and Rangeland Renewable Resources Planning Act of 1974 and recent reforms in congressional budgeting procedures. The Service should be prepared to demonstrate that it employs sound procedures in evaluating its programs, in its budget recommendations, and in its allocation of appropriated funds. In this regard, niceties of analysis are far less important than a consistent, demonstrable concern for reasonable levels of efficiency.

APPENDICES

APPENDIX A

TREATMENT YIELD COMPUTATIONS, NATIONAL FORESTS

Table A1.--Reforestation of all western types except Douglas-fir in Regions 5 and 6 and spruce-fir in Region 6

Description of current stand: Nonstocked backlog areas

Indicated treatment: Site preparation and complete planting job

1,000-cubic-foot-per-acre yield by site productivity class[1]

Stand age	Investment year	Treatment	Site prod. class	120+ Sawtimber	120+ Other	120+ Total	85-120 Sawtimber	85-120 Other	85-120 Total	50-85 Sawtimber	50-85 Other	50-85 Total	20-50 Sawtimber	20-50 Other	20-50 Total
		REGIME WITH INDICATED INITIAL TREATMENT													
0	0	Reforest.	All												
10	10	Precomm. thin.	120+												
15	15	.....do.......	85-120												
20	20	.....do.......	20-85												
30	30	Comm. thin.		1.00	0.30	1.30									
50	50	.....do.......		1.50	.15	1.65	1.30	0.26	1.56						
60	60	.....do.......								0.80	0.24	1.04			
65	65	.....do.......		2.20	.01	2.21									
70	70	.....do.......					2.20	.21	2.31						
80	80	Final harvest		7.30	.04	7.34							1.70	0.51	2.21
85	85	.....do.......								1.80	.18	1.98			
90	90	.....do.......					6.00	.03	6.03						
100	100	.....do.......								4.80	.02	4.82			
120	120	.....do.......											3.00	.02	3.02
			TOTALS	12.00	0.50	12.50	9.50	.50	9.90	7.40	0.44	7.84	4.70	0.53	5.23
Mean annual increment						0.156			.110			0.78			0.044
		REGIME WITHOUT INDICATED INITIAL TREATMENT													
90	90	Comm. thin.		0.70	0.21	0.91									
130	130	Final harvest		4.00	.04	4.04	3.00	0.30	3.30	2.00	0.40	2.40	1.00	0.30	1.30
			TOTALS	4.70	.25	4.95	3.00	0.30	3.30	2.00	0.40	2.40	1.00	0.30	1.30
Mean annual increment						0.038			0.025			0.018			0.010

[1] Site productivity class in cubic-foot-per-acre mean annual increment, natural stands, "normal" yields.

Table A2.--Reforestation of parts of Region 1 backlog

Description of current stand: Nonstocked backlog area seed source available

Indicated treatment: Site preparation and natural regeneration (or partial planting to improve species mix)

1,000-cubic-foot-per-acre yield by site productivity class[1]

Stand age	Investment year	Treatment	Site prod. class	120+ Sawtimber	120+ Other	120+ Total	85-120 Sawtimber	85-120 Other	85-120 Total	50-85 Sawtimber	50-85 Other	50-85 Total	20-50 Sawtimber	20-50 Other	20-50 Total
		REGIME WITH INDICATED INITIAL TREATMENT													
0	0	Reforest.	All												
10	10	Precomm. thin.	120+												
15	15	......do......	85-120												
20	20	......do......	20-85												
30	30	Comm. thin.		1.00	0.30	1.30									
50	50	......do......		1.50	.15	1.65	1.30	0.26	1.56						
60	60	......do......								0.80	0.24	1.04			
65	65	......do......		2.20	.01	2.21									
70	70	......do......					2.20	.21	2.31						
80	80	Final harvest		7.30	.04	7.34									
80	80	Comm. thin.											1.70	0.51	2.21
85	85	......do......								1.80	0.18	1.98			
90	90	Final harvest					6.00	.03	6.03						
100	100	......do......								4.80	.02	4.82			
120	120	......do......											3.00	.02	3.02
			TOTALS	12.00	0.50	12.50	9.40	0.50	9.90	7.40	0.44	7.84	4.70	0.53	5.23
Mean annual increment						0.156			0.110			0.078			0.044
		REGIME WITHOUT INDICATED INITIAL TREATMENT													
60	60	Comm. thin.		1.00	0.40	1.40									
80	80	......do......					0.80	0.30	1.10						
130	130	Final harvest		5.00	.40	5.40	3.50	.29	3.79	3.00	0.30	3.30	2.00	0.20	2.20
			TOTALS	6.00	0.80	6.80	4.30	0.59	4.89	3.00	0.30	3.30	1.00	0.20	2.20
Mean annual increment						0.052			0.038			0.025			0.017

[1] Site productivity class in cubic-foot-per-acre mean annual increment, natural stands, "normal" yields.

Table A3.--Precommercial thinning of overstocked sapling stands--all western types except Douglas-fir in Regions 5 and 6 and spruce-fir in Region 6

Description of current stand: Overstocked sapling stands

Indicated treatment: Precommercial thin

1,000-cubic-foot-per-acre yield by site productivity class[1]

Stand age	Investment year	Treatment	Site prod. class	120+ Saw-timber	120+ Other	120+ Total	85-120 Saw-timber	85-120 Other	85-120 Total	50-85 Saw-timber	50-85 Other	50-85 Total	20-50 Saw-timber	20-50 Other	20-50 Total
				REGIME WITH INDICATED INITIAL TREATMENT											
25	0	Precomm. thin.	120+												
35	0	......do......	85-120												
45	0	......do......	20-85												
45	20	Comm. thin.		1.00	0.30	1.30									
65	30	......do......					1.00	0.30	1.30						
65	40	......do......		1.50	.15	1.65									
75	30	......do......								0.80	0.24	1.04			
80	55	......do......		2.20	.01	2.21									
85	50	......do......					2.00	.20	2.20				1.00	0.40	1.40
95	70	Final harvest		7.30	.04	7.34									
100	55	Comm. thin.								1.80	.18	1.98			
105	70	Final harvest					6.00	.30	6.30						
125	80	......do......								4.40	.22	4.62			
145	100	......do......											3.00	.15	3.15
			TOTALS	12.00	0.50	12.50	9.00	0.80	9.80	7.00	0.64	7.64	4.00	0.55	4.55
Mean annual increment						0.179			0.140			0.096			0.046
				REGIME WITHOUT INDICATED INITIAL TREATMENT											
60	35	Comm. thin.		1.00	0.50	1.50									
80	45	......do......					1.00	0.50	1.50						
100	55	......do......								1.00	0.50	1.50			
130	95	Final harvest					5.00	.50	5.50						
130	105	......do......		7.00	0.70	7.70									
160	115	......do......								3.00	.20	3.20	3.00	0.30	3.30
			TOTALS	8.00	1.20	9.20	6.00	1.00	7.00	4.00	0.70	4.70	3.00	0.30	3.30
Mean annual increment						0.088			0.074			0.041			0.029

[1] Site productivity class in cubic-foot-per-acre mean annual increment, natural stands, "normal" yields.

Table A4.--Precommercial thinning of overstocked poletimber stands--all western types except Douglas-fir in Regions 5 and 6 and spruce-fir in Region 6

Description of current stand: Overstocked poletimber stands

Indicated treatment: Precommercial thin

1,000-cubic-foot-per-acre yield by site productivity class[1]

Stand age	Investment year	Treatment	Site prod. class	120+ Saw-timber	120+ Other	120+ Total	85-120 Saw-timber	85-120 Other	85-120 Total	50-85 Saw-timber	50-85 Other	50-85 Total	20-50 Saw-timber	20-50 Other	20-50 Total
REGIME WITH INDICATED INITIAL TREATMENT															
50	0	Precomm. thin.	All												
60	10	......do......		1.00	0.50	1.50									
80	30	Comm. thin.					1.00	0.50	1.50						
100	50	......do......		1.00	.20	1.20				1.00	0.50	1.50			
110	60	......do......					1.00	.20	1.20				1.00	0.50	1.50
130	80	Final harvest		7.00	.70	7.70	5.00	.50	5.50						
160	110	......do......								3.00	.20	3.20	2.00	.20	2.20
			TOTALS	9.00	1.40	10.40	7.00	1.20	8.20	4.00	0.70	4.70	3.00	0.70	3.70
Mean annual increment						0.130			0.102			0.043			0.034
REGIME WITHOUT INDICATED INITIAL TREATMENT															
60	10	Comm. thin.		1.00	0.50	1.50									
80	30	......do......					1.00	0.50	1.50						
100	50	......do......								1.00	0.50	1.50			
130	80	Final harvest		7.00	.70	7.70	5.00	.50	5.50						
160	110	......do......								3.00	.20	3.20	3.00	0.70	3.70
			TOTALS	8.00	1.20	9.20	6.00	1.00	7.00	4.00	0.70	4.70	3.00	0.70	3.70
Mean annual increment						0.115			0.088			0.043			0.034

[1] Site productivity class in cubic-foot-per-acre mean annual increment, natural stands, "normal" yields.

Table A5.--Release of lodgepole pine and ponderosa pine from aspen overstory--Region 2

Description of current stand: Aspen overstory

Indicated treatment: Release

1,000-cubic-foot-per-acre yield by site productivity class[1]

Stand age	Investment year	Treatment	Site prod. class	120+ Sawtimber	120+ Other	120+ Total	85-120 Sawtimber	85-120 Other	85-120 Total	50-85 Sawtimber	50-85 Other	50-85 Total	20-50 Sawtimber	20-50 Other	20-50 Total
		REGIME WITH INDICATED INITIAL TREATMENT													
25	0	Precomm. thin.	120+												
35	0	......do......	85-120												
45	0	......do......	20-85												
45	20	Comm. thin.		1.00	0.30	1.30									
65	30	......do......					1.00	0.30	1.30						
65	40	......do......		1.50	.15	1.65									
75	30	......do......								0.80	0.24	1.04			
80	55	......do......		2.20	.01	2.21									
85	50	......do......					2.00	0.20	2.20				1.00	0.40	1.40
95	70	Final harvest		7.30	.04	7.34									
100	55	Comm. thin.								1.80	0.18	1.98			
105	70	Final harvest					6.00	.30	6.30						
125	80	......do......								4.40	.22	4.62			
145	100	......do......											3.00	.15	3.15
			TOTALS	12.00	0.50	12.50	9.00	0.80	9.80	7.00	0.64	7.64	4.00	0.55	4.55
Mean annual increment						0.179			0.140			0.096			0.046
		REGIME WITHOUT INDICATED INITIAL TREATMENT													
60	35	Comm. thin.		1.00	0.50	1.50									
80	45	......do......					1.00	0.50	1.50						
100	55	......do......								1.00	0.50	1.50			
130	95	Final harvest					5.00	.50	5.50						
130	105	......do......		7.00	0.70	7.70									
160	115	......do......								3.00	.20	3.20	3.00	0.30	3.30
			TOTALS	8.00	1.20	9.20	6.00	1.00	7.00	4.00	0.70	4.70	3.00	0.30	3.30
Mean annual increment						0.088			0.074			0.041			0.029

[1] Site productivity class in cubic-foot-per-acre mean annual increment, natural stands, "normal" yields.

Table A6.--Release of spruce-fir from aspen overstory--Region 2

Description of current stand: Aspen overstory

Indicated treatment: Release

1,000-cubic-foot-per-acre yield by site productivity class[1]

Stand age	Investment year	Treatment	Site prod. class	120+ Saw-timber	120+ Other	120+ Total	85-120 Saw-timber	85-120 Other	85-120 Total	50-85 Saw-timber	50-85 Other	50-85 Total	20-50 Saw-timber	20-50 Other	20-50 Total
		REGIME WITH INDICATED INITIAL TREATMENT													
25	0	Precomm. thin.	120+												
35	0	......do......	85-120												
45	0	......do......	20-85												
45	20	Comm. thin.		1.00	0.30	1.30									
65	30	......do......					1.00	0.30	1.30						
65	40	......do......		1.50	.15	1.65									
75	30	......do......								0.80	0.24	1.04			
80	55	......do......		2.20	.01	2.21									
85	50	......do......					2.00	0.20	2.20				1.00	0.40	1.40
95	70	Final harvest		7.30	.04	7.34									
100	55	Comm. thin.								1.80	.18	1.98			
105	70	Final harvest					6.00	.30	6.30						
125	80	......do......								4.40	.22	4.62			
145	100	......do......											3.00	.15	3.15
		TOTALS		12.00	0.50	12.50	9.00	0.80	9.80	7.00	0.64	7.64	4.00	0.55	4.55
Mean annual increment						0.179			0.140			0.096			0.046
		REGIME WITHOUT INDICATED INITIAL TREATMENT													
90	45	Comm. thin.					1.00	0.20	1.20	1.00	0.20	1.20			
130	85	Final harvest					4.00	.20	4.20	3.00	.15	3.15			
		TOTALS					5.00	0.40	5.40	4.00	0.35	4.35			
Mean annual increment									0.064			0.051			

[1] Site productivity class in cubic-foot-per-acre mean annual increment, natural stands, "normal" yields.

Table A7.--Reforestation of Douglas-fir in Regions 5 and 6

Description of current stand: Nonstocked backlog areas

Indicated treatment: Site preparation and planting

1,000-cubic-foot-per-acre yield by site productivity class[1]

Stand age	Investment year	Treatment	Site prod. class	120+			85-120			50-85			20-50		
				Saw-timber	Other	Total	Saw-timber	Other	Total	Saw-timber	Other	Total	Saw-timber	Other	Total
		REGIME WITH INDICATED INITIAL TREATMENT													
0	0	Site prep. and planting	All												
15	15	Precomm. thin.	..do...												
35	35	Comm. thin.				1.70									
40	40	......do......							1.40						
45	45	......do......				1.70						1.00			
50	50	......do......							1.30						
55	55	......do......				1.70						1.00			
60	60	......do......							1.30						
65	65	......do......				1.70						1.00			
70	70	......do......							1.10						
75	75	......do......				1.40									
80	80	......do......													0.80
95	95	Final harvest				9.00									
100	100	......do......							7.00						
110	110	......do......										5.00			
120	120	......do......													2.80
		TOTALS				17.20			12.00			8.00			3.60
Mean annual increment						0.181			0.120			0.073			0.030
		REGIME WITHOUT INDICATED INITIAL TREATMENT													
95	95	Final harvest				7.80									
100	100	......do......							5.80						
110	110	......do......										4.80			
120	120	......do......													1.20
Mean annual increment						0.082			0.058			0.044			0.010

[1] Site productivity class in cubic-foot-per-acre mean annual increment, natural stands, "normal" yields.

Table A8.--Precommercial thinning or release of Douglas-fir in Regions 5 and 6 and spruce-fir in Region 6

Description of current stand: Overstocked (or with brush competition

Indicated treatment: Precommercial thinning (or release)

1,000-cubic-foot-per-acre yield by site productivity class[1]

Stand age	Invest-ment year	Treatment	Site prod. class	120+			85-120			50-85			20-50		
				Saw-timber	Other	Total	Saw-timber	Other	Total	Saw-timber	Other	Total	Saw-timber	Other	Total
		REGIME WITH INDICATED INITIAL TREATMENT													
15	0	Precomm. thin.	All												
35	20	Comm. thin.				1.70									
40	25	......do......							1.40						
45	30	......do......				1.70						1.00			
50	35	......do......							1.30						
55	40	......do......				1.70						1.00			
60	45	......do......							1.30						
65	40	......do......				1.70									
65	50	......do......										1.00			
70	55	......do......							1.10						
75	60	......do......				1.40									
80	65	......do......													0.80
95	80	Final harvest				9.00									
100	85	......do......							7.00						
110	95	......do......										5.00			
120	105	......do......													2.80
		TOTALS				17.20			12.00			8.00			3.60
Mean annual increment						0.215			0.142			0.084			0.030
		REGIME WITHOUT INDICATED INITIAL TREATMENT													
55	40	Comm. thin.				2.80									
60	45	......do......							2.00						
65	50	......do......				1.70									
70	55	......do......							1.20			1.60			
75	60	......do......				1.10									
95	80	Harvest cutting				7.50									
100	85	......do......							5.20						
110	95	......do......										2.90			
120	105	......do......													1.20
		TOTALS				13.10			8.40			3.50			1.20
Mean annual increment						0.164			0.099			0.37			0.011

[1] Site productivity class in cubic-foot-per-acre mean annual increment, natural stands, "normal" yields.

Table A9.--Reforestation of longleaf-slash pine

Description of current stand: Nonstocked backlog

Indicated treatment: Site preparation and planting

1,000-cubic-foot-per-acre yield by site productivity class[1]

Stand age	Investment year	Treatment	Site prod. class	120+ Sawtimber Hdwd.	120+ Sawtimber Soft.	120+ Other Hdwd.	120+ Other Soft.	120+ Total Hdwd.	120+ Total Soft.	85-120 Sawtimber Hdwd.	85-120 Sawtimber Soft.	85-120 Other Hdwd.	85-120 Other Soft.	85-120 Total Hdwd.	85-120 Total Soft.
		REGIME WITH INDICATED INITIAL TREATMENT													
0	0	Site preparation and planting	All												
10	10	Prescr. burn.	...do..												
20	20	......do.......	...do..												
30	30	......do.......	...do..												
30	30	Comm. thin.			-		1.88		1.88		-		1.19		1.19
40	40	......do.......			0.82		.82		1.64		0.59		.59		1.18
50	50	......do.......			1.49		.37		1.86		1.42		.35		1.77
70	70	Final harvest			4.72		1.18		5.90		4.10		1.03		5.13
		TOTALS			7.03		4.25		11.28		6.11		3.16		9.27
Mean annual increment									0.161						0.132
		REGIME WITHOUT INDICATED INITIAL TREATMENT													
40	40	Final harvest		0.53	0.38	1.23	0.48	1.76	0.86	0.45	0.33	0.98	0.38	1.43	0.71
Mean annual increment								0.044	0.022					0.036	0.018

[1]Site productivity class in cubic foot per acre mean annual increment, natural stands, "normal" yields.

Table A9.--(cont'd.)

Description of current stand: Nonstocked backlog

Indicated treatment: Site preparation and planting

1,000-cubic-foot-per-acre yield by site productivity class[1]

Stand age	Investment year	Treatment	Site prod. class	50-85 Sawtimber Hdwd.	50-85 Sawtimber Soft.	50-85 Other Hdwd.	50-85 Other Soft.	50-85 Total Hdwd.	50-85 Total Soft.	20-50 Sawtimber Hdwd.	20-50 Sawtimber Soft.	20-50 Other Hdwd.	20-50 Other Soft.	20-50 Total Hdwd.	20-50 Total Soft.
REGIME WITH INDICATED INITIAL TREATMENT															
0	0	Site preparation: and planting	All												
10	10	Prescr. burn.	do												
20	20	do	do												
30	30	do	do												
30	30	Comm. thin.			-		0.62		0.62		-				
40	40	do			0.34		.34		.68		0.20		0.19		0.39
50	50	do			.86		.21		1.07		.46		.11		.57
60	60	Final harvest			3.03		.76		3.79		1.58		.40		1.98
		TOTALS			4.23		1.93		6.16		2.24		0.70		2.94
Mean annual increment									0.103						0.049
REGIME WITHOUT INDICATED INITIAL TREATMENT															
40	40	Final harvest		0.32	0.23	0.61	0.24	0.93	0.47	0.15	0.12	0.27	0.10	0.42	0.22
Mean annual increment								0.023	0.012					0.010	0.006

[1] Site productivity class in cubic foot per acre mean annual increment, natural stands, "normal" yields.

Table A10.--Precommercial thinning or release of longleaf-slash pine

Description of current stand: Overstocked with competing hardwoods

Indicated treatment: Precommercial thinning (or release)

1,000-cubic-foot-per-acre yield by site productivity class[1]

Stand age	Investment year	Treatment	Site prod. class	120+ Sawtimber Hdwd.	120+ Sawtimber Soft.	120+ Other Hdwd.	120+ Other Soft.	120+ Total Hdwd.	120+ Total Soft.	85-120 Sawtimber Hdwd.	85-120 Sawtimber Soft.	85-120 Other Hdwd.	85-120 Other Soft.	85-120 Total Hdwd.	85-120 Total Soft.
		REGIME WITH INDICATED INITIAL TREATMENT													
10	0	Precomm. thin. (or release)	All												
10	10	Prescr. burn.	..do...												
30	20	......do.......	..do...												
30	20	Comm. thin.			-		1.88		1.88		-		1.19		1.19
40	30	......do.......			0.82		.82		1.64		0.59		.59		1.18
50	40	......do.......			1.49		.37		1.86		1.42		.35		1.77
70	60	Final harvest			4.72		1.18		5.90		4.10		1.03		5.13
			TOTALS		7.03		4.25		11.28		6.11		3.16		9.27
Mean annual increment									0.188						0.155
		REGIME WITHOUT INDICATED INITIAL TREATMENT													
45	35	Final harvest		1.13	0.85	2.56	1.14	3.69	1.99	0.92	0.68	2.05	0.91	2.97	1.59
Mean annual increment								0.105	0.057					0.085	0.045

[1] Site productivity class in cubic foot per acre mean annual increment, natural stands, "normal" yields.

Table A10.--(cont'd.)

