Riparian zones. Stream channels (the area of seasonal high-water flows) were removed from the suitable timber land base for each alternative This corrected an earlier model deficiency. In addition, timber yield tables for these areas were modified to provide longer rotations and more structural material for the stream channels

Snags and Snag Replacements. These are now set to provide a minimum of 40% of potential populations The calculation for this is done outside FORPLAN.

Wild and Scenic Rivers. The suitable land base was reduced to reflect the inclusion of areas under the Omnibus Oregon Wild and Scenic Rivers Act of 1988

Uneven-age timber management. Provision for this was added to the revised model and applied to alternatives C-Modified and I

Old growth replacement. Provision was made in the revised model to replace a specified fraction of areas managed for old growth with other areas having similar characteristics This option was used in alternative I only.

Board foot volumes. A more accurate method of calculating board foot volumes was employed, based on variable conversion ratios appropriate to the average diameter

B. ANALYSIS PROCESS AND ANALYTICAL TOOLS

As directed in the Planning Regulations (36 CFR 219.12) "Each alternative shall represent to the extent practicable the most cost-efficient combination of Management Prescriptions examined that can meet the objectives established in the alternative "

The Interdisciplinary Team analyzed economic efficiency at several stages of the planning process in order to be reasonably assured that the alternatives developed and displayed in the Final Environmental Impact Statement complied with the intent of the direction The discussion of the analytical process and tools used will follow the general outline below:

1 Analysis prior to FORPLAN.
2 How FORPLAN was used in the analysis
3 Analysis done in addition to FORPLAN model analysis

1. Analysis Prior to FORPLAN

Once the issues, concerns, and opportunities were identified and planning criteria developed, the Interdisciplinary Team began to formulate management strategies and their associated standards The step was probably one of the most difficult and laborious, and possibly the most important task of the interdisciplinary planning process Management strategies coupled with their respective standards provide specific direction for implementation and serve as a framework for how to use, develop, and protect the Forest's resources in a manner consistent with the goals and objectives of the alternatives

Since the standards provide general rather than site or project-specific direction on how to implement the Forest Plan, it was not possible to calculate a present net value for most of the standards However, economic efficiency was a consideration throughout their development. For example, from a silvicultural standpoint, clearcutting and planting is more desirable in terms of control over species mix than is natural regeneration However, natural regeneration is often more cost effective and successful in various plant communities.

Concurrently with the formulation of Management Areas and the Standards, the Interdisciplinary Team also began to identify the analysis areas to be used in the FORPLAN model. The computerized Forest data base was used extensively to analyze different analysis area combinations which could be used to model and evaluate the production and economic tradeoffs between the recreation, timber, visual, and wildlife resources on the Forest. The objective was to delineate the analysis areas in a way to capture the important variations in the biological, social, and economic characteristics of the land and yet keep the FORPLAN model size to a minimum to maximize operational efficiency The ability to respond to issues, concerns, and opportunities was also a major consideration in the analysis area identification process.

Following the resolution of the analysis area stratification scheme, the process of developing FORPLAN prescriptions was initiated. Developing the prescriptions required the derivation of timber yield tables, other resource yield coefficients, and the economic costs and benefits (see Section IV) associated with each FORPLAN prescription The prescriptions were designed to enable FORPLAN to analyze the *timber, range, and cover outputs associated with alternative land assignments and* multiple-use objectives. Other wildlife, fish, soil, and recreation related outputs and effects were evaluated outside FORPLAN

2. How FORPLAN Was Used in the Analysis

FORPLAN was used to analyze the production and economic tradeoffs between the recreation, timber, visual, range, and wildlife resources on the Forest The model was utilized to analyze the most economically efficient timber related outputs and effects associated with the achievement of the multiple-use objectives of an alternative The prescriptions chosen by the model depended upon the objective function and the set of constraints used to represent a particular benchmark or alternative. The objective functions used were

a. Maximize Present Net Value,
b. Maximize timber production,
c. Maximize Animal Unit Month production, or
d. Maximize wildlife cover.

Each objective function was optimally achieved based on the data present in the model and after satisfying all the specified constraints. Constraints were designed to represent land assignment and scheduling schemes necessary to achieve the objectives of a benchmark or alternative. The constraints attempted to provide assignments and activity schedules which were spatially and temporally feasible. Following is a list of the types of constraints used:

a. Constraints on timber harvest flows, rotation lengths, ending inventories, harvest types, and harvest dispersion;

b. Land assignment constraints for analysis areas and assignment zones,

c. Old-growth constraints including old-growth replacement;

d. Forage assignment constraints,

e. Riparian area constraints;

f. Visual management constraints;

g. Cover constraints (For alternatives only);

h. Watershed constraints (For alternatives only), and

i Mixed conifer to ponderosa pine site conversion constraints (For alternatives C-Modified and I only).