Description of current stand: Overstocked with competing hardwoods

Indicated treatment: Precommercial thinning (or release)

1,000-cubic-foot-per-acre yield by site productivity class[1]

Stand age	Investment year	Treatment	Site prod. class	50-85						20-50					
				Sawtimber		Other		Total		Sawtimber		Other		Total	
				Hdwd.	Soft.	Hdwd.	Soft.	Hdwd.	Soft.	Hdwd.	Soft.	Hdwd.	Soft.	Hdwd.	Soft.
		REGIME WITH INDICATED INITIAL TREATMENT													
10	0	Precomm. thin. (or release)	All												
10	10	Prescr. burn.	..do...												
30	20	......do.......	..do...												
30	20	Comm. thin.			-		0.62		0.62		-		-		-
40	30	......do.......			0.34		.34		.68		0.20		0.19		0.39
50	40	......do.......			.86		.21		1.07		.46		.11		.57
70	60	Final harvest			3.03		.76		3.79		1.58		.40		1.98
			TOTALS		4.23		1.93		6.16		2.24		0.70		2.94
Mean annual increment									0.103						0.049
		REGIME WITHOUT INDICATED INITIAL TREATMENT													
45	35	Final harvest		0.60	0.45	1.34	0.60	1.94	1.05	0.30	0.23	0.67	0.30	0.97	0.53
Mean annual increment								0.055	0.030					0.028	0.015

[1]Site productivity class in cubic foot per acre mean annual increment, natural stands, "normal" yields.

Table A11.--Precommercial thinning of loblolly-shortleaf pine

Description of current stand: Overstocked (or with competing hardwoods)

Indicated treatment: Precommercial thinning (or release)

1,000-cubic-foot-per-acre yield by site productivity class[1]

Stand age	Investment year	Treatment	Site prod. class	120+ Sawtimber Hdwd.	120+ Sawtimber Soft.	120+ Other Hdwd.	120+ Other Soft.	120+ Total Hdwd.	120+ Total Soft.	85-120 Sawtimber Hdwd.	85-120 Sawtimber Soft.	85-120 Other Hdwd.	85-120 Other Soft.	85-120 Total Hdwd.	85-120 Total Soft.
		REGIME WITH INDICATED INITIAL TREATMENT													
10	0	Precomm. thin. (or release)	All												
20	10	Prescr. burn.	..do...												
30	20	......do.......	..do...												
30	20	Comm. thin.			-		1.65		1.65		-		1.16		1.16
40	30	......do.......			0.86		.85		1.71		0.54		.54		1.08
50	40	......do.......			1.95		.49		2.44		1.30		.32		1.62
70	60	Final harvest			5.68		1.42		7.10		4.16		1.04		5.20
		TOTALS			8.49		4.41		12.90		6.00		3.06		9.06
Mean annual increment									0.215						0.151
		REGIME WITHOUT INDICATED INITIAL TREATMENT													
45	35	Final harvest		0.95	0.72	2.14	0.95	3.09	1.67	0.70	0.53	1.59	0.70	2.29	1.23
Mean annual increment									0.048						0.034

[1]Site productivity class in cubic foot per acre mean annual increment, natural stands, "normal" yields.

Table A11.-- (cont'd.)

Description of current stand: Overstocked (or with competing hardwoods)

Indicated treatment: Precommercial thinning (or release)

1,000-cubic-foot-per-acre yield by site productivity class[1]

Stand age	Invest-ment year	Treatment	Site prod. class	50-85						20-50					
				Sawtimber		Other		Total		Sawtimber		Other		Total	
				Hdwd.	Soft.	Hdwd.	Soft.	Hdwd.	Soft.	Hdwd.	Soft.	Hdwd.	Soft.	Hdwd.	Soft.
				REGIME WITH INDICATED INITIAL TREATMENT											
10	0	Precomm. thin. (or release)	All												
20	10	Prescr. burn.	..do...												
30	20	......do.......	..do...												
30	20	Comm. thin.			-		0.60		0.60		-		0.36		0.36
40	30	......do.......			0.38		.37		.75		0.23		.22		.45
50	40	......do.......			.73		.48		.91		.44		.11		.55
70	60	Final harvest			2.49		.62		3.11		1.49		.37		1.86
		TOTALS			3.60		1.77		5.37		2.16		1.06		3.22
Mean annual increment									0.090						0.054
				REGIME WITHOUT INDICATED INITIAL TREATMENT											
50	50	Final harvest		0.55	0.42	1.25	0.55	1.80	0.97	0.33	0.25	0.75	0.33	1.08	0.58
Mean annual increment								0.045	0.024					0.027	0.014

[1]Site productivity class in cubic foot per acre mean annual increment, natural stands, "normal" yields.

Table A12.--Reforestation of loblolly-shortleaf pine

Description of current stand: Brush and inferior hardwoods

Indicated treatment: Site preparation and planting

1,000-cubic-foot-per-acre yield by site productivity class[1]

Stand age	Investment year	Treatment	Site prod. class	120+						85-120					
				Sawtimber		Other		Total		Sawtimber		Other		Total	
				Hdwd.	Soft.	Hdwd.	Soft.	Hdwd.	Soft.	Hdwd.	Soft.	Hdwd.	Soft.	Hdwd.	Soft.
REGIME WITH INDICATED INITIAL TREATMENT															
0	0	Site prep. and planting	All												
10	10	Prescr. burn.	..do...												
20	20	......do.......	..do...												
30	30	......do.......	..do...												
30	30	Comm. thin.			-		1.65		1.65		-		1.16		1.16
40	40	......do.......			0.86		.85		1.71		0.54		.54		1.08
50	50	......do.......			1.95		.49		2.44		1.30		.32		1.62
70	70	Final harvest			5.68		1.42		7.10		4.16		1.04		5.20
			TOTALS		8.49		4.41		12.90		6.00		3.06		9.06
Mean annual increment									0.184						0.129
REGIME WITHOUT INDICATED INITIAL TREATMENT															
40	40	Final harvest		0.63	0.45	1.43	0.55	2.09	1.00	0.45	0.33	0.98	0.38	1.43	0.71
Mean annual increment								0.052	0.025					0.036	0.018

[1] Site productivity class in cubic foot per acre mean annual increment, natural stands, "normal" yields.

Table A12.--Reforestation of loblolly-shortleaf pine --cont.

Description of current stand: Brush and inferior hardwoods

Indicated treatment: Site preparation and planting

1,000-cubic-foot-per-acre yield by site productivity class[1]

Stand age	Investment year	Treatment	Site prod. class	50-85						20-50					
				Sawtimber		Other		Total		Sawtimber		Other		Total	
				Hdwd.	Soft.	Hdwd.	Soft.	Hdwd.	Soft.	Hdwd.	Soft.	Hdwd.	Soft.	Hdwd.	Soft.
		REGIME WITH INDICATED INITIAL TREATMENT													
0	0	Site prep. and planting	All												
10	10	Prescr. burn.	..do...												
20	20	......do.......	..do...												
30	30	......do.......	..do...												
30	30	Comm. thin.			-		0.60		0.60		-		0.36		0.36
40	40	......do.......			0.38		.37		.75		0.23		.22		.45
50	50	......do.......			.73		.18		.91		.44		.11		.55
70	70	Final harvest			2.49		.62		3.11		1.49		.37		1.86
		TOTALS			3.60		1.77		5.37		2.16		1.06		3.22
Mean annual increment									0.077						0.046
		REGIME WITHOUT INDICATED INITIAL TREATMENT													
40	40	Final harvest		0.27	0.20	0.58	0.22	0.85	0.42	0.17	0.12	0.35	0.13	0.52	0.25
Mean annual increment								0.021	0.010					0.013	0.006

[1] Site productivity class in cubic foot per acre mean annual increment, natural stands, "normal" yields.

APPENDIX B

TREATMENT COSTS AND ACREAGES, NATIONAL FORESTS

Table B1.--Estimated treatment costs for backlog national forest reforestation and stand improvement, by administrative region, practice, type of cost, and species

Practice	Kind of cost	Cost by species type: LP	Cost by species type: All species except LP
		Dollars per acre	
REGION 1			
Site preparation only	Direct	23	25
	Other	20	21
	Subtotal	43	46
Complete planting without site preparation	Direct	25	25
	Other	21	21
	Subtotal	46	46
Partial planting	Direct	17	17
	Other	14	15
	Subtotal	31	32
Total reforestation, all PWI opportunities	Direct	50	44
	Other	42	38
	Subtotal	92	82
Release	Direct	15	16
	Other	13	14
	Subtotal	28	30
Precommercial thinning	Direct	27	29
	Other	23	24
	Subtotal	50	53

Table Bl.-- (cont'd.)

Practice	Kind of cost	Cost by species type				
		DF	LP	FS	PP	Average all types
		Dollars per acre				
	REGION 2					
Site preparation	Direct	20	13	18	13	15
	Other	20	12	17	12	15
	Subtotal	40	25	35	25	30
Planting	Direct	50	60	65	58	58
	Other	50	60	65	57	58
	Subtotal	100	120	130	115	116
Total reforestation, all PWI opportunities	Direct	65	70	80	68	72
	Other	65	70	80	67	71
	Subtotal	130	140	160	135	143
Release (weeding)	Direct	18	21	26	17	21
	Other	18	20	26	16	20
	Subtotal	36	41	52	33	41
Precommercial thinning	Direct	38	34	43	32	36
	Other	37	33	43	32	36
	Subtotal	75	67	86	64	72

NOTE: Where site preparation and planting are to be done on average project, the reforestation cost should be used.

Table B1.--(cont'd.)

Practice	Kind of cost	Cost by species type					
		DF	LP	FS	PP	WWP-larch	Average all types
		Dollars per acre					
	REGION 3						
Site preparation and planting	Direct	61	62	69	61	57	63
	Other	57	58	64	57	53	59
	Subtotal	118	120	133	118	110	122
Precommercial thinning	Direct	20	---	22	17	---	19
	Other	18	---	21	16	---	17
	Subtotal	38	---	43	33	---	36
Release	Direct	13	13	16	12		13
	Other	12	12	14	12		12
	Subtotal	25	25	30	24		25
	REGION 4						
Site preparation and planting	Direct	70	66	71	63	71	69
	Other	65	61	66	59	66	63
	Subtotal	135	127	137	122	137	132
Precommercial thinning	Direct	28	25	32	24	27	27
	Other	26	24	29	22	24	24
	Subtotal	54	49	61	46	51	51
Release	Direct	13	13	17	12		13
	Other	12	12	15	12		12
	Subtotal	25	25	32	24		25

Table B1.-- (cont'd.)

Practice	Kind of cost	Cost by species type					
		DF	LP	FS	PP	WWP-larch	Average all types
		Dollars per acre					
	REGION 5						
Site preparation and planting	Direct	63	67	71	63	67	67
	Other	59	61	66	59	61	61
	Subtotal	122	128	137	122	128	128
Release	Direct	14	---	17	13	---	14
	Other	12	---	16	12	---	12
	Subtotal	16	---	33	25	---	26
Precommercial thinning	Direct	31	---	35	27	---	29
	Other	28	---	32	24	---	27
	Subtotal	59	---	67	51	---	56
	REGION 6						
Site preparation and planting	Direct	64	64	74	69	61	64
	Other	59	59	69	64	56	59
	Subtotal	123	123	143	133	117	123
Precommercial thinning	Direct	36	33	42	31	31	35
	Other	34	31	38	29	29	32
	Subtotal	70	64	80	60	60	67
Release	Direct	12		16	12		13
	Other	12		14	12		12
	Subtotal	24		30	24		25

Table B1.--(cont'd.)

Practice	Kind of cost	Cost by species type					
		Longleaf slash	Shortleaf loblolly	Oak hickory	Red-white pine	Other	Average all types
		Dollars per acre					
	REGION 8						
Site preparation and planting	Direct	58	58	63	54	58	58
	Other	54	54	59	50	54	54
	Subtotal	112	112	122	104	112	112
Site preparation (pr. burn.)	Direct	3	3	4	4		3
	Other	2	3	3	3		3
	Subtotal	5	6	7	7		6
Release	Direct	21	21	21	21	21	21
	Other	20	20	20	20	20	20
	Subtotal	41	41	41	41	41	41
Precommercial thinning	Direct	14	14	19	14	14	16
	Other	12	12	17	12	12	15
	Subtotal	26	26	36	26	26	31

Table B1.--(cont'd.)

Practice	Kind of cost	Cost by species type					
		Spruce fir (E)	Oak, hickory	Maple, beech, birch	Red-eastern white pine	Other	Average all types
		Dollars per acre					
REGION 9							
Site preparation and planting	Direct	43	53	45	50	50	48
	Other	39	49	42	47	47	44
	Subtotal	82	102	87	97	97	92
Release	Direct	17	17	20	20	17	19
	Other	16	16	19	19	16	17
	Subtotal	33	33	39	39	33	36
Precommercial thinning	Direct			19	19	19	19
	Other			17	17	17	17
	Subtotal			36	36	36	36

Table B2.--National forest backlog reforestation acreages by forest type, site, and administrative region

Forest type group	Site productivity class[1]	Backlog acreages by region							
		1[2]	2	3	4	Rocky Mountain subtotal	5	6	Pacific Coast subtotal
	Cu. ft./acre/yr.	Thousands of acres							
Douglas-fir	120+	29	--	--	1	30	14	19	33
	85-119	50	9	2	5	66	92	54	146
	50-84	30	8	11	13	62	--	52	52
	20-49	20	6	15	11	52	--	11	11
Ponderosa pine	120+	16	1	--	2	19	23	2	25
	85-119	20	31	1	6	58	52	13	65
	50-84	5	61	35	10	111	72	32	104
	20-49	1	18	108	5	132	13	20	33
Fir-spruce	120+	35	3	--	1	39	6	4	10
	85-119	43	20	2	3	68	4	5	9
	50-84	10	39	9	10	68	2	5	7
	20-49	1	54	5	10	70	--	33	33
Lodgepole pine	120+	11	--	--	1	12	--	--	--
	85-119	14	6	--	8	28	--	2	2
	50-84	--	79	--	21	100	--	13	13
	20-49	--	5	--	24	29	--	16	16
Larch, western white pine	120+	35	--	--	--	35	--	--	--
	85-119	36	--	--	--	35	--	--	--
	50-84	2	--	--	--	2	--	--	--
	29-49	1	--	--	--	1	--	--	--
Other types	120+	--	--	--	--	--	--	1	1
	85-119	--	--	--	--	--	--	5	5
	50-84	--	--	--	--	--	--	3	3
	20-49	--	--	--	--	--	--	1	1
TOTAL		359	351	188	130	1,028	280	293	573

[1] Site productivity classes in cubic-foot-per-year normal yield.

[2] Includes some acreages expected to remain roadless.

Table B2.--(cont'd.)

Forest type group	Site productivity class	South 8	North 9
	Cu. ft./acre/yr.		
Longleaf-slash pine	120+	--	--
	85-119	30	
	50-84	35	
	20-49	25	
Red pine, eastern white pine	120+	50	16
	85-119	9	36
	50-84	5	116
	20-49	--	2
Oak, hickory	120+	1	--
	85-119	7	1
	50-84	47	2
	20-49	8	2
Shortleaf, loblolly pine	120+	11	--
	85-119	49	1
	50-84	412	60
	20-49	11	6
Maple, beech, birch	120+	--	1
	85-119	--	5
	50-84	--	5
	20-49	--	--
Spruce, fir	120+	--	7
	85-119	--	30
	50-84	--	52
	20-49	--	1
Other types	120+	2	--
	85-119	16	6
	50-84	71	49
	20-49	32	8
TOTAL		821	406

APPENDIX C

TREATMENT OPPORTUNITY RANKINGS, NATIONAL FORESTS

TABLE C1

NFS ACCESSIBLE BACKLOG TREATMENT OPPORTUNUTIES RANKED BY
INCREASE IN SAWTIMBER MEAN ANNUAL INCREMENT PER DOLLAR OF TOTAL COST

LOCATION CODE	SPECIES	SITE	TREAT-MENT CODE	GROWTH INCR. PER $ TOT.COST		CUMULATIVE AREA	CUMULATIVE ANN.GROWTH SAWTIMBER	INCREASED POTENTIAL GRO. STK	CUMULATIVE AAC INCREASE 10TH YR	30TH YR	CUMULATIVE PROGRAM COSTS DIRECT	TOTAL
				BF/$	CF/$	M ACRES	MMBF	MMCF	MMCF	MMCF	$MM	$MM
821	SHL-LOB	1	3	25.9	6.0	7.0	5068.0	1169.0	119.0	1169.0	98.0	196.0
828	RED-EWP	1	3	25.9	6.0	58.0	41992.0	9686.0	986.0	3311.0	812.0	1624.0
421A	PP	1	2	20.9	3.3	59.0	42536.0	9773.0	1029.0	3398.0	824.0	1650.0
615	PP	1	2	20.9	3.3	61.0	43624.0	9947.0	1203.0	3572.0	848.0	1702.0
509	PP	1	2	20.1	3.2	116.0	73544.0	14732.0	5988.0	8357.0	1563.0	3187.0
809	LONG-SL	1	3	19.1	4.7	116.0	73544.0	14732.0	5988.0	8357.0	1563.0	3187.0
822	SHL-LOB	2	3	18.8	4.1	152.0	92444.0	18908.0	6420.0	12533.0	2067.0	4195.0
125	LODGEPO	1	2	18.1	2.9	179.0	107132.0	21257.0	6420.0	14882.0	2472.0	5005.0
129	CONIFER	1	2	18.1	2.9	207.0	122364.0	23693.0	8856.0	17318.0	2892.0	5845.0
810	LONG-SL	2	3	17.0	3.9	208.0	122840.0	23803.0	8867.0	17428.0	2906.0	5873.0
817	SHL-LOB	1	2	16.8	3.9	222.0	132976.0	26141.0	9105.0	19766.0	3200.0	6475.0
830	RED-EWP	1	2	16.8	3.9	238.0	144560.0	28813.0	9377.0	20438.0	3536.0	7163.0
301A	PP	1	3	15.5	2.5	239.0	145104.0	28900.0	9420.0	20525.0	3553.0	7198.0
515	FIR-SPR	1	2	15.5	2.5	248.0	150000.0	29683.0	10203.0	21308.0	3706.0	7513.0
906	RED-EWP	2	2	15.0	3.3	341.0	198825.0	40471.0	11319.0	24005.0	5287.0	10768.0
911	SHL-LOB	2	3	13.8	3.1	354.0	205650.0	41979.0	11475.0	24382.0	5534.0	11262.0
805	LONG-SL	1	2	12.4	3.0	354.0	205650.0	41979.0	11475.0	24382.0	5534.0	11262.0
818	SHL-LOB	2	2	12.2	2.7	382.0	220350.0	45227.0	11811.0	27630.0	6122.0	12466.0
811	LONG-SL	3	3	11.9	2.6	383.0	220683.0	45300.0	11818.0	27703.0	6136.0	12494.0
410A	PP	1	3	11.3	1.8	385.0	221771.0	45474.0	11904.0	27877.0	6184.0	12590.0
309B	PP	2	2	11.2	2.5	386.0	222062.0	45540.0	11937.0	27943.0	6196.0	12616.0
421B	PP	2	2	11.2	2.5	389.0	222935.0	45738.0	12036.0	28141.0	6232.0	12694.0
616A	PP	2	2	11.2	2.5	395.0	224681.0	46134.0	12432.0	28537.0	6304.0	12850.0
806	LONG-SL	2	2	11.1	2.6	400.0	227061.0	46684.0	12487.0	29087.0	6409.0	13065.0
307B	DF	2	2	10.8	2.4	402.0	227643.0	46816.0	12619.0	29219.0	6435.0	13119.0
419B	DF	2	2	10.8	2.4	404.0	228225.0	46948.0	12751.0	29351.0	6461.0	13173.0
425B	LODGEPO	2	2	10.8	2.4	407.0	229098.0	47146.0	12949.0	29549.0	6500.0	13254.0
510	PP	2	2	10.8	2.4	465.0	245976.0	50974.0	16777.0	33377.0	7254.0	14820.0
404A	LODGEPO	1	3	10.7	1.7	466.0	246520.0	51061.0	16864.0	33464.0	7279.0	14871.0
823	SHL-LOB	3	3	10.6	2.4	482.0	251256.0	52117.0	16960.0	33560.0	7503.0	15319.0

TABLE C1 (CONT'D.)

829	RED-EWP	3	3	10.6	2.4	486.0	252440.0	52381.0	16988.0	33624.0	7559.0	15431.0
117	LODGEPO	1	3	10.5	1.7	531.0	276920.0	56296.0	16988.0	37539.0	8774.0	17771.0
517	PP	1	3	10.3	1.6	578.0	302483.0	60385.0	21077.0	41628.0	10043.0	20262.0
614B	DF	3	2	10.0	1.8	610.0	310808.0	61889.0	22581.0	43132.0	10427.0	21094.0
107	CONIFER	1	3	9.9	1.6	660.0	338008.0	66239.0	26931.0	47482.0	11877.0	23844.0
126	LODGEPO	2	2	9.7	2.2	714.0	353722.0	69803.0	26931.0	51046.0	12687.0	25464.0
130	CONIFER	2	2	9.7	2.2	769.0	369727.0	73433.0	30561.0	54676.0	13512.0	27114.0
422A	PP	3	2	9.6	2.1	775.0	371221.0	73763.0	30726.0	55006.0	13584.0	27270.0
616B	PP	3	2	9.6	2.1	784.0	373462.0	74258.0	31221.0	55501.0	13692.0	27504.0
307C	DF	3	2	9.2	2.0	788.0	374458.0	74478.0	31441.0	55721.0	13744.0	27612.0
420A	DF	3	2	9.2	2.0	792.0	375454.0	74698.0	31661.0	55941.0	13796.0	27720.0
426A	LODGEPO	3	2	9.2	2.0	800.0	377446.0	75138.0	32101.0	56381.0	13900.0	27936.0
511	PP	3	2	9.2	2.0	822.0	382924.0	76348.0	33311.0	57591.0	14186.0	28530.0
308B	FIR-SPR	2	2	9.1	2.1	823.0	383215.0	76414.0	33377.0	57657.0	14202.0	28562.0
613	DF	1	2	8.8	2.0	869.0	393703.0	73760.0	35723.0	60003.0	14754.0	29758.0
601	PP	1	3	8.8	1.4	874.0	396423.0	79195.0	36158.0	60438.0	14909.0	30068.0
423B	FIR-SPR	2	2	8.6	1.9	875.0	396714.0	79261.0	36224.0	60504.0	14926.0	30102.0
908	RED-EWP	3	2	8.5	1.9	995.0	432234.0	87181.0	37064.0	62424.0	16966.0	34302.0
910	SHL-LOB	3	2	8.5	1.9	1035.0	444074.0	89821.0	37344.0	63064.0	17646.0	35702.0
127	LODGEPO	3	2	8.3	1.8	1097.0	459512.0	93231.0	37344.0	66474.0	18576.0	37562.0
131	CONIFER	3	2	8.3	1.8	1163.0	475946.0	96861.0	40974.0	70104.0	19566.0	39542.0
216	PP	2	2	8.3	1.9	1175.0	479438.0	97653.0	41370.0	70896.0	19770.0	39962.0
301B	PP	2	3	8.3	1.9	1182.0	481475.0	98115.0	41601.0	71358.0	19889.0	40207.0
516A	FIR-SPR	2	2	8.3	1.9	1188.0	483221.0	98511.0	41997.0	71754.0	19991.0	40417.0
513	DF	1	2	8.1	1.8	1196.0	485045.0	98919.0	42405.0	72162.0	20103.0	40641.0
618B	FIR-SPR	3	2	8.1	1.5	1200.0	486085.0	99107.0	42593.0	72350.0	20167.0	40769.0
614A	DF	2	2	7.9	1.6	1260.0	498445.0	101627.0	45113.0	74870.0	20887.0	42329.0
523	FIR-SPR	1	3	7.9	1.3	1269.0	503341.0	102410.0	45896.0	75653.0	21202.0	42950.0
101	CONIFER	1	1	7.8	1.4	1330.0	539453.0	109608.0	53094.0	82851.0	23886.0	48074.0
308C	FIR-SPR	3	2	7.8	1.7	1332.0	539951.0	109718.0	53204.0	82961.0	23918.0	48138.0
905	RED-EWP	3	3	7.8	1.7	1383.0	555047.0	113084.0	53561.0	83777.0	24887.0	50076.0
807	LONG-SL	3	2	7.7	1.7	1387.0	556379.0	113376.0	53589.0	84069.0	24971.0	50248.0
424A	FIR-SPR	3	2	7.3	1.6	1390.0	557126.0	113541.0	53754.0	84234.0	25022.0	50350.0
310B	DF	2	3	7.3	1.6	1391.0	557417.0	113607.0	53820.0	84300.0	25042.0	50390.0
217	PP	3	2	7.1	1.6	1410.0	562148.0	114652.0	54342.5	85345.0	25365.0	51055.0
301C	PP	3	3	7.1	1.6	1588.0	606470.0	124442.0	59237.5	95135.0	28391.0	57285.0
516B	FIR-SPR	3	2	7.1	1.6	1590.0	606968.0	124552.0	59347.5	95245.0	28425.0	57355.0
617	FIR-SPR	1	2	7.1	1.6	1592.0	607424.0	124654.0	59449.5	95347.0	28457.0	57419.0
819	SHL-LOB	3	2	6.9	1.5	1631.0	618968.0	127228.0	59683.5	95581.0	29276.0	59096.0

TABLE C1 (CONT'D.)

215A	LODGEPO	2	2	6.8	1.5	1637.0	620714.0	127624.0	60079.5	95977.0	29402.0	59354.0
105	CONIFER	1	1	6.7	1.3	1654.0	629894.0	129392.0	61847.5	97745.0	30116.0	60714.0
901	RED-EWP	1	1	6.7	1.6	1670.0	640438.0	131936.0	62103.5	98385.0	30916.0	62298.0
303B	FIR-SPR	2	3	6.5	1.5	1671.0	640729.0	132002.0	62169.5	98451.0	30938.0	62343.0
106	CONIFER	2	1	6.4	1.5	1679.0	643193.0	132578.0	62745.5	99027.0	31138.0	62727.0
618A	FIR-SPR	2	2	6.4	1.3	1681.0	643605.0	132662.0	62829.5	99111.0	31170.0	62791.0
115	LODGEPO	1	1	6.3	1.3	1692.0	650117.0	133960.0	64127.5	100409.0	31720.0	63825.0
812	LONG-SL	4	3	6.3	1.2	1692.0	650117.0	133960.0	64127.5	100409.0	31720.0	63825.0
824	SHL-LOB	4	3	6.3	1.4	1693.0	650293.0	133999.0	64131.5	100446.0	31734.0	63853.0
310C	DF	3	3	6.2	1.4	1703.0	652783.0	134549.0	64681.5	100996.0	31934.0	64253.0
825	RED-EWP	1	1	6.2	1.5	1750.0	683756.0	142022.0	65433.5	102782.0	34472.0	69235.0
213	FIR-SPR	2	2	6.1	1.4	1773.0	691277.0	143770.0	67181.5	104530.0	35070.0	70477.0
410B	PP	2	3	6.1	1.4	1783.0	694187.0	144430.0	67511.5	105190.0	35310.0	70957.0
813	SHL-LOB	1	1	5.7	1.4	1794.0	701436.0	146179.0	67687.5	106939.0	35975.5	72238.5
118	LODGEPO	2	3	5.6	1.3	1894.0	730536.0	152779.0	67687.5	113539.0	38675.5	77438.5
303C	FIR-SPR	3	3	5.5	1.2	1898.0	731532.0	152999.0	67907.5	113759.0	38763.5	77618.5
518	PP	2	3	5.5	1.2	1980.0	755394.0	158411.0	73319.5	119171.0	40977.5	81964.5
108	CONIFER	2	3	5.3	1.2	2060.0	778674.0	163691.0	78599.5	124451.0	43297.5	86364.5
411	PP	3	3	5.2	1.1	2076.0	782658.0	164571.0	79039.5	125331.0	43681.5	87132.5
427A	DF	2	3	5.2	1.2	2079.0	783531.0	164769.0	79237.5	125529.0	43765.5	87300.5
116	LODGEPO	2	1	4.9	1.3	2093.0	786849.0	165609.0	80077.5	126369.0	44115.5	87972.5
501	PP	1	1	4.8	1.0	2116.0	800465.0	168323.0	82791.5	129083.0	45564.5	90824.5
506C	DF	2	1	4.8	1.0	2153.0	822628.0	172763.0	87231.5	133523.0	47895.5	95412.5
612A	DF	2	1	4.8	1.0	2175.0	835806.0	175403.0	89871.5	136163.0	49303.5	98162.5
519	PP	3	3	4.7	1.0	2225.0	848256.0	178153.0	92621.5	138913.0	50653.5	100812.5
602A	PP	2	3	4.7	1.1	2250.0	855531.0	179803.0	94271.5	140563.0	51428.5	102362.5
801	LONG-SL	1	1	4.7	1.2	2250.0	855531.0	179803.0	94271.5	140563.0	51428.5	102362.5
902	RED-EWP	2	1	4.7	1.1	2286.0	872235.0	183799.0	94671.1	141571.0	53228.5	105926.5
401A	LODGEPO	1	1	4.6	.9	2287.0	872737.0	183917.0	94789.1	141689.0	53294.5	106055.5
407A	PP	1	1	4.6	.9	2289.0	873921.0	184153.0	95025.1	141925.0	53426.5	106313.5
416B	FIR-SPR	2	3	4.6	1.0	2292.0	874794.0	184351.0	95223.1	142123.0	53522.5	106502.5
109	CONIFER	3	3	4.5	1.0	2367.0	893469.0	188476.0	99348.1	146248.0	55697.5	110627.5
209B	PP	2	3	4.4	1.0	2379.0	896961.0	189268.0	100140.1	147040.0	56081.5	111419.5
603	PP	1	1	4.4	.9	2381.0	898145.0	189504.0	100376.1	147276.0	56219.5	111689.5
826	RED-EWP	2	1	4.4	1.0	2389.0	901857.0	190392.0	100464.1	147500.0	56651.5	112537.5
413A	FIR-SPR	1	1	4.3	.8	2390.0	902449.0	190510.0	100582.1	147618.0	56722.5	112676.5
429A	DF	1	1	4.3	.9	2391.0	903041.0	190628.0	100700.1	147736.0	56792.5	112813.5
507	FIR-SPR	1	1	4.3	.8	2397.0	906593.0	191336.0	101408.1	148444.0	57218.5	113647.5
102	SPR-FIR	2	1	4.2	1.0	2491.0	939681.0	199326.0	109398.1	156434.0	61354.5	121543.5

TABLE C1 (CONT'D.)

524A	FIR-SPR	2	3	4.2	1.0	2494.0	940554.0	199524.0	109596.1	156632.0	61459.5	121750.5
802	LONG-SL	2	1	4.1	1.0	2522.0	953826.0	202716.0	109904.1	159824.0	63153.5	125012.5
808	LONG-SL	4	2	4.1	.8	2523.0	954002.0	202750.0	109907.5	159858.0	63174.5	125055.5
602B	PP	3	3	4.0	.9	2561.0	963464.0	204840.0	111997.5	161948.0	64352.5	127411.5
814	SHL-LOB	2	1	4.0	1.0	2607.0	984806.0	209946.0	112457.5	167054.0	67135.5	132770.5
502B	PP	2	1	3.8	.9	2628.0	994615.0	212256.0	114767.5	169364.0	68458.5	135374.5
521	DF	1	3	3.7	.8	2636.0	996439.0	212664.0	115175.5	169772.0	68706.5	135862.5
608B	DF	3	3	3.6	.7	2688.0	1009959.0	215108.0	117619.5	172216.0	70578.5	139606.5
606A	PP	2	1	3.5	.8	2693.0	1012294.0	215658.0	118169.5	172766.0	70923.5	140281.5
522A	DF	2	3	3.4	.7	2708.0	1015384.0	216288.0	118799.5	173396.0	71388.5	141196.5
909	SHL-LOB	3	1	3.3	.8	2746.0	1025948.0	218758.0	119027.5	174004.0	73022.5	144388.5
103	CONIFER	3	1	3.2	.7	2779.0	1034693.0	220738.0	121007.5	175984.0	74474.5	147160.5
607	DF	1	3	3.2	.7	2850.0	1050881.0	224359.0	124628.5	179605.0	77030.5	152272.5
505	DF	1	1	3.0	.8	2864.0	1056131.0	225745.0	126014.5	180991.0	77912.5	154008.5
609	DF	1	1	3.0	.8	2883.0	1063256.0	227626.0	127895.5	182872.0	79128.5	156383.5
304B	PP	2	1	2.9	.7	2884.0	1063608.0	227711.0	127980.5	182957.0	79189.5	156503.5
306F	DF	2	1	2.9	.7	2886.0	1064312.0	227881.0	128150.5	183127.0	79311.5	156743.5
612B	DF	3	1	2.9	.6	2907.0	1072040.0	229414.0	129683.5	184660.0	80655.5	159368.5
608A	DF	2	3	2.9	.6	2956.0	1082134.0	231472.0	131741.5	186718.0	82419.5	162896.5
502	PP	2	1	2.8	.7	2987.0	1093046.0	234107.0	134376.5	189353.0	84372.5	166740.5
621	FIR-SPR	1	3	2.8	.6	2994.0	1094642.0	234464.0	134733.5	189710.0	84666.5	167314.5
803	LONG-SL	3	1	2.8	.8	3024.0	1104512.0	237194.0	135003.5	192440.0	86481.5	170809.5
903	RED-EWP	3	1	2.8	.7	3140.0	1136760.0	244734.0	135699.5	194296.0	92281.5	182293.5
912	OTHER	3	1	2.8	.7	3193.0	1151494.0	248179.0	136017.5	195144.0	94931.5	187540.5
203D	DF	2	1	2.7	.6	3202.0	1154662.0	248944.0	136782.5	195909.0	95516.5	188728.5
401B	LODGEPO	2	1	2.7	.7	3210.0	1157478.0	249624.0	137462.5	196589.0	96044.5	189760.5
407B	PP	2	1	2.7	.7	3216.0	1159590.0	250134.0	137972.5	197099.0	96440.5	190534.5
503B	PP	3	1	2.7	.6	3245.0	1169334.0	252396.0	140234.5	199361.0	98267.5	194130.5
205B	PP	2	1	2.6	.6	3277.0	1180598.0	255116.0	142954.5	202081.0	100443.5	198540.5
306B	FIR-SPR	2	1	2.6	.6	3279.0	1181302.0	255286.0	143124.5	202251.0	100581.5	198816.5
429B	DF	2	1	2.6	.6	3284.0	1183062.0	255711.0	143549.5	202676.0	100931.5	199501.5
604A	PP	2	1	2.6	.6	3292.0	1185878.0	256391.0	144229.5	203356.0	101483.5	200581.5
619	FIR-SPR	1	1	2.6	.7	3296.0	1187378.0	256787.0	144625.5	203752.0	101779.5	201161.5
827	RED-EWP	3	1	2.6	.6	3300.0	1188490.0	257047.0	144649.5	203816.0	101995.5	201585.5
201H	LODGEPO	2	1	2.5	.6	3306.0	1190602.0	257557.0	145159.5	204326.0	102415.5	202437.5
413B	FIR-SPR	2	1	2.5	.6	3309.0	1191658.0	257812.0	145414.5	204581.0	102628.5	202854.5
508A	FIR-SPR	2	1	2.5	.6	3313.0	1193066.0	258152.0	145754.5	204921.0	102912.5	203410.5
606B	PP	3	1	2.5	.6	3326.0	1197434.0	259166.0	146768.5	205935.0	103809.5	205165.5
622A	FIR-SPR	2	3	2.5	.5	3344.0	1201142.0	259922.0	147524.5	206691.0	104565.5	206641.5

TABLE C1 (CONT'D.)

815	SHL-LOB	3	1	2.4	.6	3689.0	1297052.0	282347.0	149594.5	218076.0	125438.0	246834.0
203B	FIR-SPR	2	1	2.2	.5	3712.0	1305148.0	284302.0	151549.5	220031.0	127278.0	250560.0
304C	PP	3	1	2.2	.5	3747.0	1314423.0	286402.0	153649.5	222131.0	129413.0	254760.0
306G	DF	3	1	2.2	.5	3758.0	1317338.0	287062.0	154309.5	222791.0	130084.0	256080.0
402	LODGEPO	3	1	2.1	.5	3779.0	1322903.0	288322.0	155569.5	224051.0	131470.0	258789.0
408	PP	3	1	2.1	.5	3789.0	1325553.0	288922.0	156169.5	224651.0	132130.0	260079.0
503	PP	3	1	2.1	.5	3832.0	1336948.0	291502.0	158749.5	227231.0	134839.0	265411.0
203E	DF	3	1	2.0	.5	3840.0	1339068.0	291982.0	159229.5	227711.0	135359.0	266467.0
306C	FIR-SPR	3	1	2.0	.4	3849.0	1341453.0	292522.0	159769.5	228251.0	135980.0	267682.0
506A	DF	2	1	2.0	.5	3904.0	1355258.0	295932.0	163179.5	231661.0	139445.0	274502.0
604B	PP	3	1	2.0	.4	3923.0	1360293.0	297072.0	164319.5	232801.0	140756.0	277067.0
610A	DF	2	1	2.0	.5	3955.0	1368325.0	299056.0	166303.5	234785.0	142604.0	281067.0
202A	LODGEPO	3	1	1.9	.4	4034.0	1389260.0	303796.0	171043.5	239525.0	148334.0	292285.0
205C	PP	3	1	1.9	.4	4095.0	1405425.0	307456.0	174703.5	243185.0	152482.0	300703.0
414	FIR-SPR	3	1	1.9	.4	4105.0	1408075.0	308056.0	175303.5	243785.0	153192.0	302093.0
430A	DF	3	1	1.9	.4	4118.0	1411520.0	308836.0	176083.5	244565.0	154102.0	303874.0
508B	FIR-SPR	3	1	1.9	.4	4120.0	1412050.0	308956.0	176203.5	244685.0	154244.0	304152.0
620A	FIR-SPR	2	1	1.7	.4	4125.0	1413305.0	309266.0	176513.5	244995.0	154614.0	304877.0
104	CONIFER	4	1	1.6	.4	4141.0	1415497.0	309810.0	177057.5	245539.0	155318.0	306221.0
204A	FIR-SPR	3	1	1.6	.4	4180.0	1425832.0	312150.0	179397.5	247879.0	158438.0	312539.0
804	LONG-SL	4	1	1.5	.4	4199.0	1429119.0	312967.0	179473.5	248696.0	159587.5	314752.5
816	SHL-LOB	4	1	1.4	.3	4207.0	1430439.0	313287.0	179505.5	249016.0	160071.5	315684.5
305C	PP	4	1	1.1	.3	4325.0	1446605.0	317299.0	183517.5	253028.0	167269.5	329844.5
306H	DF	4	1	1.1	.3	4340.0	1448660.0	317809.0	184027.5	253538.0	168184.5	331644.5
403	LODGEPO	4	1	1.1	.3	4354.0	1450578.0	318285.0	184503.5	254014.0	169108.5	333450.5
409	PP	4	1	1.1	.3	4359.0	1451263.0	318455.0	184673.5	254184.0	169438.5	334095.5
504	PP	4	1	1.1	.3	4367.0	1452359.0	318727.0	184945.5	254456.0	169942.5	335087.5
202B	LODGEPO	4	1	1.0	.2	4372.0	1453044.0	318897.0	185115.5	254626.0	170292.5	335797.5
203F	DF	4	1	1.0	.3	4378.0	1453866.0	319101.0	185319.5	254830.0	170682.5	336589.5
205D	PP	4	1	1.0	.2	4396.0	1456332.0	319713.0	185931.5	255442.0	171906.5	339073.5
306D	FIR-SPR	4	1	1.0	.3	4401.0	1457017.0	319883.0	186101.5	255612.0	172251.5	339748.5
415	FIR-SPR	4	1	1.0	.2	4411.0	1458387.0	320223.0	186441.5	255952.0	172961.5	341138.5
430B	DF	4	1	1.0	.2	4422.0	1459894.0	320597.0	186815.5	256326.0	173731.5	342645.5
204B	FIR-SPR	4	1	.8	.2	4476.0	1467292.0	322433.0	188651.5	258162.0	178051.5	351393.5
610B	DF	3	1	.8	.2	4507.0	1470516.0	323332.0	189550.5	259061.0	180035.5	355268.5
620B	FIR-SPR	3	1	.7	.2	4512.0	1471036.0	323477.0	189695.5	259206.0	180405.5	355993.5

TABLE C2
NFS ACCESSIBLE BACKLOG TREATMENT OPPORTUNUTIES RANKED BY
INCREASE IN ALLOWABLE ANNUAL CUT, 10TH YEAR, PER DOLLAR OF TOTAL COST

LOCA-TION CODE	SPECIES	SITE	TREAT-MENT CODE	AAC INCREASE PER $ TOT.COST 10TH YEAR	AAC INCREASE PER $ TOT.COST 30TH YEAR	CUMULA-TIVE AREA	CUMULATIVE ANN.GROWTH SAWTIMBER	INCREASED POTENTIAL GRO. STK	CUMULATIVE AAC INCREASE 10TH YR	CUMULATIVE AAC INCREASE 30TH YR	CUMULATIVE PROGRAM COSTS DIRECT	CUMULATIVE PROGRAM COSTS TOTAL
						M ACRES	MMBF	MMCF	MMCF	MMCF	$MM	$MM
615	PP	1	2	3.3	3.3	2.0	1088.0	174.0	174.0	174.0	24.0	52.0
509	PP	1	2	3.2	3.2	57.0	31008.0	4959.0	4959.0	4959.0	739.0	1537.0
515	FIR-SPR	1	2	2.5	2.5	66.0	35904.0	5742.0	5742.0	5742.0	892.0	1852.0
616A	PP	2	2	2.5	2.5	72.0	37650.0	6138.0	6138.0	6138.0	964.0	2008.0
307B	DF	2	2	2.4	2.4	74.0	38232.0	6270.0	6270.0	6270.0	990.0	2062.0
419B	DF	2	2	2.4	2.4	76.0	38814.0	6402.0	6402.0	6402.0	1016.0	2116.0
425B	LODGEPO	2	2	2.4	2.4	79.0	39687.0	6600.0	6600.0	6600.0	1055.0	2197.0
510	PP	2	2	2.4	2.4	137.0	56565.0	10428.0	10428.0	10428.0	1809.0	3763.0
130	CONIFER	2	2	2.2	2.2	192.0	72570.0	14058.0	14058.0	14058.0	2634.0	5413.0
308B	FIR-SPR	2	2	2.1	2.1	193.0	72861.0	14124.0	14124.0	14124.0	2650.0	5445.0
616B	PP	3	2	2.1	2.1	202.0	75102.0	14619.0	14619.0	14619.0	2758.0	5679.0
129	CONIFER	1	2	2.0	2.9	230.0	90334.0	17055.0	17055.0	17055.0	3178.0	6519.0
307C	DF	3	2	2.0	2.0	234.0	91330.0	17275.0	17275.0	17275.0	3230.0	6627.0
420A	DF	3	2	2.0	2.0	238.0	92326.0	17495.0	17495.0	17495.0	3282.0	6735.0
426A	LODGEPO	3	2	2.0	2.0	246.0	94318.0	17935.0	17935.0	17935.0	3386.0	6951.0
511	PP	3	2	2.0	2.0	268.0	99796.0	19145.0	19145.0	19145.0	3672.0	7545.0
613	DF	1	2	2.0	2.0	314.0	110284.0	21491.0	21491.0	21491.0	4224.0	8741.0
423B	FIR-SPR	2	2	1.9	1.9	315.0	110575.0	21557.0	21557.0	21557.0	4241.0	8775.0
516A	FIR-SPR	2	2	1.9	1.9	321.0	112321.0	21953.0	21953.0	21953.0	4343.0	8985.0
131	CONIFER	3	2	1.8	1.8	387.0	128755.0	25583.0	25583.0	25583.0	5333.0	10965.0
513	DF	1	2	1.8	1.8	395.0	130579.0	25991.0	25991.0	25991.0	5445.0	11189.0
614B	DF	3	2	1.8	1.8	427.0	138899.0	27495.0	27495.0	27495.0	5829.0	12021.0
308C	FIR-SPR	3	2	1.7	1.7	429.0	139397.0	27605.0	27605.0	27605.0	5861.0	12085.0
421A	PP	1	2	1.7	3.3	430.0	139941.0	27692.0	27648.0	27692.0	5873.0	12111.0
404A	LODGEPO	1	3	1.7	1.7	431.0	140485.0	27779.0	27735.0	27779.0	5898.0	12162.0
424A	FIR-SPR	3	2	1.6	1.6	434.0	141232.0	27944.0	27900.0	27944.0	5949.0	12264.0
107	CONIFER	1	3	1.6	1.6	484.0	168432.0	32294.0	32250.0	32294.0	7399.0	15014.0
310B	DF	2	3	1.6	1.6	485.0	168723.0	32360.0	32316.0	32360.0	7419.0	15054.0
516B	FIR-SPR	3	2	1.6	1.6	487.0	169221.0	32470.0	32426.0	32470.0	7453.0	15124.0
614A	DF	2	2	1.6	1.6	547.0	181581.0	34990.0	34946.0	34990.0	8173.0	16684.0

TABLE C2 (CONT'D.)