Once the model had arrived at a feasible solution by satisfying all of the constraints, the algorithm would search for the set of prescriptions and timing choices which permitted it to optimize the solution according to the specified objective function

For the alternatives, FORPLAN was used to determine optimal assignments and scheduling of Management Prescriptions for each analysis area within the seven separate major forest watersheds (Refer to Figure B-1) This process allowed for a greater level of geographic specificity in selection of the most cost-efficient Management Prescriptions and land assignments

3. Benchmarks

FORPLAN was used to develop benchmarks for the Analysis of the Management Situation Maximum resource production levels were determined using the objective functions and constraints discussed above. Assignments and activity schedules which maximized net economic returns were calculated. The FORPLAN model was also used to estimate the tradeoffs in costs, outputs, and benefits associated with specific legal and policy requirements such as Management Requirements

Where the benchmark analyses were completed, the Interdisciplinary Team proceeded to develop a range of alternatives to address the issues, concerns, and opportunities (refer to Section VII). Each issue, concern, and opportunity was addressed in the alternatives either through land assignments, harvest scheduling, standards, or policy statements Information from the benchmark analysis was used to determine the "decision space" available to the Interdisciplinary Team for constructing alternatives Alternatives were modeled through the specification of an objective function and a set of constraints necessary to achieve the intent of a particular alternative

4. Timber Inventory Update Analysis

Since the vegetative inventory of standing timber was collected during 1979-1980, timber sales and harvests have been ongoing, thereby altering the components of that standing inventory. In order to address the concern that a time lag exists between when the timber inventory data was originally collected and when it was applied to the beginning of the planning period, a provision was added to the FORPLAN model to simulate harvests that have occurred in the past decade as the first period of the model The second period of the model then becomes the first period of the alternative simulated.

To complete this analysis, harvests from the past decade were simulated for the time period 1980-1989 This was done by inserting the past 10 years of scheduled timber harvests into the appropriate prescriptions within the FORPLAN model structure. As the amount of timber volume sold during this time period is known, these numbers were readily fit into the planning model All periods following the years associated with 1980-1989 time period were allowed freedom of harvest choice, unlike the harvests programmed into the first decade of the planning model The method of estimating the prior harvest is described in the process paper "Calculation of prior harvest fractions for FORPLAN", 3/16/89.

All the alternatives brought forward have been analyzed using this procedure, but the benchmarks have not. The relatively minor effects on benchmark outputs from this procedure would not have a significant effect on the conclusions of the analysis.

5. Manageable Understories

When the FORPLAN model was revised as a result of comments on the Draft Environmental Impact Statement, provision was made to define the manageability of understories in two story stands as a function of watershed, working group, land class, and condition class This replaced a single number definition which applied forest wide New estimates of manageability were made in May 1989, and these reflected changed conditions in the forest due to prior harvests, insect and disease conditions, and potential for future management These are shown in Table B-6, which shows an overall weighted average of 62% compared with 80% used as the *basis for the Draft Environmental Impact Statement. This is also discussed in* Section III.E Development of Timber Options, and in the process paper "Manageable Understories Review", 5/10/89

6. Wild & Scenic Rivers

The management of areas designated under the Omnibus Oregon Wild and Scenic Rivers Act of 1988 can be approximated closely through a visual prescription. Two corridors representing these areas were therefore added to the list of visual corridors used in FORPLAN The details are described in the process paper "Wild and Scenic Corridors in FORPLAN", 12/29/88, (Lindley)

7. Analysis in Addition to FORPLAN

Outputs calculated outside the FORPLAN model are listed below·

1. Developed recreation use
2. Nonwilderness dispersed use
3. Wilderness use
4 Trail construction/reconstruction
5. Developed site reconstruction
6 Visual quality objectives
7. Big-game use
8. Anadromous fish use
9. Anadromous fish commercial harvest
10. Anadromous fish habitat improvement
11. Pileated woodpecker
12 Pine marten
13 Three-toed woodpecker
14 Primary cavity excavators
15 Steelhead escapement
16 *Chinook salmon escapement*
17. Rocky Mountain elk
18 Wildlife habitat improvement
19. Fuelwood
20. Other wood fiber
21 Forest residue
22. Water yield
23. Habitat Effectiveness Index
24. Reduction in timber harvest due to snags and snag replacements

Water yield was initially included in FORPLAN but was removed because it showed no significant variation between alternatives, and because the scheduled output position it occupied was required for another purpose.