617	FIR-SPR	1	2	1.6	1.6	549.0	182037.0	35092.0	35048.0	35092.0	8205.0	16748.0
517	PP	1	3	1.6	1.6	596.0	207605.0	39181.0	39137.0	39181.0	9474.0	19239.0
106	CONIFER	2	1	1.5	1.5	604.0	210069.0	39757.0	39713.0	39757.0	9674.0	19623.0
215A	LODGEPO	2	2	1.5	1.5	610.0	211815.0	40153.0	40109.0	40153.0	9800.0	19881.0
303B	FIR-SPR	2	3	1.5	1.5	611.0	212106.0	40219.0	40175.0	40219.0	9822.0	19926.0
618B	FIR-SPR	3	2	1.5	1.5	615.0	213146.0	40407.0	40363.0	40407.0	9886.0	20054.0
101	CONIFER	1	1	1.4	1.4	676.0	249258.0	47605.0	47561.0	47605.0	12570.0	25178.0
213	FIR-SPR	2	2	1.4	1.4	699.0	256779.0	49353.0	49309.0	49353.0	13168.0	26420.0
310C	DF	3	3	1.4	1.4	709.0	259269.0	49903.0	49859.0	49903.0	13368.0	26820.0
601	PP	1	3	1.4	1.4	714.0	261989.0	50338.0	50294.0	50338.0	13523.0	27130.0
105	CONIFER	1	1	1.3	1.3	731.0	271169.0	52106.0	52062.0	52106.0	14237.0	28490.0
115	LODGEPO	1	1	1.3	1.3	742.0	277681.0	53404.0	53360.0	53404.0	14787.0	29524.0
116	LODGEPO	2	1	1.3	1.3	756.0	280999.0	54244.0	54200.0	54244.0	15137.0	30196.0
309B	PP	2	2	1.3	2.5	757.0	281290.0	54310.0	54233.0	54310.0	15149.0	30222.0
421B	PP	2	2	1.3	2.5	760.0	282163.0	54508.0	54332.0	54508.0	15185.0	30300.0
618A	FIR-SPR	2	2	1.3	1.3	762.0	282575.0	54592.0	54416.0	54592.0	15217.0	30364.0
523	FIR-SPR	1	3	1.3	1.3	771.0	287471.0	55375.0	55199.0	55375.0	15532.0	30985.0
108	CONIFER	2	3	1.2	1.2	851.0	310751.0	60655.0	60479.0	60655.0	17852.0	35385.0
301A	PP	1	3	1.2	2.5	852.0	311295.0	60742.0	60522.0	60742.0	17869.0	35420.0
303C	FIR-SPR	3	3	1.2	1.2	856.0	312291.0	60962.0	60742.0	60962.0	17957.0	35600.0
427A	DF	2	3	1.2	1.2	859.0	313164.0	61160.0	60940.0	61160.0	18041.0	35768.0
518	PP	2	3	1.2	1.2	941.0	337026.0	66572.0	66352.0	66572.0	20255.0	40114.0
602A	PP	2	3	1.1	1.1	966.0	344301.0	68222.0	68002.0	68222.0	21030.0	41664.0
102	SPR-FIR	2	1	1.0	1.0	1060.0	377389.0	76212.0	75992.0	76212.0	25166.0	49560.0
422A	PP	3	2	1.0	2.1	1066.0	378883.0	76542.0	76157.0	76542.0	25238.0	49716.0
109	CONIFER	3	3	1.0	1.0	1141.0	397558.0	80667.0	80282.0	80667.0	27413.0	53841.0
209B	PP	2	3	1.0	1.0	1153.0	401050.0	81459.0	81074.0	81459.0	27797.0	54633.0
416B	FIR-SPR	2	3	1.0	1.0	1156.0	401923.0	81657.0	81272.0	81657.0	27893.0	54822.0
501	PP	1	1	1.0	1.0	1179.0	415539.0	84371.0	83986.0	84371.0	29342.0	57674.0
506C	DF	2	1	1.0	1.0	1216.0	437702.0	88811.0	88426.0	88811.0	31673.0	62262.0
612A	DF	2	1	1.0	1.0	1238.0	450880.0	91451.0	91066.0	91451.0	33081.0	65012.0
519	PP	3	3	1.0	1.0	1288.0	463330.0	94201.0	93816.0	94201.0	34431.0	67662.0
524A	FIR-SPR	2	3	1.0	1.0	1291.0	464203.0	94399.0	94014.0	94399.0	34536.0	67869.0
401A	LODGEPO	1	1	.9	.9	1292.0	464705.0	94517.0	94132.0	94517.0	34602.0	67998.0
407A	PP	1	1	.9	.9	1294.0	465889.0	94753.0	94368.0	94753.0	34734.0	68256.0
429A	DF	1	1	.9	.9	1295.0	466481.0	94871.0	94486.0	94871.0	34804.0	68393.0
216	PP	2	2	.9	1.9	1307.0	469973.0	95663.0	94882.0	95663.0	35008.0	68813.0
301B	PP	2	3	.9	1.9	1314.0	472010.0	96125.0	95113.0	96125.0	35127.0	69058.0
410A	PP	1	3	.9	1.8	1316.0	473098.0	96299.0	95199.0	96299.0	35175.0	69154.0

TABLE C2 (CONT'D.)

502B	PP	2	1	.9	.9	1337.0	482905.0	98609.0	97509.0	98609.0	36498.0	71758.0
603	PP	1	1	.9	.9	1339.0	484089.0	98845.0	97745.0	98845.0	36636.0	72028.0
602B	PP	3	3	.9	.9	1377.0	493551.0	100935.0	99835.0	100935.0	37814.0	74384.0
413A	FIR-SPR	1	1	.8	.8	1378.0	494143.0	101053.0	99953.0	101053.0	37885.0	74523.0
217	PP	3	2	.8	1.6	1397.0	498674.0	102098.0	100475.5	102098.0	38208.0	75188.0
301C	PP	3	3	.8	1.6	1575.0	543196.0	111688.0	105370.5	111688.0	41234.0	81418.0
505	DF	1	1	.8	.8	1589.0	548446.0	113274.0	106756.5	113274.0	42116.0	83154.0
606A	PP	2	1	.8	.8	1594.0	550781.0	113824.0	107306.5	113824.0	42461.0	83829.0
609	DF	1	1	.8	.8	1613.0	557906.0	115705.0	109187.5	115705.0	43677.0	86204.0
521	DF	1	3	.8	.8	1621.0	559730.0	116113.0	109595.5	116113.0	43925.0	86692.0
103	CONIFER	3	1	.7	.7	1654.0	568475.0	118093.0	111575.5	118093.0	45377.0	89464.0
304B	PP	2	1	.7	.7	1655.0	568827.0	118178.0	111660.5	118178.0	45438.0	89584.0
306F	DF	2	1	.7	.7	1657.0	569531.0	118348.0	111830.5	118348.0	45560.0	89824.0
401B	LODGEPO	2	1	.7	.7	1665.0	572347.0	119028.0	112510.5	119028.0	46088.0	90856.0
407B	PP	2	1	.7	.7	1671.0	574459.0	119538.0	113020.5	119538.0	46484.0	91630.0
410B	PP	2	3	.7	1.4	1681.0	577369.0	120198.0	113350.5	120198.0	46724.0	92110.0
502	PP	2	1	.7	.7	1712.0	588281.0	122833.0	115985.5	122833.0	48677.0	95954.0
619	FIR-SPR	1	1	.7	.7	1716.0	589781.0	123229.0	116381.5	123229.0	48973.0	96534.0
522A	DF	2	3	.7	.7	1731.0	592871.0	123859.0	117011.5	123859.0	49438.0	97449.0
607	DF	1	3	.7	.7	1802.0	609059.0	127480.0	120632.5	127480.0	51994.0	102561.0
608B	DF	3	3	.7	.7	1854.0	622579.0	129924.0	123076.5	129924.0	53866.0	106305.0
201H	LODGEPO	2	1	.6	.6	1860.0	624691.0	130434.0	123586.5	130434.0	54286.0	107157.0
203D	DF	2	1	.6	.6	1869.0	627859.0	131199.0	124351.5	131199.0	54871.0	108345.0
205B	PP	2	1	.6	.6	1901.0	639123.0	133919.0	127071.5	133919.0	57047.0	112761.0
306H	FIR-SPR	2	1	.6	.6	1903.0	639827.0	134089.0	127241.5	134089.0	57185.0	113031.0
413B	FIR-SPR	2	1	.6	.6	1906.0	640883.0	134344.0	127496.5	134344.0	57398.0	113448.0
429B	DF	2	1	.6	.6	1911.0	642643.0	134769.0	127921.5	134769.0	57748.0	114133.0
411	PP	3	3	.6	1.1	1927.0	646627.0	135649.0	128361.5	135649.0	58132.0	114901.0
503B	PP	3	1	.6	.6	1956.0	656371.0	137911.0	130623.5	137911.0	59959.0	118497.0
508A	FIR-SPR	2	1	.6	.6	1960.0	657779.0	138251.0	130963.5	138251.0	60243.0	119053.0
604A	PP	2	1	.6	.6	1968.0	660595.0	138931.0	131643.5	138931.0	60795.0	120133.0
606B	PP	3	1	.6	.6	1981.0	664963.0	139945.0	132657.5	139945.0	61692.0	121888.0
612B	DF	3	1	.6	.6	2002.0	672691.0	141478.0	134190.5	141478.0	63036.0	124513.0
608A	DF	2	3	.6	.6	2051.0	682785.0	143536.0	136248.5	143536.0	64800.0	128041.0
621	FIR-SPR	1	3	.6	.6	2058.0	684381.0	143893.0	136605.5	143893.0	65094.0	128615.0
821	SHL-LOB	1	3	.6	6.0	2065.0	689449.0	145062.0	136724.5	145062.0	65192.0	128811.0
828	RED-EWP	1	3	.6	1.5	2116.0	726373.0	153579.0	137591.5	147204.0	65906.0	130239.0
203B	FIR-SPR	2	1	.5	.5	2139.0	734469.0	155534.0	139546.5	149159.0	67746.0	133965.0
203E	DF	3	1	.5	.5	2147.0	736589.0	156014.0	140026.5	149639.0	68266.0	135021.0

TABLE C2 (CONT'D.)

304C	PP	3	1	.5	.5	2182.0	745864.0	158114.0	142126.5	151739.0	70401.0	139221.0
306G	DF	3	1	.5	.5	2193.0	748779.0	158774.0	142786.5	152399.0	71072.0	140541.0
402	LODGEPO	3	1	.5	.5	2214.0	754344.0	160034.0	144046.5	153659.0	72458.0	143250.0
408	PP	3	1	.5	.5	2224.0	756994.0	160634.0	144646.5	154259.0	73118.0	144540.0
503	PP	3	1	.5	.5	2267.0	768389.0	163214.0	147226.5	156839.0	75827.0	149872.0
506A	DF	2	1	.5	.5	2322.0	782194.0	166624.0	150636.5	160249.0	79292.0	156692.0
610A	DF	2	1	.5	.5	2354.0	790226.0	168608.0	152620.5	162233.0	81340.0	160692.0
622A	FIR-SPR	2	3	.5	.5	2372.0	793934.0	169364.0	153376.5	162989.0	82096.0	162168.0
809	LONG-SL	1	3	.5	4.7	2372.0	793934.0	169364.0	153376.5	162989.0	82096.0	162168.0
104	CONIFER	4	1	.4	.4	2388.0	796126.0	169908.0	153920.5	163533.0	82800.0	163512.0
202A	LODGEPO	3	1	.4	.4	2467.0	817061.0	174648.0	158660.5	168273.0	88330.0	174730.0
204A	FIR-SPR	3	1	.4	.4	2506.0	827396.0	176988.0	161000.5	170613.0	91450.0	181048.0
205C	PP	3	1	.4	.4	2567.0	843561.0	180648.0	164660.5	174273.0	95598.0	189466.0
306C	FIR-SPR	3	1	.4	.4	2576.0	845946.0	181188.0	165200.5	174813.0	96219.0	190681.0
414	FIR-SPR	3	1	.4	.4	2586.0	848596.0	181788.0	165800.5	175413.0	96929.0	192071.0
430A	DF	3	1	.4	.4	2599.0	852041.0	182568.0	166580.5	176193.0	97839.0	193852.0
507	FIR-SPR	1	1	.4	.4	2605.0	855593.0	183276.0	167288.5	176901.0	98265.0	194686.0
508B	FIR-SPR	3	1	.4	.4	2607.0	856123.0	183396.0	167408.5	177021.0	98407.0	194964.0
604B	PP	3	1	.4	.4	2626.0	861158.0	184536.0	168548.5	178161.0	99718.0	197529.0
620A	FIR-SPR	2	1	.4	.4	2631.0	862413.0	184846.0	168858.5	178471.0	100088.0	198254.0
817	SHL-LOB	1	2	.4	3.9	2645.0	872549.0	187184.0	169096.5	180809.0	100362.0	198856.0
830	RED-EWP	1	2	.4	1.0	2661.0	884133.0	189856.0	169368.5	181481.0	100718.0	199544.0
810	LONG-SL	2	3	.4	3.9	2662.0	884609.0	189966.0	169379.5	181591.0	100732.0	199572.0
822	SHL-LOB	2	3	.4	4.1	2698.0	903509.0	194142.0	169811.5	185767.0	101236.0	200580.0
203F	DF	4	1	.3	.3	2704.0	904331.0	194346.0	170015.5	185971.0	101626.0	201372.0
305C	PP	4	1	.3	.3	2822.0	920497.0	198358.0	174027.5	189983.0	108824.0	215532.0
306D	FIR-SPR	4	1	.3	.3	2827.0	921182.0	198528.0	174197.5	190153.0	109169.0	216207.0
306H	DF	4	1	.3	.3	2842.0	923237.0	199038.0	174707.5	190663.0	110084.0	218007.0
403	LODGEPO	4	1	.3	.3	2856.0	925155.0	199514.0	175183.5	191139.0	111008.0	219813.0
409	PP	4	1	.3	.3	2861.0	925840.0	199684.0	175353.5	191309.0	111338.0	220458.0
504	PP	4	1	.3	.3	2869.0	926936.0	199956.0	175625.5	191581.0	111842.0	221450.0
805	LONG-SL	1	2	.3	3.0	2869.0	926936.0	199956.0	175625.5	191581.0	111842.0	221450.0
806	LONG-SL	2	2	.3	2.6	2874.0	929316.0	200506.0	175680.5	192131.0	111947.0	221665.0
818	SHL-LOB	2	2	.3	2.7	2902.0	944016.0	203754.0	176016.5	195379.0	112535.0	222869.0
811	LONG-SL	3	3	.3	2.6	2903.0	944349.0	203827.0	176023.5	195452.0	112549.0	222897.0
906	RED-EWP	2	2	.3	1.3	2996.0	993174.0	214615.0	177139.5	198149.0	114130.0	226152.0
911	SHL-LOB	2	3	.3	.8	3009.0	999999.0	216123.0	177295.5	198526.0	114377.0	226646.0
202B	LODGEPO	4	1	.2	.2	3014.0	1000684.0	216293.0	177465.5	198696.0	114727.0	227356.0
204B	FIR-SPR	4	1	.2	.2	3068.0	1008082.0	218129.0	179301.5	200532.0	119047.0	236104.0

TABLE C2 (CONT'D.)

205D	PP	4	1	.2	.2	3086.0	1010548.0	218741.0	179913.5	201144.0	120271.0	238588.0
415	FIR-SPR	4	1	.2	.2	3096.0	1011918.0	219081.0	180253.5	201484.0	120981.0	239978.0
430B	DF	4	1	.2	.2	3107.0	1013425.0	219455.0	180627.5	201656.0	121751.0	241465.0
610B	DF	3	1	.2	.2	3138.0	1016649.0	220354.0	181526.5	202757.0	123735.0	245360.0
620B	FIR-SPR	3	1	.2	.2	3143.0	1017169.0	220499.0	181671.5	202902.0	124105.0	246085.0
825	RED-EWP	1	1	.2	.4	3190.0	1048142.0	227972.0	182423.5	204688.0	126643.0	251067.0
807	LONG-SL	3	2	.2	1.7	3194.0	1049474.0	228264.0	182451.5	204980.0	126727.0	251239.0
823	SHL-LOB	3	3	.2	.2	3210.0	1054210.0	229320.0	182547.5	205076.0	126951.0	251687.0
829	RED-EWP	3	3	.2	.6	3214.0	1055394.0	229584.0	182575.5	205140.0	127007.0	251799.0
901	RED-EWP	1	1	.2	.4	3230.0	1065938.0	232128.0	182831.5	205780.0	127807.0	253383.0
908	RED-EWP	3	2	.2	.5	3350.0	1101458.0	240048.0	183671.5	207700.0	129847.0	257583.0
910	SHL-LOB	3	2	.2	.5	3390.0	1113298.0	242688.0	183951.5	208340.0	130527.0	258983.0
905	RED-EWP	3	3	.2	.4	3441.0	1128394.0	246054.0	184308.5	209156.0	131496.0	260921.0
801	LONG-SL	1	1	.1	1.2	3441.0	1128394.0	246054.0	184308.5	209156.0	131496.0	260921.0
802	LONG-SL	2	1	.1	1.0	3469.0	1141666.0	249246.0	184616.5	212348.0	133190.0	264183.0
803	LONG-SL	3	1	.1	.8	3499.0	1151536.0	251976.0	184686.5	215078.0	135005.0	267678.0
813	SHL-LOB	1	1	.1	1.4	3510.0	1158785.0	253725.0	185062.5	216827.0	135670.5	268959.5
814	SHL-LOB	2	1	.1	1.0	3556.0	1180129.0	258831.0	185522.5	221933.0	138453.5	274318.5
815	SHL-LOB	3	1	.1	.3	3901.0	1276039.0	281256.0	187592.5	233318.0	159326.0	314511.0
826	RED-EWP	2	1	.1	.2	3909.0	1279751.0	282144.0	187680.5	233542.0	159758.0	315359.0
827	RED-EWP	3	1	.1	.1	3913.0	1280863.0	282404.0	187704.5	233606.0	159974.0	315783.0
808	LONG-SL	4	2	.1	.8	3914.0	1281039.0	282438.0	187707.9	233640.0	159995.0	315826.0
819	SHL-LOB	3	2	.1	.1	3953.0	1292583.0	285012.0	187941.9	233874.0	160814.0	317503.0
812	LONG-SL	4	3	.1	1.2	3953.0	1292583.0	285012.0	187941.9	233874.0	160814.0	317503.0
824	SHL-LOB	4	3	.1	1.4	3954.0	1292759.0	285051.0	187945.9	233911.0	160828.0	317531.0
902	RED-EWP	2	1	.1	.3	3990.0	1309463.0	289047.0	188345.5	234919.0	162628.0	321095.0
903	RED-EWP	3	1	.1	.2	4106.0	1341711.0	296587.0	189041.5	236775.0	168428.0	332579.0
909	SHL-LOB	3	1	.1	.2	4144.0	1352275.0	299057.0	189269.5	237383.0	170062.0	335771.0
912	OTHER	3	1	.1	.2	4197.0	1367009.0	302502.0	189587.5	238231.0	172712.0	341018.0
125	LODGEPO	1	2	.0	2.9	4224.0	1381697.0	304851.0	189587.5	240580.0	173117.0	341828.0
126	LODGEPO	2	2	.0	2.2	4278.0	1397411.0	308415.0	189587.5	244144.0	173927.0	343448.0
127	LODGEPO	3	2	.0	1.8	4340.0	1412849.0	311825.0	189587.5	247554.0	174857.0	345308.0
117	LODGEPO	1	3	.0	1.7	4385.0	1437329.0	315740.0	189587.5	251469.0	176072.0	347648.0
118	LODGEPO	2	3	.0	1.3	4485.0	1466429.0	322340.0	189587.5	258069.0	178772.0	352848.0
804	LONG-SL	4	1	.0	.4	4504.0	1469716.0	323157.0	189663.5	258886.0	179921.5	355061.5
816	SHL-LOB	4	1	.0	.3	4512.0	1471036.0	323477.0	189695.5	259206.0	180405.5	355993.5

TABLE C3
NFS ACCESSIBLE BACKLOG TREATMENT OPPORTUNUTIES RANKED BY
INCREASE IN ALLOWABLE ANNUAL CUT, 30TH YEAR, PER DOLLAR OF TOTAL COST

LOCA-TION CODE	SPECIES	SITE	TREAT-MENT CODE	AAC INCREASE PER $ TOT.COST 10TH YEAR	AAC INCREASE PER $ TOT.COST 30TH YEAR	CUMULA-TIVE AREA	CUMULATIVE ANN.GROWTH SAWTIMBER	INCREASED POTENTIAL GRO. STK	CUMULATIVE AAC INCREASE 10TH YR	CUMULATIVE AAC INCREASE 30TH YR	CUMULATIVE PROGRAM COSTS DIRECT	CUMULATIVE PROGRAM COSTS TOTAL
				YEAR	YEAR	M ACRES	MMBF	MMCF	MMCF	MMCF	$MM	$MM
821	SHL-LOB	1	3	.6	6.0	7.0	5068.0	1169.0	119.0	1169.0	98.0	196.0
809	LONG-SL	1	3	.5	4.7	7.0	5068.0	1169.0	119.0	1169.0	98.0	196.0
822	SHL-LOB	2	3	.4	4.1	43.0	23968.0	5345.0	551.0	5345.0	602.0	1204.0
817	SHL-LOB	1	2	.4	3.9	57.0	34104.0	7683.0	789.0	7683.0	896.0	1806.0
810	LONG-SL	2	3	.4	3.9	58.0	34580.0	7793.0	800.0	7793.0	910.0	1834.0
421A	PP	1	2	1.7	3.3	59.0	35124.0	7880.0	843.0	7880.0	922.0	1860.0
615	PP	1	2	3.3	3.3	61.0	36212.0	8054.0	1017.0	8054.0	946.0	1912.0
509	PP	1	2	3.2	3.2	116.0	66132.0	12839.0	5802.0	12839.0	1661.0	3397.0
805	LONG-SL	1	2	.3	3.0	116.0	66132.0	12839.0	5802.0	12839.0	1661.0	3397.0
125	LODGEPO	1	2	.0	2.9	143.0	60820.0	15188.0	5802.0	15188.0	2066.0	4207.0
129	CONIFER	1	2	2.0	2.9	171.0	96052.0	17624.0	8238.0	17624.0	2486.0	5047.0
818	SHL-LOB	2	2	.3	2.7	199.0	110752.0	20872.0	8574.0	20872.0	3074.0	6251.0
806	LONG-SL	2	2	.3	2.6	204.0	113132.0	21422.0	8629.0	21422.0	3179.0	6466.0
811	LONG-SL	3	3	.3	2.6	205.0	113465.0	21495.0	8636.0	21495.0	3193.0	6494.0
309B	PP	2	2	1.3	2.5	206.0	113756.0	21561.0	8669.0	21561.0	3205.0	6520.0
421B	PP	2	2	1.3	2.5	209.0	114629.0	21759.0	8768.0	21759.0	3241.0	6598.0
301A	PP	1	3	1.2	2.5	210.0	115173.0	21846.0	8811.0	21846.0	3258.0	6633.0
515	FIR-SPR	1	2	2.5	2.5	219.0	120069.0	22629.0	9594.0	22629.0	3411.0	6948.0
616A	PP	2	2	2.5	2.5	225.0	121815.0	23025.0	9990.0	23025.0	3483.0	7104.0
307B	DF	2	2	2.4	2.4	227.0	122397.0	23157.0	10122.0	23157.0	3509.0	7158.0
419B	DF	2	2	2.4	2.4	229.0	122979.0	23289.0	10254.0	23289.0	3535.0	7212.0
425B	LODGEPO	2	2	2.4	2.4	232.0	123852.0	23487.0	10452.0	23487.0	3574.0	7293.0
510	PP	2	2	2.4	2.4	290.0	140730.0	27315.0	14280.0	27315.0	4328.0	8859.0
126	LODGEPO	2	2	.0	2.2	344.0	156444.0	30879.0	14280.0	30879.0	5138.0	10479.0
130	CONIFER	2	2	2.2	2.2	399.0	172449.0	34509.0	17910.0	34509.0	5963.0	12129.0
308B	FIR-SPR	2	2	2.1	2.1	400.0	172740.0	34575.0	17976.0	34575.0	5979.0	12161.0
422A	PP	3	2	1.0	2.1	406.0	174234.0	34905.0	18141.0	34905.0	6051.0	12317.0
616B	PP	3	2	2.1	2.1	415.0	176475.0	35400.0	18636.0	35400.0	6159.0	12551.0
307C	DF	3	2	2.0	2.0	419.0	177471.0	35620.0	18856.0	35620.0	6211.0	12659.0
420A	DF	3	2	2.0	2.0	423.0	178467.0	35840.0	19076.0	35840.0	6263.0	12767.0

TABLE C3 (CONT'D.)

426A	LODGEPO	3	2	2.0	2.0	431.0	180459.0	36280.0	19516.0	36280.0	6367.0	12983.0
511	PP	3	2	2.0	2.0	453.0	185937.0	37490.0	20726.0	37490.0	6653.0	13577.0
613	DF	1	2	2.0	2.0	499.0	196425.0	39836.0	23072.0	39836.0	7205.0	14773.0
216	PP	2	2	.9	1.9	511.0	199917.0	40628.0	23468.0	40628.0	7409.0	15193.0
423B	FIR-SPR	2	2	1.9	1.9	512.0	200208.0	40694.0	23534.0	40694.0	7426.0	15227.0
301B	PP	2	3	.9	1.9	519.0	202245.0	41156.0	23765.0	41156.0	7545.0	15472.0
516A	FIR-SPR	2	2	1.9	1.9	525.0	203991.0	41552.0	24161.0	41552.0	7647.0	15682.0
127	LODGEPO	3	2	.0	1.8	587.0	219429.0	44962.0	24161.0	44962.0	8577.0	17542.0
131	CONIFER	3	2	1.8	1.8	653.0	235863.0	48592.0	27791.0	48592.0	9567.0	19522.0
410A	PP	1	3	.9	1.8	655.0	236951.0	48766.0	27877.0	48766.0	9615.0	19618.0
513	DF	1	2	1.8	1.8	663.0	238775.0	49174.0	28285.0	49174.0	9727.0	19842.0
614B	DF	3	2	1.8	1.8	695.0	247095.0	50678.0	29789.0	50678.0	10111.0	20674.0
308C	FIR-SPR	3	2	1.7	1.7	697.0	247593.0	50788.0	29899.0	50788.0	10143.0	20738.0
117	LODGEPO	1	3	.0	1.7	742.0	272073.0	54703.0	29899.0	54703.0	11358.0	23078.0
404A	LODGEPO	1	3	1.7	1.7	743.0	272617.0	54790.0	29986.0	54790.0	11383.0	23129.0
807	LONG-SL	3	2	.2	1.7	747.0	273949.0	55082.0	30014.0	55082.0	11467.0	23301.0
217	PP	3	2	.8	1.6	766.0	278680.0	56127.0	30536.5	56127.0	11790.0	23966.0
424A	FIR-SPR	3	2	1.6	1.6	769.0	279427.0	56292.0	30701.5	56292.0	11841.0	24068.0
107	CONIFER	1	3	1.6	1.6	819.0	306627.0	60642.0	35051.5	60642.0	13291.0	26818.0
301C	PP	3	3	.8	1.6	997.0	350949.0	70432.0	39946.5	70432.0	16317.0	33048.0
310B	DF	2	3	1.6	1.6	998.0	351240.0	70498.0	40012.5	70498.0	16337.0	33088.0
516B	FIR-SPR	3	2	1.6	1.6	1000.0	351738.0	70608.0	40122.5	70608.0	16371.0	33158.0
614A	DF	2	2	1.6	1.6	1060.0	364098.0	73128.0	42642.5	73128.0	17091.0	34718.0
617	FIR-SPR	1	2	1.6	1.6	1062.0	364554.0	73230.0	42744.5	73230.0	17123.0	34782.0
517	PP	1	3	1.6	1.6	1109.0	390122.0	77319.0	46833.5	77319.0	18392.0	37273.0
106	CONIFER	2	1	1.5	1.5	1117.0	392586.0	77895.0	47409.5	77895.0	18592.0	37657.0
215A	LODGEPO	2	2	1.5	1.5	1123.0	394332.0	78291.0	47805.5	78291.0	18718.0	37915.0
303B	FIR-SPR	2	3	1.5	1.5	1124.0	394623.0	78357.0	47871.5	78357.0	18740.0	37960.0
618B	FIR-SPR	3	2	1.5	1.5	1128.0	395663.0	78545.0	48059.5	78545.0	18804.0	38088.0
828	RED-EWP	1	3	.6	1.5	1179.0	432587.0	87062.0	48926.5	80687.0	19516.0	39516.0
101	CONIFER	1	1	1.4	1.4	1240.0	468699.0	94260.0	56124.5	87885.0	22202.0	44640.0
213	FIR-SPR	2	2	1.4	1.4	1263.0	476220.0	96008.0	57872.5	89633.0	22800.0	45862.0
310C	DF	3	3	1.4	1.4	1273.0	478710.0	96558.0	58422.5	90183.0	23000.0	46282.0
410B	PP	2	3	.7	1.4	1283.0	481620.0	97218.0	58752.5	90843.0	23240.0	46762.0
601	PP	1	3	1.4	1.4	1288.0	484340.0	97653.0	59187.5	91278.0	23395.0	47072.0
813	SHL-LOB	1	1	.1	1.4	1299.0	491589.0	99402.0	59363.5	93027.0	24060.5	48353.5
824	SHL-LOB	4	3	.1	1.4	1300.0	491765.0	99441.0	59367.5	93064.0	24074.5	48381.5
105	CONIFER	1	1	1.3	1.3	1317.0	500945.0	101209.0	61135.5	94832.0	24788.5	49741.5
115	LODGEPO	1	1	1.3	1.3	1328.0	507457.0	102507.0	62433.5	96130.0	25338.5	50775.5

TABLE C3 (CONT'D.)

116	LODGEPO	2	1	1.3	1.3	1342.0	510775.0	103347.0	63273.5	96970.0	25688.5	51447.5
118	LODGEPO	2	3	.0	1.3	1442.0	539875.0	109947.0	63273.5	103570.0	28388.5	56647.5
618A	FIR-SPR	2	2	1.3	1.3	1444.0	540287.0	110031.0	63357.5	103654.0	28420.5	56711.5
523	FIR-SPR	1	3	1.3	1.3	1453.0	545183.0	110814.0	64140.5	104437.0	28735.5	57332.5
906	RED-EWP	2	2	.3	1.3	1546.0	594008.0	121602.0	65256.5	107134.0	30316.5	60587.5
108	CONIFER	2	3	1.2	1.2	1626.0	617288.0	126882.0	70536.5	112414.0	32636.5	64987.5
303C	FIR-SPR	3	3	1.2	1.2	1630.0	618284.0	127102.0	70756.5	112634.0	32724.5	65167.5
427A	DF	2	3	1.2	1.2	1633.0	619157.0	127300.0	70954.5	112832.0	32808.5	65335.5
518	PP	2	3	1.2	1.2	1715.0	643019.0	132712.0	76366.5	118244.0	35022.5	69681.5
801	LONG-SL	1	1	.1	1.2	1715.0	643019.0	132712.0	76366.5	118244.0	35022.5	69681.5
812	LONG-SL	4	3	.1	1.2	1715.0	643019.0	132712.0	76366.5	118244.0	35022.5	69681.5
411	PP	3	3	.6	1.1	1731.0	647003.0	133592.0	76806.5	119124.0	35406.5	70449.5
602A	PP	2	3	1.1	1.1	1756.0	654278.0	135242.0	78456.5	120774.0	36181.5	71999.5
102	SPR-FIR	2	1	1.0	1.0	1850.0	687366.0	143232.0	86446.5	128764.0	40317.5	79895.5
109	CONIFER	3	3	1.0	1.0	1925.0	706041.0	147357.0	90571.5	132889.0	42492.5	84020.5
209B	PP	2	3	1.0	1.0	1937.0	709533.0	148149.0	91363.5	133681.0	42876.5	84612.5
416B	FIR-SPR	2	3	1.0	1.0	1940.0	710406.0	148347.0	91561.5	133879.0	42972.5	85001.5
501	PP	1	1	1.0	1.0	1963.0	724022.0	151061.0	94275.5	136593.0	44421.5	87853.5
506C	DF	2	1	1.0	1.0	2000.0	746185.0	155501.0	98715.5	141033.0	46752.5	92441.5
612A	DF	2	1	1.0	1.0	2022.0	759363.0	158141.0	101355.5	143673.0	48160.5	95191.5
519	PP	3	3	1.0	1.0	2072.0	771813.0	160891.0	104105.5	146423.0	49510.5	97841.5
524A	FIR-SPR	2	3	1.0	1.0	2075.0	772686.0	161089.0	104303.5	146621.0	49615.5	98048.5
802	LONG-SL	2	1	.1	1.0	2103.0	785958.0	164281.0	104611.5	149813.0	51309.5	101310.5
814	SHL-LOB	2	1	.1	1.0	2149.0	807302.0	169387.0	105071.5	154919.0	54092.5	106669.5
830	RED-EWP	1	2	.4	1.0	2165.0	818886.0	172059.0	105343.5	155591.0	54428.5	107357.5
401A	LODGEPO	1	1	.9	.9	2166.0	819388.0	172177.0	105461.5	155709.0	54494.5	107486.5
407A	PP	1	1	.9	.9	2168.0	820572.0	172413.0	105697.5	155945.0	54626.5	107744.5
429A	DF	1	1	.9	.9	2169.0	821164.0	172531.0	105815.5	156063.0	54696.5	107881.5
502B	PP	2	1	.9	.9	2190.0	830971.0	174841.0	108125.5	158373.0	56019.5	110485.5
603	PP	1	1	.9	.9	2192.0	832155.0	175077.0	108361.5	158609.0	56157.5	110755.5
602B	PP	3	3	.9	.9	2230.0	841617.0	177167.0	110451.5	160699.0	57335.5	113111.5
413A	FIR-SPR	1	1	.8	.8	2231.0	842209.0	177285.0	110569.5	160817.0	57406.5	113250.5
505	DF	1	1	.8	.8	2245.0	847459.0	178671.0	111955.5	162203.0	58288.5	114986.5
606A	PP	2	1	.8	.8	2250.0	849794.0	179221.0	112505.5	162753.0	58633.5	115661.5
609	DF	1	1	.8	.8	2269.0	856919.0	181102.0	114386.5	164634.0	59849.5	118036.5
521	DF	1	3	.8	.8	2277.0	858743.0	181510.0	114794.5	165042.0	60097.5	118524.5
803	LONG-SL	3	1	.1	.8	2307.0	868613.0	184240.0	115064.5	167772.0	61912.5	122019.5
808	LONG-SL	4	2	.1	.8	2308.0	868789.0	184274.0	115067.9	167806.0	61933.5	122062.5
911	SHL-LOB	2	3	.3	.8	2321.0	875614.0	185782.0	115223.9	168183.0	62180.5	122556.5

TABLE C3 (CONT'D.)

103	CONIFER	3	1	.7	.7	2354.0	884359.0	187762.0	117203.9	170163.0	63632.5	125328.5
304B	PP	2	1	.7	.7	2355.0	884711.0	187847.0	117288.9	170248.0	63693.5	125448.5
306F	DF	2	1	.7	.7	2357.0	885415.0	188017.0	117458.9	170418.0	63815.5	125688.5
401B	LODGEPO	2	1	.7	.7	2365.0	888231.0	188697.0	118138.9	171098.0	64343.5	126720.5
407B	PP	2	1	.7	.7	2371.0	890343.0	189207.0	118648.9	171608.0	64739.5	127494.5
502	PP	2	1	.7	.7	2402.0	901255.0	191842.0	121283.9	174243.0	66692.5	131338.5
619	FIR-SPR	1	1	.7	.7	2406.0	902755.0	192238.0	121679.9	174639.0	66988.5	131918.5
522A	DF	2	3	.7	.7	2421.0	905845.0	192868.0	122309.9	175269.0	67453.5	132833.5
607	DF	1	3	.7	.7	2492.0	922033.0	196489.0	125930.9	178890.0	70009.5	137945.5
608B	DF	3	3	.7	.7	2544.0	935553.0	198933.0	128374.9	181334.0	71881.5	141689.5
201H	LODGEPO	2	1	.6	.6	2550.0	937665.0	199443.0	128884.9	181844.0	72301.5	142541.5
203D	DF	2	1	.6	.6	2559.0	940833.0	200208.0	129649.9	182609.0	72886.5	143729.5
205B	PP	2	1	.6	.6	2591.0	952097.0	202928.0	132369.9	185329.0	75062.5	148145.5
306B	FIR-SPR	2	1	.6	.6	2593.0	952801.0	203098.0	132539.9	185499.0	75200.5	148415.5
413B	FIR-SPR	2	1	.6	.6	2596.0	953857.0	203353.0	132794.9	185754.0	75413.5	148832.5
429B	DF	2	1	.6	.6	2601.0	955617.0	203778.0	133219.9	186179.0	75763.5	149517.5
503B	PP	3	1	.6	.6	2630.0	965361.0	206040.0	135481.9	188441.0	77590.5	153113.5
508A	FIR-SPR	2	1	.6	.6	2634.0	966769.0	206380.0	135821.9	188781.0	77874.5	153669.5
604A	PP	2	1	.6	.6	2642.0	969585.0	207060.0	136501.9	189461.0	78426.5	154749.5
606B	PP	3	1	.6	.6	2655.0	973953.0	208074.0	137515.9	190475.0	79323.5	156504.5
612B	DF	3	1	.6	.6	2676.0	981681.0	209607.0	139048.9	192008.0	80667.5	159129.5
608A	DF	2	3	.6	.6	2725.0	991775.0	211665.0	141106.9	194066.0	82431.5	162657.5
621	FIR-SPR	1	3	.6	.6	2732.0	993371.0	212022.0	141463.9	194423.0	82725.5	163231.5
829	RED-EWP	3	3	.2	.6	2736.0	994555.0	212286.0	141491.9	194487.0	82781.5	163343.5
203B	FIR-SPR	2	1	.5	.5	2759.0	1002651.0	214241.0	143446.9	196442.0	84621.5	167069.5
203E	DF	3	1	.5	.5	2767.0	1004771.0	214721.0	143926.9	196922.0	85141.5	168125.5
304C	PP	3	1	.5	.5	2802.0	1014046.0	216821.0	146026.9	199022.0	87276.5	172325.5
306G	DF	3	1	.5	.5	2813.0	1016961.0	217481.0	146686.9	199682.0	87947.5	173645.5
402	LODGEPO	3	1	.5	.5	2834.0	1022526.0	218741.0	147946.9	200942.0	89333.5	176354.5
408	PP	3	1	.5	.5	2844.0	1025176.0	219341.0	148546.9	201542.0	89993.5	177644.5
503	PP	3	1	.5	.5	2887.0	1036571.0	221921.0	151126.9	204122.0	92702.5	182976.5
506A	DF	2	1	.5	.5	2942.0	1050376.0	225331.0	154536.9	207532.0	96167.5	189796.5
610A	DF	2	1	.5	.5	2974.0	1058408.0	227315.0	156520.9	209516.0	98215.5	193796.5
622A	FIR-SPR	2	3	.5	.5	2992.0	1062116.0	228071.0	157276.9	210272.0	98971.5	195272.5
908	RED-EWP	3	2	.2	.5	3112.0	1097636.0	235991.0	158116.9	212192.0	101011.5	199472.5
910	SHL-LOB	3	2	.2	.5	3152.0	1109476.0	236631.0	158396.9	212832.0	101691.5	200872.5
104	CONIFER	4	1	.4	.4	3168.0	1111668.0	239175.0	158940.9	213376.0	102395.5	202216.5
202A	LODGEPO	3	1	.4	.4	3247.0	1132603.0	243915.0	163680.9	218116.0	107925.5	213434.5
204A	FIR-SPR	3	1	.4	.4	3286.0	1142938.0	246255.0	166020.9	220456.0	111045.5	219752.5

TABLE C3 (CONT'D.)