Most of the outputs listed above were derived using other outputs from the FORPLAN reports.

Table B-1 lists all outputs and their derivations

TABLE B-1

RESOURCE OUTPUTS AND DERIVATIONS

Resource Output	Unit	How Derived
Developed recreation use	1,000 RVD	See Section III G - Recreation
Nonwilderness dispersed use	1,000 RVD	See Section III G - Recreation
-Semi-Primitive Non-Motorized		
-Semi-Primitive Motorized		
-Roaded Natural		
-Roaded Modified		
Wilderness use	1,000 RVD	See Section III G - Recreation
-Primitive trailed		
-Primitive no trails		
-Semi-Primitive		
Trail construction/reconstruction	Miles	See Section III.G - Recreation
Developed site reconstruction	PAOT	Based on 25-year reconstruction cycle
Visual quality objectives	Acres	Based on "National Forest Landscape
-Preservation		Management,"
-Retention		U.S D A , Vol. 2, Chap. 1.
-Partial retention		
-Modification/Max modification		
Unroaded areas assigned to unroaded Management Prescription	Acres	Selection by management team based on public input.
Big-game use	1,000 WFUD	See Section III G - Wildlife
Smolt Habitat Capability Index (SHCI)	1,000 smolts	See Section III.G - Fish
Anadromous fish use	1,000 WFUD	See Section III.G - Fish
Anadromous fish commercial harvest	1,000 pounds	See Section III.G - Fish
Anadromous fish habitat improvement	1,000 pounds	See Section III G - Fish
Pileated woodpecker	Potential pairs	See Section III G - Wildlife
Pine marten	Potential pairs	See Section III.G - Wildlife
Three-toed woodpecker	Potential pairs	See Section III.G - Wildlife
Primary cavity excavators	Percent of Potential Population	See Section III G - Wildlife
Rocky Mountain elk	1,000 Head	See Section III G - Wildlife
-Potential summer population		
-Potential winter population		
Wildlife habitat improvement	Acres	See Section III.G - Wildlife
Wildlife habitat improvement	Structures	See Section III.G - Wildlife

TABLE B-1 (Continued)
RESOURCE OUTPUTS AND DERIVATIONS

Resource Output	Unit	How Derived
Range-permitted grazing	1,000 AUM	FORPLAN output. See also Section III.G - Range
Timber sale program quantity	MMBF	See Section III.G.2.c
Timber sale program quantity	MMCF	
Allowable Sale Quantity	MMBF	See Section III.G 2.c
Allowable Sale Quantity	MMCF	
Fuelwood (not estimated)	MMCF	Not applicable
Other wood fiber (biomass)	MMCF	See Section III.G - Firewood/Biomass
Forest residue	MMCF	See Section III.G - Firewood/Biomass
Reforestation (planting)	1,000 Acres	See Section III.G.2.d
Timber stand improvement	1,000 Acres	See Section III.G.2.e
Long-term sustained yield	MMCF	FORPLAN output
Timber growth in year 2030	MMCF	FORPLAN output
Water yield	1000 Acre-ft.	See Section III G - Water Yield
Sediment	Index	FORPLAN output
Improved watershed condition	Acres	Professional estimate
Fire management effectiveness index	$/1000 Acres protected	See Section III G - Fire
Arterial and collector road construction and reconstruction	Miles	See Section III.G - Roads
Timber purchaser road -Construction -Reconstruction	Miles	See Section III.G - Roads
Roads suitable for public use -Passenger car -High-clearance vehicle only	Miles	See Section III.G - Roads
Fuel treatment	1,000 Acres	See Section III.G - Fire
Operational costs	Million $	See Section III.G - Economic Effects
Capital investment costs -Allocated -Appropriated	Million $	See Section III.G - Economic Effects
Returns to Government	Million $	See Section III.G - Economic Effects
Changes in jobs	Number	See Section III.G - Economic Effects
Changes in income	Million $	See Section III.G - Economic Effects

TABLE B-1 (Continued)
RESOURCE OUTPUTS AND DERIVATIONS

Resource Output	Unit	How Derived
Payments to Counties	Million $	See Section III.G - Economic Effects
Area available for specific resource uses	Acres	
-Timber harvest		See Section II A 4
-Grazing		All land except wilderness and roads
-Mineral exploration		All acres not withdrawn
Acreage of available timber by harvest prescription	Acres	FORPLAN output
-Clearcut		
-Shelterwood		
-Selection		
Lands tentatively suitable for timber production	Acres	See section II.A.4 - Suitable Lands
Lands suitable for timber production	Acres	Suitability analysis + FORPLAN output
Lands with timber yield reductions	Acres	RO Direction + FORPLAN output