205C	PP	3	1	.4	.4	3347.0	1159103.0	249915.0	169680.9	224116.0	115193.5	228170.5
306C	FIR-SPR	3	1	.4	.4	3356.0	1161488.0	250455.0	170220.9	224656.0	115814.5	229385.5
414	FIR-SPR	3	1	.4	.4	3366.0	1164138.0	251055.0	170820.9	225256.0	116524.5	230775.5
430A	DF	3	1	.4	.4	3379.0	1167583.0	251835.0	171600.9	226036.0	117434.5	232556.5
507	FIR-SPR	1	1	.4	.4	3385.0	1171135.0	252543.0	172308.9	226744.0	117860.5	233390.5
508B	FIR-SPR	3	1	.4	.4	3387.0	1171665.0	252663.0	172428.9	226864.0	118002.5	233668.5
604B	PP	3	1	.4	.4	3406.0	1176700.0	253803.0	173568.9	228004.0	119313.5	236233.5
620A	FIR-SPR	2	1	.4	.4	3411.0	1177955.0	254113.0	173878.9	228314.0	119683.5	236958.5
804	LONG-SL	4	1	.0	.4	3430.0	1181242.0	254930.0	173954.9	229131.0	120833.0	239172.0
825	RED-EWP	1	1	.2	.4	3477.0	1212215.0	262403.0	174706.9	230917.0	123371.0	244154.0
901	RED-EWP	1	1	.2	.4	3493.0	1222759.0	264947.0	174962.9	231557.0	124171.0	245738.0
905	RED-EWP	3	3	.2	.4	3544.0	1237655.0	268313.0	175319.9	232373.0	125140.0	247676.0
203F	DF	4	1	.3	.3	3550.0	1238677.0	268517.0	175523.9	232577.0	125530.0	248468.0
305C	PP	4	1	.3	.3	3668.0	1254843.0	272529.0	179535.9	236589.0	132728.0	262628.0
306D	FIR-SPR	4	1	.3	.3	3673.0	1255528.0	272699.0	179705.9	236759.0	133073.0	263303.0
306H	DF	4	1	.3	.3	3688.0	1257583.0	273209.0	180215.9	237269.0	133988.0	265103.0
403	LODGEPO	4	1	.3	.3	3702.0	1259501.0	273685.0	180691.9	237745.0	134912.0	266909.0
409	PP	4	1	.3	.3	3707.0	1260186.0	273855.0	180861.9	237915.0	135242.0	267554.0
504	PP	4	1	.3	.3	3715.0	1261282.0	274127.0	181133.9	238187.0	135746.0	268546.0
815	SHL-LOB	3	1	.1	.3	4060.0	1357192.0	296552.0	183203.9	249572.0	156618.5	308738.5
816	SHL-LOB	4	1	.0	.3	4068.0	1358512.0	296872.0	183235.9	249892.0	157102.5	309670.5
902	RED-EWP	2	1	.1	.3	4104.0	1375216.0	300868.0	183635.5	250900.0	158902.5	313234.5
202B	LODGEPO	4	1	.2	.2	4109.0	1375901.0	301038.0	183805.5	251070.0	159252.5	313944.5
204B	FIR-SPR	4	1	.2	.2	4163.0	1383299.0	302874.0	185641.5	252906.0	163572.5	322692.5
205D	PP	4	1	.2	.2	4181.0	1385765.0	303486.0	186253.5	253518.0	164796.5	325176.5
415	FIR-SPR	4	1	.2	.2	4191.0	1387135.0	303826.0	186593.5	253858.0	165506.5	326566.5
430B	DF	4	1	.2	.2	4202.0	1388642.0	304200.0	186967.5	254232.0	166276.5	328073.5
610B	DF	3	1	.2	.2	4233.0	1391866.0	305099.0	187866.5	255131.0	168260.5	331948.5
620B	FIR-SPR	3	1	.2	.2	4238.0	1392386.0	305244.0	188011.5	255276.0	168630.5	332673.5
826	RED-EWP	2	1	.1	.2	4246.0	1396098.0	306132.0	188099.5	255500.0	169062.5	333521.5
823	SHL-LOB	3	3	.2	.2	4262.0	1400834.0	307188.0	188195.5	255596.0	169286.5	333969.5
903	RED-EWP	3	1	.1	.2	4378.0	1433082.0	314726.0	188891.5	257452.0	175066.5	345453.5
909	SHL-LOB	3	1	.1	.2	4416.0	1443646.0	317198.0	189119.5	258060.0	176720.5	348645.5
912	OTHER	3	1	.1	.2	4469.0	1458380.0	320643.0	189437.5	258908.0	179370.5	353892.5
827	RED-EWP	3	1	.1	.1	4473.0	1459492.0	320903.0	189461.5	258972.0	179586.5	354316.5
819	SHL-LOB	3	2	.1	.1	4512.0	1471036.0	323477.0	189695.5	259206.0	180405.5	355993.5

TABLE C4

NFS ACCESSIBLE BACKLOG TREATMENT OPPORTUNUTIES RANKED BY
INCREASE IN GROWING STOCK MEAN ANNUAL INCREMENT PER DOLLAR OF TOTAL COST

LOCA-TION CODE	SPECIES	SITE	TREAT-MENT CODE	GROWTH INCR. PER $ TOT.COST		CUMULA-TIVE AREA	CUMULATIVE ANN.GROWTH SAWTIMBER	INCREASED POTENTIAL GRO. STK	CUMULATIVE AAC INCREASE 10TH YR	30TH YR	CUMULATIVE PROGRAM COSTS DIRECT	TOTAL
				BF/$	CF/$	M ACRES	MMBF	MMCF	MMCF	MMCF	$MM	$MM
821	SHL-LOB	1	3	25.9	6.0	7.0	5068.0	1169.0	119.0	1169.0	98.0	196.0
828	RED-EWP	1	3	25.9	6.0	58.0	41992.0	9686.0	986.0	3311.0	812.0	1624.0
809	LONG-SL	1	3	19.1	4.7	58.0	41992.0	9686.0	986.0	3311.0	812.0	1624.0
822	SHL-LOB	2	3	18.8	4.1	94.0	60892.0	13862.0	1418.0	7487.0	1316.0	2632.0
817	SHL-LOB	1	2	16.8	3.9	108.0	71028.0	16200.0	1656.0	9825.0	1610.0	3234.0
830	RED-EWP	1	2	16.8	3.9	124.0	82612.0	18872.0	1928.0	10497.0	1946.0	3922.0
810	LONG-SL	2	3	17.0	3.9	125.0	83088.0	18982.0	1939.0	10607.0	1960.0	3950.0
421A	PP	1	2	20.9	3.3	126.0	83632.0	19069.0	1982.0	10694.0	1972.0	3976.0
615	PP	1	2	20.9	3.3	128.0	84720.0	19243.0	2156.0	10868.0	1996.0	4028.0
906	RED-EWP	2	2	15.0	3.3	221.0	133545.0	30031.0	3272.0	13565.0	3577.0	7283.0
509	PP	1	2	20.1	3.2	276.0	163465.0	34816.0	8057.0	18350.0	4292.0	8768.0
911	SHL-LOB	2	3	13.8	3.1	289.0	170290.0	36324.0	8213.0	18727.0	4539.0	9262.0
805	LONG-SL	1	2	12.4	3.0	289.0	170290.0	36324.0	8213.0	18727.0	4539.0	9262.0
125	LODGEPO	1	2	18.1	2.9	316.0	184978.0	38673.0	8213.0	21076.0	4944.0	10072.0
129	CONIFER	1	2	18.1	2.9	344.0	200210.0	41109.0	10649.0	23512.0	5364.0	10912.0
818	SHL-LOB	2	2	12.2	2.7	372.0	214910.0	44357.0	10985.0	26760.0	5952.0	12116.0
806	LONG-SL	2	2	11.1	2.6	377.0	217290.0	44907.0	11040.0	27310.0	6057.0	12331.0
811	LONG-SL	3	3	11.9	2.6	378.0	217623.0	44980.0	11047.0	27383.0	6071.0	12359.0
309B	PP	2	2	11.2	2.5	379.0	217914.0	45046.0	11080.0	27449.0	6083.0	12385.0
421B	PP	2	2	11.2	2.5	382.0	218787.0	45244.0	11179.0	27647.0	6119.0	12463.0
301A	PP	1	3	15.5	2.5	383.0	219331.0	45331.0	11222.0	27734.0	6136.0	12498.0
515	FIR-SPR	1	2	15.5	2.5	392.0	224227.0	46114.0	12005.0	28517.0	6289.0	12813.0
616A	PP	2	2	11.2	2.5	398.0	225973.0	46510.0	12401.0	28913.0	6361.0	12969.0
307B	DF	2	2	10.8	2.4	400.0	226555.0	46642.0	12533.0	29045.0	6387.0	13023.0
419B	DF	2	2	10.8	2.4	402.0	227137.0	46774.0	12665.0	29177.0	6413.0	13077.0
425B	LODGEPO	2	2	10.8	2.4	405.0	228010.0	46972.0	12863.0	29375.0	6452.0	13158.0
510	PP	2	2	10.8	2.4	463.0	244888.0	50800.0	16691.0	33203.0	7206.0	14724.0
823	SHL-LOB	3	3	10.6	2.4	479.0	249624.0	51856.0	16787.0	33299.0	7430.0	15172.0
829	RED-EWP	3	3	10.6	2.4	483.0	250808.0	52120.0	16815.0	33363.0	7486.0	15284.0
126	LODGEPO	2	2	9.7	2.2	537.0	266522.0	55684.0	16815.0	36927.0	8296.0	16904.0

TABLE C4 (CONT'D.)

130	CONIFER	2	2	9.7	2.2	592.0	282527.0	59314.0	20445.0	40557.0	9121.0	18554.0
308B	FIR-SPR	2	2	9.1	2.1	593.0	282818.0	59380.0	20511.0	40623.0	9137.0	18586.0
422A	PP	3	2	9.6	2.1	599.0	284312.0	59710.0	20676.0	40953.0	9209.0	18742.0
616B	PP	3	2	9.6	2.1	608.0	286553.0	60205.0	21171.0	41448.0	9317.0	18976.0
307C	DF	3	2	9.2	2.0	612.0	287549.0	60425.0	21391.0	41668.0	9369.0	19084.0
420A	DF	3	2	9.2	2.0	616.0	288545.0	60645.0	21611.0	41888.0	9421.0	19192.0
426A	LODGEPO	3	2	9.2	2.0	624.0	290537.0	61085.0	22051.0	42328.0	9525.0	19408.0
511	PP	3	2	9.2	2.0	646.0	296015.0	62295.0	23261.0	43538.0	9811.0	20002.0
613	DF	1	2	8.8	2.0	692.0	306503.0	64641.0	25607.0	45884.0	10363.0	21198.0
216	PP	2	2	8.3	1.9	704.0	309995.0	65433.0	26003.0	46676.0	10567.0	21618.0
423B	FIR-SPR	2	2	8.6	1.9	705.0	310286.0	65499.0	26069.0	46742.0	10584.0	21652.0
301B	PP	2	3	8.3	1.9	712.0	312323.0	65961.0	26300.0	47204.0	10703.0	21897.0
516A	FIR-SPR	2	2	8.3	1.9	718.0	314069.0	66357.0	26696.0	47600.0	10805.0	22107.0
908	RED-EWP	3	2	8.5	1.9	838.0	349589.0	74277.0	27536.0	49520.0	12845.0	26307.0
910	SHL-LOB	3	2	8.5	1.9	878.0	361429.0	76917.0	27816.0	50160.0	13525.0	27707.0
127	LODGEPO	3	2	8.3	1.8	940.0	376867.0	80327.0	27816.0	53570.0	14455.0	29567.0
131	CONIFER	3	2	8.3	1.8	1006.0	393301.0	83957.0	31446.0	57200.0	15445.0	31547.0
410A	PP	1	3	11.3	1.8	1008.0	394389.0	84131.0	31532.0	57374.0	15493.0	31643.0
513	DF	1	2	8.1	1.8	1016.0	396213.0	84539.0	31940.0	57782.0	15605.0	31867.0
614B	DF	3	2	10.0	1.8	1048.0	404533.0	86043.0	33444.0	59286.0	15989.0	32699.0
308C	FIR-SPR	3	2	7.8	1.7	1050.0	405031.0	86153.0	33554.0	59396.0	16021.0	32763.0
117	LODGEPO	1	3	10.5	1.7	1095.0	429511.0	90068.0	33554.0	63311.0	17236.0	35103.0
404A	LODGEPO	1	3	10.7	1.7	1096.0	430055.0	90155.0	33641.0	63398.0	17261.0	35154.0
807	LONG-SL	3	2	7.7	1.7	1100.0	431387.0	90447.0	33669.0	63690.0	17345.0	35326.0
905	RED-EWP	3	3	7.8	1.7	1151.0	446483.0	93813.0	34026.0	64506.0	18314.0	37264.0
217	PP	3	2	7.1	1.6	1170.0	451214.0	94858.0	34548.5	65551.0	18637.0	37929.0
424A	FIR-SPR	3	2	7.3	1.6	1173.0	451961.0	95023.0	34713.5	65716.0	18688.0	38031.0
107	CONIFER	1	3	9.9	1.6	1223.0	479161.0	99373.0	39063.5	70066.0	20138.0	40781.0
301C	PP	3	3	7.1	1.6	1401.0	523483.0	109163.0	43958.5	79856.0	23164.0	47011.0
310B	DF	2	3	7.3	1.6	1402.0	523774.0	109229.0	44024.5	79922.0	23184.0	47051.0
516B	FIR-SPR	3	2	7.1	1.6	1404.0	524272.0	109339.0	44134.5	80032.0	23218.0	47121.0
614A	DF	2	2	7.9	1.6	1464.0	536632.0	111859.0	46654.5	82552.0	23938.0	48681.0
617	FIR-SPR	1	2	7.1	1.6	1466.0	537088.0	111961.0	46756.5	82654.0	23970.0	48745.0
517	PP	1	3	10.3	1.6	1513.0	562656.0	116050.0	50845.5	86743.0	25239.0	51236.0
901	RED-EWP	1	1	6.7	1.6	1529.0	573200.0	118594.0	51101.5	87383.0	26039.0	52820.0
106	CONIFER	2	1	6.4	1.5	1537.0	575664.0	119170.0	51677.5	87959.0	26239.0	53204.0
215A	LODGEPO	2	2	6.8	1.5	1543.0	577410.0	119566.0	52073.5	88355.0	26365.0	53462.0
303B	FIR-SPR	2	3	6.5	1.5	1544.0	577701.0	119632.0	52139.5	88421.0	26387.0	53507.0
618B	FIR-SPR	3	2	8.1	1.5	1548.0	578741.0	119820.0	52327.5	88609.0	26451.0	53635.0

TABLE C4 (CONT'D.)

825	RED-EWP	1	1	6.2	1.5	1595.0	609714.0	127293.0	53079.5	90395.0	28989.0	58617.0
819	SHL-LOB	3	2	6.9	1.5	1634.0	621258.0	129867.0	53313.5	90629.0	29808.0	60294.0
101	CONIFER	1	1	7.8	1.4	1695.0	657370.0	137065.0	60511.5	97827.0	32492.0	65418.0
213	FIR-SPR	2	2	6.1	1.4	1718.0	664891.0	138813.0	62259.5	99575.0	33090.0	66660.0
310C	DF	3	3	6.2	1.4	1728.0	667381.0	139363.0	62809.5	100125.0	33290.0	67060.0
410B	PP	2	3	6.1	1.4	1738.0	670291.0	140023.0	63139.5	100785.0	33530.0	67540.0
601	PP	1	3	8.8	1.4	1743.0	673011.0	140458.0	63574.5	101220.0	33685.0	67850.0
813	SHL-LOB	1	1	5.7	1.4	1754.0	680260.0	142207.0	63750.5	102969.0	34350.5	69131.5
824	SHL-LOB	4	3	6.3	1.4	1755.0	680436.0	142246.0	63754.5	103006.0	34364.5	69159.5
105	CONIFER	1	1	6.7	1.3	1772.0	689616.0	144014.0	65522.5	104774.0	35078.5	70519.5
115	LODGEPO	1	1	6.3	1.3	1783.0	696128.0	145312.0	66820.5	106072.0	35628.5	71553.5
116	LODGEPO	2	1	4.9	1.3	1797.0	699446.0	146152.0	67660.5	106912.0	35978.5	72225.5
118	LODGEPO	2	3	5.6	1.3	1897.0	728546.0	152752.0	67660.5	113512.0	38678.5	77425.5
618A	FIR-SPR	2	2	6.4	1.3	1899.0	728958.0	152836.0	67744.5	113596.0	38710.5	77489.5
523	FIR-SPR	1	3	7.9	1.3	1908.0	733654.0	153619.0	68527.5	114379.0	39025.5	78110.5
108	CONIFER	2	3	5.3	1.2	1988.0	757134.0	158899.0	73807.5	119659.0	41345.5	82510.5
303C	FIR-SPR	3	3	5.5	1.2	1992.0	758130.0	159119.0	74027.5	119879.0	41433.5	82690.5
427A	DF	2	3	5.2	1.2	1995.0	759003.0	159317.0	74225.5	120077.0	41517.5	82858.5
518	PP	2	3	5.5	1.2	2077.0	782865.0	164729.0	79637.5	125489.0	43731.5	87204.5
801	LONG-SL	1	1	4.7	1.2	2077.0	782865.0	164729.0	79637.5	125489.0	43731.5	87204.5
812	LONG-SL	4	3	6.3	1.2	2077.0	782865.0	164729.0	79637.5	125489.0	43731.5	87204.5
411	PP	3	3	5.2	1.1	2093.0	786849.0	165609.0	80077.5	126369.0	44115.5	87972.5
602A	PP	2	3	4.7	1.1	2118.0	794124.0	167259.0	81727.5	128019.0	44890.5	89522.5
902	RED-EWP	2	1	4.7	1.1	2154.0	810828.0	171255.0	82127.1	129027.0	46690.5	93086.5
102	SPR-FIR	2	1	4.2	1.0	2248.0	843916.0	179245.0	90117.1	137017.0	50626.5	100982.5
109	CONIFER	3	3	4.5	1.0	2323.0	862591.0	183370.0	94242.1	141142.0	53001.5	105107.5
209B	PP	2	3	4.4	1.0	2335.0	866083.0	184162.0	95034.1	141934.0	53385.5	105899.5
416B	FIR-SPR	2	3	4.6	1.0	2338.0	866956.0	184360.0	95232.1	142132.0	53481.5	106088.5
501	PP	1	1	4.8	1.0	2361.0	880572.0	187074.0	97946.1	144846.0	54930.5	108940.5
506C	DF	2	1	4.8	1.0	2398.0	902735.0	191514.0	102386.1	149286.0	57261.5	113528.5
612A	DF	2	1	4.8	1.0	2420.0	915913.0	194154.0	105026.1	151926.0	58669.5	116278.5
519	PP	3	3	4.7	1.0	2470.0	928363.0	196904.0	107776.1	154676.0	60019.5	118928.5
524A	FIR-SPR	2	3	4.2	1.0	2473.0	929236.0	197102.0	107974.1	154874.0	60124.5	119135.5
802	LONG-SL	2	1	4.1	1.0	2501.0	942508.0	200294.0	108282.1	158066.0	61818.5	122397.5
814	SHL-LOB	2	1	4.0	1.0	2547.0	963852.0	205400.0	108742.1	163172.0	64601.5	127756.5
826	RED-EWP	2	1	4.4	1.0	2555.0	967564.0	206288.0	108830.1	163396.0	65033.5	128604.5
401A	LODGEPO	1	1	4.6	.9	2556.0	968066.0	206406.0	108948.1	163514.0	65099.5	128733.5
407A	PP	1	1	4.6	.9	2558.0	969250.0	206642.0	109184.1	163750.0	65231.5	128991.5
429A	DF	1	1	4.3	.9	2559.0	969842.0	206760.0	109302.1	163868.0	65301.5	129128.5

TABLE C4 (CONT'D.)

502B	PP	2	1	3.8	.9	2580.0	979649.0	209070.0	111612.1	166178.0	66624.5	131732.5
603	PP	1	1	4.4	.9	2582.0	980833.0	209306.0	111848.1	166414.0	66762.5	132002.5
602B	PP	3	3	4.0	.9	2620.0	990295.0	211396.0	113938.1	168504.0	67940.5	134358.5
413A	FIR-SPR	1	1	4.3	.8	2621.0	990687.0	211514.0	114056.1	168622.0	68011.5	134497.5
505	DF	1	1	3.0	.8	2635.0	996137.0	212900.0	115442.1	170008.0	68893.5	136233.5
507	FIR-SPR	1	1	4.3	.8	2641.0	999689.0	213608.0	116150.1	170716.0	69319.5	137067.5
606A	PP	2	1	3.5	.8	2646.0	1002024.0	214158.0	116700.1	171266.0	69664.5	137742.5
609	DF	1	1	3.0	.8	2665.0	1009149.0	216039.0	118581.1	173147.0	70880.5	140117.5
521	DF	1	3	3.7	.8	2673.0	1010973.0	216447.0	118989.1	173555.0	71128.5	140605.5
803	LONG-SL	3	1	2.8	.8	2703.0	1020843.0	219177.0	119259.1	176285.0	72943.5	144100.5
808	LONG-SL	4	2	4.1	.8	2704.0	1021019.0	219211.0	119262.5	176319.0	72964.5	144143.5
909	SHL-LOB	3	1	3.3	.8	2742.0	1031583.0	221681.0	119490.5	176927.0	74598.5	147335.5
103	CONIFER	3	1	3.2	.7	2775.0	1040328.0	223661.0	121470.5	178907.0	76050.5	150107.5
304B	PP	2	1	2.9	.7	2776.0	1040680.0	223746.0	121555.5	178992.0	76111.5	150227.5
306F	DF	2	1	2.9	.7	2778.0	1041384.0	223916.0	121725.5	179162.0	76233.5	150467.5
401B	LODGEPO	2	1	2.7	.7	2786.0	1044200.0	224596.0	122405.5	179842.0	76761.5	151499.5
407B	PP	2	1	2.7	.7	2792.0	1046312.0	225106.0	122915.5	180352.0	77157.5	152273.5
502	PP	2	1	2.8	.7	2823.0	1057224.0	227741.0	125550.5	182987.0	79110.5	156117.5
619	FIR-SPR	1	1	2.6	.7	2827.0	1058724.0	228137.0	125946.5	183383.0	79406.5	156697.5
522A	DF	2	3	3.4	.7	2842.0	1061814.0	228767.0	126576.5	184013.0	79871.5	157612.5
607	DF	1	3	3.2	.7	2913.0	1078002.0	232388.0	130197.5	187634.0	82427.5	162724.5
608B	DF	3	3	3.6	.7	2965.0	1091522.0	234832.0	132641.5	190078.0	84299.5	166468.5
903	RED-EWP	3	1	2.8	.7	3081.0	1123770.0	242372.0	133337.5	191934.0	90099.5	177952.5
912	OTHER	3	1	2.8	.7	3134.0	1138504.0	245817.0	133655.5	192782.0	92749.5	183199.5
201H	LODGEPO	2	1	2.5	.6	3140.0	1140616.0	246327.0	134165.5	193292.0	93169.5	184051.5
203D	DF	2	1	2.7	.6	3149.0	1143784.0	247092.0	134930.5	194057.0	93754.5	185239.5
205B	PP	2	1	2.6	.6	3181.0	1155048.0	249812.0	137650.5	196777.0	95930.5	189655.5
306B	FIR-SPR	2	1	2.6	.6	3183.0	1155752.0	249982.0	137820.5	196947.0	96068.5	189925.5
413B	FIR-SPR	2	1	2.5	.6	3186.0	1156808.0	250237.0	138075.5	197202.0	96281.5	190342.5
429B	DF	2	1	2.6	.6	3191.0	1158568.0	250662.0	138500.5	197627.0	96631.5	191027.5
503B	PP	3	1	2.7	.6	3220.0	1168312.0	252924.0	140762.5	199889.0	98458.5	194623.5
506A	FIR-SPR	2	1	2.5	.6	3224.0	1169720.0	253264.0	141102.5	200229.0	98742.5	195179.5
604A	PP	2	1	2.6	.6	3232.0	1172536.0	253944.0	141782.5	200909.0	99294.5	196259.5
606B	PP	3	1	2.5	.6	3245.0	1176904.0	254958.0	142796.5	201923.0	100191.5	198014.5
612B	DF	3	1	2.9	.6	3266.0	1184632.0	256491.0	144329.5	203456.0	101535.5	200639.5
608A	DF	2	3	2.9	.6	3315.0	1194726.0	258549.0	146387.5	205514.0	103299.5	204167.5
621	FIR-SPR	1	3	2.8	.6	3322.0	1196322.0	258906.0	146744.5	205871.0	103593.5	204741.5
815	SHL-LOB	3	1	2.4	.6	3667.0	1292232.0	281331.0	148814.5	217256.0	124466.0	244934.0
827	RED-EWP	3	1	2.6	.6	3671.0	1293344.0	281591.0	148838.5	217320.0	124682.0	245358.0

TABLE C4 (CONT'D.)

203B	FIR-SPR	2	1	2.2	.5	3694.0	1301440.0	283546.0	150793.5	219275.0	126522.0	249084.0
203E	DF	3	1	2.0	.5	3702.0	1303560.0	284026.0	151273.5	219755.0	127042.0	250140.0
304C	PP	3	1	2.2	.5	3737.0	1312835.0	286126.0	153373.5	221855.0	129177.0	254340.0
306G	DF	3	1	2.2	.5	3748.0	1315750.0	286786.0	154033.5	222515.0	129848.0	255660.0
402	LODGEPO	3	1	2.1	.5	3769.0	1321315.0	288046.0	155293.5	223775.0	131234.0	258369.0
408	PP	3	1	2.1	.5	3779.0	1323965.0	288646.0	155893.5	224375.0	131894.0	259659.0
503	PP	3	1	2.1	.5	3822.0	1335360.0	291226.0	158473.5	226955.0	134603.0	264991.0
506A	DF	2	1	2.0	.5	3877.0	1349165.0	294636.0	161883.5	230365.0	138068.0	271811.0
610A	DF	2	1	2.0	.5	3909.0	1357197.0	296620.0	163867.5	232349.0	140116.0	275811.0
622A	FIR-SPR	2	3	2.5	.5	3927.0	1360905.0	297376.0	164623.5	233105.0	140872.0	277287.0
104	CONIFER	4	1	1.6	.4	3943.0	1363097.0	297920.0	165167.5	233649.0	141576.0	278631.0
202A	LODGEPO	3	1	1.9	.4	4022.0	1384032.0	302660.0	169907.5	238389.0	147106.0	289849.0
204A	FIR-SPR	3	1	1.6	.4	4061.0	1394367.0	305000.0	172247.5	240729.0	150226.0	296167.0
205C	PP	3	1	1.9	.4	4122.0	1410532.0	308660.0	175907.5	244389.0	154374.0	304585.0
306C	FIR-SPR	3	1	2.0	.4	4131.0	1412917.0	309200.0	176447.5	244929.0	154995.0	305800.0
414	FIR-SPR	3	1	1.9	.4	4141.0	1415567.0	309800.0	177047.5	245529.0	155705.0	307190.0
430A	DF	3	1	1.9	.4	4154.0	1419012.0	310580.0	177827.5	246309.0	156615.0	308971.0
508B	FIR-SPR	3	1	1.9	.4	4156.0	1419542.0	310700.0	177947.5	246429.0	156757.0	309249.0
604B	PP	3	1	2.0	.4	4175.0	1424577.0	311840.0	179087.5	247569.0	158068.0	311814.0
620A	FIR-SPR	2	1	1.7	.4	4180.0	1425832.0	312150.0	179397.5	247879.0	158438.0	312539.0
804	LONG-SL	4	1	1.5	.4	4199.0	1429119.0	312967.0	179473.5	248696.0	159587.5	314752.5
203F	DF	4	1	1.0	.3	4205.0	1429941.0	313171.0	179677.5	248900.0	159977.5	315544.5
305C	PP	4	1	1.1	.3	4323.0	1446107.0	317183.0	183689.5	252912.0	167175.5	329704.5
306D	FIR-SPR	4	1	1.0	.3	4328.0	1446792.0	317353.0	183859.5	253082.0	167520.5	330379.5
306H	DF	4	1	1.1	.3	4343.0	1448847.0	317863.0	184369.5	253592.0	168435.5	332179.5
403	LODGEPO	4	1	1.1	.3	4357.0	1450765.0	318339.0	184845.5	254068.0	169359.5	333985.5
409	PP	4	1	1.1	.3	4362.0	1451450.0	318509.0	185015.5	254238.0	169689.5	334630.5
504	PP	4	1	1.1	.3	4370.0	1452546.0	318781.0	185287.5	254510.0	170193.5	335622.5
816	SHL-LOB	4	1	1.4	.3	4378.0	1453866.0	319101.0	185319.5	254830.0	170677.5	336554.5
202B	LODGEPO	4	1	1.0	.2	4383.0	1454551.0	319271.0	185489.5	255000.0	171027.5	337264.5
204B	FIR-SPR	4	1	.8	.2	4437.0	1461949.0	321107.0	187325.5	256836.0	175347.5	346012.5
205D	PP	4	1	1.0	.2	4455.0	1464415.0	321719.0	187937.5	257448.0	176571.5	348496.5
415	FIR-SPR	4	1	1.0	.2	4465.0	1465785.0	322059.0	188277.5	257788.0	177281.5	349886.5
430B	DF	4	1	1.0	.2	4476.0	1467292.0	322433.0	188651.5	258162.0	178051.5	351393.5
610B	DF	3	1	.8	.2	4507.0	1470516.0	323332.0	189550.5	259061.0	180035.5	355268.5
620B	FIR-SPR	3	1	.7	.2	4512.0	1471036.0	323477.0	189695.5	259206.0	180405.5	355993.5

TABLE C5

NFS ACCESSIBLE BACKLOG TREATMENT OPPORTUNUTIES RANKED BY
RATE OF RETURN ON DIRECT COST

LOCATION CODE	SPECIES	SITE	TREAT-MENT CODE	B/C RATIO	RATE OF RETURN	CUMULATIVE AREA	CUMULATIVE ANN.GROWTH SAWTIMBER	INCREASED POTENTIAL GRO. STK	CUMULATIVE AAC INCREASE 10TH YR	CUMULATIVE AAC INCREASE 30TH YR	CUMULATIVE PROGRAM COSTS DIRECT	CUMULATIVE PROGRAM COSTS TOTAL
					PCT.	M ACRES	MMBF	MMCF	MMCF	MMCF	$MM	$MM
129	CONIFER	1	2	2.6	17.4	28.0	15232.0	2436.0	2436.0	2436.0	420.0	840.0
829	RED-EWP	3	3	1.8	15.0	32.0	16416.0	2700.0	2464.0	2500.0	476.0	952.0
821	SHL-LOB	1	3	3.0	13.9	39.0	21484.0	3869.0	2583.0	3669.0	574.0	1148.0
809	LONG-SL	1	3	2.3	13.7	39.0	21464.0	3869.0	2583.0	3669.0	574.0	1148.0
613	DF	1	2	5.2	13.0	85.0	31972.0	6215.0	4929.0	6015.0	1126.0	2344.0
828	RED-EWP	1	3	2.9	12.4	136.0	68896.0	14732.0	5796.0	8157.0	1840.0	3772.0
905	RED-EWP	3	3	1.9	12.3	187.0	83992.0	18098.0	6153.0	8973.0	2609.0	5710.0
817	SHL-LOB	1	2	2.8	12.1	201.0	94128.0	20436.0	6391.0	11311.0	3103.0	6312.0
822	SHL-LOB	2	3	2.6	12.0	237.0	113028.0	24612.0	6823.0	15487.0	3607.0	7320.0
805	LONG-SL	1	2	2.2	11.8	237.0	113028.0	24612.0	6823.0	15487.0	3607.0	7320.0
810	LONG-SL	2	3	2.2	11.8	238.0	113504.0	24722.0	6834.0	15597.0	3621.0	7348.0
513	DF	1	2	3.4	11.1	246.0	115328.0	25130.0	7242.0	16005.0	3733.0	7572.0
830	RED-EWP	1	2	2.5	10.8	262.0	126912.0	27802.0	7514.0	16677.0	4069.0	8260.0
906	RED-EWP	2	2	2.5	10.8	355.0	175737.0	38590.0	8630.0	19374.0	5650.0	11515.0
818	SHL-LOB	2	2	2.4	10.4	383.0	190437.0	41838.0	8966.0	22622.0	6238.0	12719.0
806	LONG-SL	2	2	2.1	10.2	388.0	192817.0	42388.0	9021.0	23172.0	6343.0	12934.0
823	SHL-LOB	3	3	3.7	10.2	404.0	197553.0	43444.0	9117.0	23268.0	6567.0	13382.0
614A	DF	2	2	3.4	9.9	464.0	209913.0	45964.0	11637.0	25788.0	7287.0	14942.0
908	RED-EWP	3	2	1.8	9.9	584.0	245433.0	53884.0	12477.0	27708.0	9327.0	19142.0
811	LONG-SL	3	3	2.0	9.5	585.0	245766.0	53957.0	12484.0	27781.0	9341.0	19170.0
509	PP	1	2	4.5	9.2	640.0	275686.0	58742.0	17269.0	32566.0	10056.0	20655.0
819	SHL-LOB	3	2	2.9	8.8	679.0	287230.0	61316.0	17503.0	32800.0	10875.0	22332.0
617	FIR-SPR	1	2	2.1	8.6	681.0	287686.0	61418.0	17605.0	32902.0	10907.0	22396.0
824	SHL-LOB	4	3	2.6	8.4	682.0	287862.0	61457.0	17609.0	32939.0	10921.0	22424.0
807	LONG-SL	3	2	1.8	8.2	686.0	289194.0	61749.0	17637.0	33231.0	11005.0	22596.0
607	DF	1	3	1.9	7.9	757.0	305382.0	65370.0	21258.0	36852.0	13561.0	27708.0
515	FIR-SPR	1	2	2.8	7.8	766.0	310278.0	66153.0	22041.0	37635.0	13714.0	28023.0
615	PP	1	2	2.8	7.8	768.0	311366.0	66327.0	22215.0	37809.0	13738.0	28075.0
614B	DF	3	2	2.2	7.5	800.0	319686.0	67831.0	23719.0	39315.0	14122.0	28907.0
421A	PP	1	2	2.4	7.4	801.0	320230.0	67918.0	23762.0	39400.0	14134.0	28933.0

TABLE C5 (CONT'D.)

510	PP	2	2	2.5	7.2	859.0	337108.0	71746.0	27590.0	43228.0	14888.0	30499.0
521	DF	1	3	1.6	7.2	867.0	338932.0	72154.0	27998.0	43636.0	15136.0	30987.0
517	PP	1	3	2.3	7.1	914.0	364500.0	76243.0	32087.0	47725.0	16405.0	33478.0
910	SHL-LOB	3	2	1.5	7.1	954.0	376340.0	78883.0	32367.0	48365.0	17085.0	34878.0
309B	PP	2	2	2.2	7.0	955.0	376631.0	78949.0	32400.0	48431.0	17097.0	34904.0
911	SHL-LOB	2	3	1.4	6.7	968.0	383456.0	80457.0	32556.0	48808.0	17344.0	35398.0
812	LONG-SL	4	3	1.5	6.6	968.0	383456.0	80457.0	32556.0	48808.0	17344.0	35398.0
825	RED-EWP	1	1	1.9	6.5	1015.0	414429.0	87930.0	33308.0	50594.0	19882.0	40380.0
511	PP	3	2	1.7	6.3	1037.0	419907.0	89140.0	34518.0	51804.0	20168.0	40974.0
801	LONG-SL	1	1	1.8	6.3	1037.0	419907.0	89140.0	34518.0	51804.0	20168.0	40974.0
301A	PP	1	3	1.6	6.2	1038.0	420451.0	89227.0	34561.0	51891.0	20185.0	41009.0
901	RED-EWP	1	1	1.7	6.2	1054.0	430995.0	91771.0	34817.0	52531.0	20985.0	42593.0
616A	PP	2	2	1.5	6.1	1060.0	432741.0	92167.0	35213.0	52927.0	21057.0	42749.0
618A	FIR-SPR	2	2	1.3	6.1	1062.0	433153.0	92251.0	35297.0	53011.0	21089.0	42813.0
125	LODGEPO	1	2	1.4	5.9	1089.0	447841.0	94600.0	35297.0	55360.0	21494.0	43623.0
808	LONG-SL	4	2	1.3	5.9	1090.0	448017.0	94634.0	35300.4	55394.0	21515.0	43666.0
130	CONIFER	2	2	1.4	5.8	1145.0	464022.0	98264.0	38930.4	59024.0	22340.0	45316.0
107	CONIFER	1	3	1.4	5.8	1195.0	491222.0	102614.0	43280.4	63374.0	23790.0	48066.0
421B	PP	2	2	1.3	5.7	1198.0	492095.0	102812.0	43379.4	63572.0	23826.0	48144.0
802	LONG-SL	2	1	1.4	5.7	1226.0	505367.0	106004.0	43687.4	66764.0	25520.0	51406.0
410A	PP	1	3	1.3	5.6	1228.0	506455.0	106178.0	43773.4	66938.0	25568.0	51502.0
518	PP	2	3	1.3	5.6	1310.0	530317.0	111590.0	49185.4	72350.0	27782.0	55848.0
608A	DF	2	3	1.2	5.6	1359.0	540411.0	113648.0	51243.4	74408.0	29546.0	59376.0
814	SHL-LOB	2	1	1.3	5.6	1405.0	561755.0	118754.0	51703.4	79514.0	32329.0	64735.0
813	SHL-LOB	1	1	1.2	5.5	1416.0	569004.0	120503.0	51879.4	81263.0	32994.5	66016.5
601	PP	1	3	1.2	5.4	1421.0	571724.0	120938.0	52314.4	81698.0	33149.5	66326.5
301B	PP	2	3	1.1	5.3	1428.0	573761.0	121400.0	52545.4	82160.0	33268.5	66571.5
516A	FIR-SPR	2	2	1.1	5.3	1434.0	575507.0	121796.0	52941.4	82556.0	33370.5	66781.5
616B	PP	3	2	1.1	5.2	1443.0	577748.0	122291.0	53436.4	83051.0	33478.5	67015.5
827	RED-EWP	3	1	1.1	5.2	1447.0	578860.0	122551.0	53460.4	83115.0	33694.5	67439.5
522A	DF	2	3	1.0	5.1	1462.0	581950.0	123181.0	54090.4	83745.0	34159.5	68354.5
523	FIR-SPR	1	3	1.1	5.1	1471.0	586846.0	123964.0	54873.4	84528.0	34474.5	68975.5
903	RED-EWP	3	1	1.1	5.1	1587.0	619094.0	131504.0	55569.4	86384.0	40274.5	80459.5
131	CONIFER	3	2	1.0	5.0	1653.0	635528.0	135134.0	59199.4	90014.0	41264.5	82439.5
422A	PP	3	2	.9	4.9	1659.0	637022.0	135464.0	59364.4	90344.0	41336.5	82595.5
803	LONG-SL	3	1	.9	4.8	1689.0	646892.0	138194.0	59634.4	93074.0	43151.5	86090.5
912	OTHER	3	1	.9	4.8	1742.0	661626.0	141639.0	59952.4	93922.0	45801.5	91337.5
117	LODGEPO	1	3	.9	4.7	1787.0	686106.0	145554.0	59952.4	97837.0	47016.5	93677.5
519	PP	3	3	.9	4.7	1837.0	698556.0	148304.0	62702.4	100587.0	48366.5	96327.5

TABLE C5 (CONT'D.)

618B	FIR-SPR	3	2	.9	4.6	1841.0	699596.0	148492.0	62890.4	100775.0	48430.5	96455.5
815	SHL-LOB	3	1	.8	4.6	2186.0	795506.0	170917.0	64960.4	112160.0	69303.0	136648.0
307B	DF	2	2	.8	4.5	2188.0	796088.0	171049.0	65092.4	112292.0	69329.0	136702.0
516B	FIR-SPR	3	2	.8	4.5	2190.0	796586.0	171159.0	65202.4	112402.0	69363.0	136772.0
126	LODGEPO	2	2	.8	4.4	2244.0	812300.0	174723.0	65202.4	115966.0	70173.0	138392.0
108	CONIFER	2	3	.8	4.4	2324.0	835580.0	180003.0	70482.4	121246.0	72493.0	142792.0
608B	DF	3	3	.8	4.3	2376.0	849100.0	182447.0	72926.4	123690.0	74365.0	146536.0
410B	PP	2	3	.7	4.2	2386.0	852010.0	183107.0	73256.4	124350.0	74605.0	147016.0
501	PP	1	1	.6	4.2	2409.0	865626.0	185821.0	75970.4	127064.0	76054.0	149868.0
826	RED-EWP	2	1	.7	4.2	2417.0	869338.0	186709.0	76058.4	127288.0	76486.0	150716.0
621	FIR-SPR	1	3	.8	4.1	2424.0	870934.0	187066.0	76415.4	127645.0	76780.0	151290.0
609	DF	1	1	.7	4.0	2443.0	878059.0	188947.0	78296.4	129526.0	77996.0	153665.0
602A	PP	2	3	.7	4.0	2468.0	885334.0	190597.0	79946.4	131176.0	78771.0	155215.0
101	CONIFER	1	1	.5	3.8	2529.0	921446.0	197795.0	87144.4	138374.0	81455.0	160339.0
909	SHL-LOB	3	1	.6	3.8	2567.0	932010.0	200265.0	87372.4	138982.0	83089.0	163531.0
105	CONIFER	1	1	.5	3.7	2584.0	941190.0	202033.0	89140.4	140750.0	83803.0	164891.0
127	LODGEPO	3	2	.6	3.7	2646.0	956628.0	205443.0	89140.4	144160.0	84733.0	166751.0
217	PP	3	2	.5	3.7	2665.0	961359.0	206488.0	89662.9	145205.0	85056.0	167416.0
307C	DF	3	2	.6	3.7	2669.0	962355.0	206708.0	89882.9	145425.0	85108.0	167524.0
308B	FIR-SPR	2	2	.6	3.7	2670.0	962646.0	206774.0	89948.9	145491.0	85124.0	167556.0
109	CONIFER	3	3	.5	3.7	2745.0	981321.0	210899.0	94073.9	149616.0	87299.0	171681.0
612A	DF	2	1	.5	3.7	2767.0	994499.0	213539.0	96713.9	152256.0	88707.0	174431.0
524A	FIR-SPR	2	3	.6	3.7	2770.0	995372.0	213737.0	96911.9	152454.0	88612.0	174638.0
816	SHL-LOB	4	1	.5	3.6	2778.0	996692.0	214057.0	96943.9	152774.0	89296.0	175570.0
902	RED-EWP	2	1	.5	3.6	2814.0	1013396.0	218053.0	97343.5	153782.0	91096.0	179134.0
310B	DF	2	3	.6	3.5	2815.0	1013687.0	218119.0	97409.5	153848.0	91116.0	179174.0
411	PP	3	3	.5	3.5	2831.0	1017671.0	218999.0	97849.5	154728.0	91500.0	179942.0
505	DF	1	1	.5	3.5	2845.0	1022921.0	220385.0	99235.5	156114.0	92382.0	181678.0
804	LONG-SL	4	1	.4	3.5	2864.0	1026208.0	221202.0	99311.5	156931.0	93531.5	183891.5
404A	LODGEPO	1	3	.5	3.3	2865.0	1026752.0	221289.0	99398.5	157018.0	93556.5	183942.5
506C	DF	2	1	.4	3.3	2902.0	1048915.0	225729.0	103838.5	161458.0	95887.5	188530.5
602B	PP	3	3	.4	3.3	2940.0	1058377.0	227819.0	105928.5	163548.0	97065.5	190886.5
118	LODGEPO	2	3	.5	3.1	3040.0	1087477.0	234419.0	105928.5	170148.0	99765.5	196086.5
603	PP	1	1	.3	3.1	3042.0	1088661.0	234655.0	106164.5	170384.0	99903.5	196356.5
106	CONIFER	2	1	.3	3.0	3050.0	1091125.0	235231.0	106740.5	170960.0	100103.5	196740.5
308C	FIR-SPR	3	2	.4	3.0	3052.0	1091623.0	235341.0	106850.5	171070.0	100135.5	196804.5
303B	FIR-SPR	2	3	.5	3.0	3053.0	1091914.0	235407.0	106916.5	171136.0	100157.5	196849.5
610A	DF	2	1	.4	3.0	3085.0	1099946.0	237391.0	108900.5	173120.0	102205.5	200849.5
407A	PP	1	1	.3	2.9	3087.0	1101130.0	237627.0	109136.5	173356.0	102337.5	201107.5

TABLE C5 (CONT'D.)

423B	FIR-SPR	2	2	.5	2.9	3088.0	1101421.0	237693.0	109202.5	173422.0	102354.5	201141.5
502	PP	2	1	.3	2.9	3119.0	1112333.0	240328.0	111837.5	176057.0	104307.5	204985.5
425B	LODGEPO	2	2	.5	2.8	3122.0	1113206.0	240526.0	112035.5	176255.0	104346.5	205066.5
310C	DF	3	3	.4	2.8	3132.0	1115696.0	241076.0	112585.5	176805.0	104546.5	205466.5
502B	PP	2	1	.2	2.8	3153.0	1125503.0	243386.0	114895.5	179115.0	105869.5	208070.5
507	FIR-SPR	1	1	.3	2.8	3159.0	1129055.0	244094.0	115603.5	179823.0	106295.5	208904.5
612B	DF	3	1	.2	2.8	3180.0	1136783.0	245627.0	117136.5	181356.0	107639.5	211529.5
622A	FIR-SPR	2	3	.5	2.8	3198.0	1140491.0	246383.0	117892.5	182112.0	108395.5	213005.5
304B	PP	2	1	.2	2.7	3199.0	1140843.0	246468.0	117977.5	182197.0	108456.5	213125.5
301C	PP	3	3	.3	2.7	3377.0	1185165.0	256258.0	122872.5	191987.0	111482.5	219355.5
102	SPR-FIR	2	1	.2	2.6	3471.0	1218253.0	264248.0	130862.5	199977.0	115618.5	227251.5
115	LODGEPO	1	1	.3	2.6	3482.0	1224765.0	265546.0	132160.5	201275.0	116168.5	228285.5
419B	DF	2	2	.5	2.6	3484.0	1225547.0	265678.0	132292.5	201407.0	116194.5	228339.5
116	LODGEPO	2	1	.3	2.4	3498.0	1228665.0	266518.0	133132.5	202247.0	116544.5	229011.5
619	FIR-SPR	1	1	.3	2.4	3502.0	1230165.0	266914.0	133528.5	202643.0	116840.5	229591.5
620A	FIR-SPR	2	1	.4	2.4	3507.0	1231420.0	267224.0	133838.5	202953.0	117210.5	230316.5
610B	DF	3	1	.2	2.3	3538.0	1234644.0	268123.0	134737.5	203852.0	119194.5	234191.5
213	FIR-SPR	2	2	.4	2.1	3561.0	1242165.0	269871.0	136485.5	205600.0	119792.5	235433.5
215A	LODGEPO	2	2	.3	2.0	3567.0	1243911.0	270267.0	136881.5	205996.0	119918.5	235691.5
216	PP	2	2	.3	2.0	3579.0	1247403.0	271059.0	137277.5	206788.0	120122.5	236111.5
420A	DF	3	2	.4	2.0	3583.0	1248399.0	271279.0	137497.5	207008.0	120174.5	236219.5
426A	LODGEPO	3	2	.4	2.0	3591.0	1250391.0	271719.0	137937.5	207448.0	120278.5	236435.5
424A	FIR-SPR	3	2	.3	1.9	3594.0	1251138.0	271884.0	138102.5	207613.0	120329.5	236537.5
209B	PP	2	3	.3	1.9	3606.0	1254630.0	272676.0	138894.5	208405.0	120713.5	237329.5
303C	FIR-SPR	3	3	.3	1.9	3610.0	1255626.0	272896.0	139114.5	208625.0	120801.5	237509.5
416B	FIR-SPR	2	3	.3	1.9	3613.0	1256499.0	273094.0	139312.5	208823.0	120897.5	237698.5
427A	DF	2	3	.3	1.9	3616.0	1257372.0	273292.0	139510.5	209021.0	120981.5	237866.5
506A	DF	2	1	.3	1.9	3671.0	1271177.0	276702.0	142920.5	212431.0	124446.5	244686.5
413A	FIR-SPR	1	1	.1	1.6	3672.0	1271769.0	276820.0	143038.5	212549.0	124517.5	244825.5
429A	DF	1	1	.1	1.6	3673.0	1272361.0	276938.0	143156.5	212667.0	124587.5	244962.5
401A	LODGEPO	1	1	.1	1.4	3674.0	1272863.0	277056.0	143274.5	212785.0	124653.5	245091.5
306B	FIR-SPR	2	1	.1	1.3	3676.0	1273567.0	277226.0	143444.5	212955.0	124791.5	245361.5
306F	DF	2	1	.1	1.3	3678.0	1274271.0	277396.0	143614.5	213125.0	124913.5	245601.5
407B	PP	2	1	.1	1.3	3684.0	1276383.0	277906.0	144124.5	213635.0	125309.5	246375.5
508A	FIR-SPR	2	1	.1	1.3	3688.0	1277791.0	278246.0	144464.5	213975.0	125593.5	246931.5
604A	PP	2	1	.1	1.3	3696.0	1280607.0	278926.0	145144.5	214655.0	126145.5	248011.5
606A	PP	2	1	.1	1.3	3701.0	1282942.0	279476.0	145694.5	215205.0	126490.5	248686.5
103	CONIFER	3	1	.1	1.2	3734.0	1291687.0	281456.0	147674.5	217185.0	127942.5	251458.5
205B	PP	2	1	.1	1.2	3766.0	1302951.0	284176.0	150394.5	219905.0	130118.5	255874.5

TABLE C5 (CONT'D.)

304C	PP	3	1	.1	1.2	3801.0	1312226.0	286276.0	152494.5	222005.0	132253.5	260074.5
401B	LODGEPO	2	1	.1	1.2	3809.0	1315042.0	286956.0	153174.5	222685.0	132781.5	261106.5
408	PP	3	1	.1	1.2	3819.0	1317692.0	287556.0	153774.5	223285.0	133441.5	262396.5
413B	FIR-SPR	2	1	.1	1.2	3822.0	1318748.0	287811.0	154029.5	223540.0	133654.5	262813.5
503	PP	3	1	.1	1.2	3865.0	1330143.0	290391.0	156609.5	226120.0	136363.5	268145.5
503B	PP	3	1	.1	1.2	3894.0	1339887.0	292653.0	158871.5	228382.0	138190.5	271741.5
604B	PP	3	1	.1	1.2	3913.0	1344922.0	293793.0	160011.5	229522.0	139501.5	274306.5
606B	PP	3	1	.1	1.2	3926.0	1349290.0	294807.0	161025.5	230536.0	140398.5	276061.5
620B	FIR-SPR	3	1	.1	1.2	3931.0	1349810.0	294952.0	161170.5	230681.0	140768.5	276786.5
508B	FIR-SPR	3	1	.1	1.1	3933.0	1350340.0	295072.0	161290.5	230801.0	140910.5	277064.5
203D	DF	2	1	.0	.3	3942.0	1353508.0	295837.0	162055.5	231566.0	141495.5	278252.5
203B	FIR-SPR	2	1	.0	.2	3965.0	1361604.0	297792.0	164010.5	233521.0	143335.5	281978.5
429B	DF	2	1	.0	.2	3970.0	1363364.0	298217.0	164435.5	233946.0	143685.5	282663.5
201H	LODGEPO	2	1	.0	.1	3976.0	1365476.0	298727.0	164945.5	234456.0	144105.5	283515.5
202A	LODGEPO	3	1	.0	.1	4055.0	1386411.0	303467.0	169685.5	239196.0	149635.5	294735.5
203E	DF	3	1	.0	.1	4063.0	1388531.0	303947.0	170165.5	239676.0	150155.5	295789.5
204A	FIR-SPR	3	1	.0	.1	4102.0	1398866.0	306287.0	172505.5	242016.0	153275.5	302107.5
205C	PP	3	1	.0	.1	4163.0	1415031.0	309947.0	176165.5	245676.0	157423.5	310525.5
305C	PP	4	1	.0	.1	4281.0	1431197.0	313959.0	180177.5	249688.0	164621.5	324685.5
306C	FIR-SPR	3	1	.0	.1	4290.0	1433582.0	314499.0	180717.5	250228.0	165242.5	325900.5
306G	DF	3	1	.0	.1	4301.0	1436497.0	315159.0	181377.5	250888.0	165913.5	327220.5
306H	DF	4	1	.0	.1	4316.0	1438552.0	315669.0	181887.5	251398.0	166826.5	329020.5
402	LODGEPO	3	1	.0	.1	4337.0	1444117.0	316929.0	183147.5	252658.0	168214.5	331729.5
409	PP	4	1	.0	.1	4342.0	1444802.0	317099.0	183317.5	252828.0	168544.5	332374.5
414	FIR-SPR	3	1	.0	.1	4352.0	1447452.0	317699.0	183917.5	253428.0	169254.5	333764.5
430A	DF	3	1	.0	.1	4365.0	1450897.0	318479.0	184697.5	254208.0	170164.5	335545.5
504	PP	4	1	.0	.1	4373.0	1451993.0	318751.0	184969.5	254480.0	170668.5	336537.5
104	CONIFER	4	1	.0	.0	4389.0	1454185.0	319295.0	185513.5	255024.0	171372.5	337881.5
202B	LODGEPO	4	1	.0	.0	4394.0	1454870.0	319465.0	185683.5	255194.0	171722.5	338591.5
203F	DF	4	1	.0	.0	4400.0	1455692.0	319669.0	185887.5	255398.0	172112.5	339383.5
204B	FIR-SPR	4	1	.0	.0	4454.0	1463090.0	321505.0	187723.5	257234.0	176432.5	348131.5
205D	PP	4	1	.0	.0	4472.0	1465556.0	322117.0	188335.5	257846.0	177656.5	350615.5
306D	FIR-SPR	4	1	.0	.0	4477.0	1466241.0	322287.0	188505.5	258016.0	178001.5	351290.5
403	LODGEPO	4	1	.0	.0	4491.0	1468159.0	322763.0	188981.5	258492.0	178925.5	353096.5
415	FIR-SPR	4	1	.0	.0	4501.0	1469529.0	323103.0	189321.5	258832.0	179635.5	354486.5
430B	DF	4	1	.0	.0	4512.0	1471036.0	323477.0	189695.5	259206.0	180405.5	355993.5

APPENDIX D

TREATMENT OPPORTUNITY RANKINGS, NONINDUSTRIAL PRIVATE

TABLE D1
NONINDUSTRIAL PRIVATE TREATMENT OPPORTUNITIES ACCESSIBLE AREAS RANKED BY SAWTIMBER MEAN ANNUAL INCREMENT INCREASE PER DOLLAR OF FEDERAL COST

LOCATION CODE	SPECIES	SITE	TREAT-MENT CODE	INCRE-MENTAL AREA	CUMULA-TIVE AREA	M.A.I. INCREASE PER FEDERAL $ SAW-TIMBER	M.A.I. INCREASE PER FEDERAL $ GROWING STOCK	CUMULATIVE COST TOTAL	CUMULATIVE COST FEDERAL	CUMULATIVE M.A.I. INCREASE SAW-TIMBER	CUMULATIVE M.A.I. INCREASE GROWING STOCK
				M ACRE	M ACRE	BF/$	CF/$	$M	$M	MMBF	MMCF
NCBB	RED-EWP	1	1	90.0	90.0	32.	5.	3933.0	2916.0	94.5	15.7
PN22	DF	1	1	12.0	102.0	19.	3.	4363.8	3232.8	100.7	16.6
SO-1	LONG-SL	2	1	980.0	1082.0	19.	3.	25139.8	18422.8	394.7	65.6
NCBC	SHL-LOB	3	1	40.0	1122.0	18.	3.	26287.8	19266.8	410.3	68.4
NE-1	SHL-LOB	2	1	600.0	1722.0	18.	4.	39017.8	28566.8	580.1	110.4
NE-2	RED-EWP	2	1	1100.0	2822.0	17.	3.	81587.8	60026.8	1118.0	221.5
SO-2	LONG-SL	2	1	75.0	2897.0	15.	3.	83567.8	61481.8	1140.5	225.3
NCBA	RED-EWP	3	1	315.0	3212.0	15.	3.	97333.3	71687.8	1293.0	254.9
NE-3	RED-EWP	3	1	20.0	3232.0	12.	3.	98411.3	72487.8	1302.8	257.1
NC-2	RED-EWP	3	1	100.0	3332.0	11.	2.	104521.3	77017.8	1351.2	266.5
NC-4	RED-EWP	3	1	360.0	3692.0	9.	2.	131197.3	96817.8	1525.4	300.3
SO-4	SHL-LOB	3	1	1500.0	5192.0	8.	3.	208597.3	154117.8	1993.4	477.3
NC-5	RED-EWP	4	1	45.0	5237.0	8.	2.	212156.8	156763.8	2015.2	481.5
NE-4	RED-EWP	3	1	25.0	5262.0	8.	2.	213504.3	157763.8	2023.2	483.5
SE-1	SHL-LOB	2	1	860.0	6122.0	8.	5.	231736.3	171093.8	2129.0	548.0
SO-3	SHL-LOB	3	1	80.0	6202.0	7.	3.	235848.3	174141.8	2151.4	557.0
SE-2	SHL-LOB	3	1	64.0	6266.0	6.	5.	237537.9	175383.4	2159.3	562.8
SO-7	LONG-SL	3	1	690.0	6956.0	6.	3.	273141.9	201741.4	2314.5	630.4
SO-5	SHL-LOB	3	1	400.0	7356.0	4.	2.	293781.9	217021.4	2378.1	665.6
SE-3	SHL-LOB	3	1	160.0	7516.0	3.	3.	302005.9	223117.4	2397.8	681.6
SE-7	SHL-LOB	3	1	2000.0	9516.0	3.	2.	421205.9	311517.4	2641.8	881.6
SE-5	SHL-LOB	3	1	1000.0	10516.0	3.	2.	472805.9	349717.4	2738.8	961.6
SE-6	SHL-LOB	3	1	1000.0	11516.0	2.	2.	527405.9	390117.4	2825.8	1057.6
SE-4	SHL-LOB	3	1	180.0	11696.0	2.	4.	532157.9	397609.4	2832.5	1072.0
NE-5	SHL-LOB	3	1	100.0	11796.0	1.	1.	536297.9	400649.4	2835.5	1075.6

TABLE D2
NONINDUSTRIAL PRIVATE TREATMENT OPPORTUNITIES ACCESSIBLE AREAS RANKED BY GROWING STOCK MEAN ANNUAL INCREMENT INCREASE PER DOLLAR OF FEDERAL COST

LOCATION CODE	SPECIES	SITE	TREATMENT CODE	INCREMENTAL AREA	CUMULATIVE AREA	M.A.I. INCREASE PER FEDERAL $ SAWTIMEBER	M.A.I. INCREASE PER FEDERAL $ GROWING STOCK	CUMULATIVE COST TOTAL	CUMULATIVE COST FEDERAL	CUMULATIVE M.A.I. INCREASE SAWTIMBER	CUMULATIVE M.A.I. INCREASE GROWING STOCK
				M ACRE	M ACRE	BF/$	CF/$	$M	$M	MMBF	MMCF
NCBB	RED-EWP	1	1	90.0	90.0	32.	5.	3933.0	2916.0	94.5	15.7
SE-1	SHL-LOB	2	1	860.0	950.0	8.	5.	22165.0	16246.0	200.3	80.2
SE-2	SHL-LOB	3	1	64.0	1014.0	6.	5.	23854.6	17487.6	208.2	86.0
NE-1	SHL-LOB	2	1	600.0	1614.0	18.	4.	36584.6	26787.6	378.0	128.0
SE-4	SHL-LOB	3	1	180.0	1794.0	2.	4.	41336.6	34279.6	384.7	142.4
NE-2	RED-EWP	2	1	1100.0	2894.0	17.	3.	83906.6	65739.6	922.6	253.5
NCBC	SHL-LOB	3	1	40.0	2934.0	18.	3.	85054.6	66583.6	938.2	256.3
SO-1	LONG-SL	2	1	980.0	3914.0	19.	3.	105830.6	81773.6	1232.2	305.3
SO-4	SHL-LOB	3	1	1500.0	5414.0	8.	3.	183230.6	139073.6	1700.2	482.3
SO-3	SHL-LOB	3	1	80.0	5494.0	7.	3.	187342.6	142121.6	1722.6	491.3
NCBA	RED-EWP	3	1	315.0	5809.0	15.	3.	201108.1	152327.6	1875.1	520.9
PN22	DF	1	1	12.0	5821.0	19.	3.	201538.9	152644.4	1881.3	521.8
NE-3	RED-EWP	3	1	20.0	5841.0	12.	3.	202616.9	153444.4	1891.1	524.0
SO-2	LONG-SL	2	1	75.0	5916.0	15.	3.	204596.9	154899.4	1913.6	527.8
SO-7	LONG-SL	3	1	690.0	6606.0	6.	3.	240200.9	181257.4	2068.8	595.4
SE-3	SHL-LOB	3	1	160.0	6766.0	3.	3.	248424.9	187353.4	2088.5	611.4
SE-6	SHL-LOB	3	1	1000.0	7766.0	2.	2.	303024.9	227753.4	2175.5	707.4
SO-5	SHL-LOB	3	1	400.0	8166.0	4.	2.	323664.9	243033.4	2239.1	742.6
SE-7	SHL-LOB	3	1	2000.0	10166.0	3.	2.	442864.9	331433.4	2483.1	942.6
SE-5	SHL-LOB	3	1	1000.0	11166.0	3.	2.	494464.9	369633.4	2580.1	1022.6
NC-2	RED-EWP	3	1	100.0	11266.0	11.	2.	500574.9	374163.4	2628.5	1032.0
NE-4	RED-EWP	3	1	25.0	11291.0	8.	2.	501922.4	375163.4	2636.5	1034.0
NC-4	RED-EWP	3	1	360.0	11651.0	9.	2.	528598.4	394963.4	2810.7	1067.8
NC-5	RED-EWP	4	1	45.0	11696.0	8.	2.	532157.9	397609.4	2832.5	1072.0
NE-5	SHL-LOB	3	1	100.0	11796.0	1.	1.	536297.9	400649.4	2835.5	1075.6

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