Appendix B

Description of the analysis process

Introduction

The overall planning process outlined in 36 CFR 219.12 consists of the following steps:

- Identification of purpose and need
- Planning criteria
- Inventory and data collection
- Analysis of the management situation
- Formulation of alternatives
- Estimation of effects of alternatives
- Evaluation of alternatives
- Recommendation of preferred alternative
- Plan approval and implementation
- Monitoring and evaluation.

Details regarding the background, methods, and results of these steps are contained in the body of the FEIS. This appendix describes some of the specific analysis processes and techniques used by the interdisciplinary team during development of the 2002 Forest Plan.

TIMBER ANALYSIS

Changes between Draft and Final

There were a few minor changes in the timber analysis process from what was used for the draft environmental impact statement (DEIS), based on concerns communicated through internal review and public comments on the DEIS. These changes are discussed individually within appropriate sections below. The internal review is found in the administrative record in a file titled '19990609_spectrum.rtf', available at the Supervisor's Office in Glenwood Springs, CO. Public comments and Forest Service responses related to timber are found in Appendix A. Responses relating to the timber analysis process documented in this appendix include T75, T80, T81.1, T82, T89.1 T110, T118, T118.1, T118.2, T118.4, and T119.

Appendix B has been altered and expanded for the FEIS. The *Supplement to Appendix B* document, included in the administrative record, contains more details on the SPECTRUM models, analysis process, and display of results.

Introduction

The process for analyzing the timber program to establish an allowable sale quantity (ASQ) and an associated general schedule of timber harvest is presented in **Figure B-1**. There are many factors affecting selection of a timber harvest schedule, including:

- Character of existing timber stands
- Growth and decay characteristics of various land types
- Spatial distribution of suitable lands
- Interrelationships between timber and other resources, and
- Economics.

In addition, regulations require that the Forest Service manage for a non-declining flow and sustainable yield of timber products over time. A computer model is used to explore the integration of the primary factors affecting timber harvest, to help determine what timber stands should be cut, how and when.

Spectrum is the computer model used by most National Forests for development of timber harvest schedules. Spectrum is a linear program, which is a standard mathematical technique for solving simultaneous linear equations subject to constraints and an objective function. Spectrum is used to build a linear program matrix that is then solved by an optimizer, in this case, one called C-WHIZ. Solutions from C-WHIZ are then interpreted by Spectrum, which generates reports and produces data files containing results. These data files can then be used for further analyses.

Lands suited for timber production

Five standards were used to determine whether a particular parcel might be suitable for timber production:

- Is the land forested? (36 CFR 219.9(a)(1)) [1].
- Is the land withdrawn from timber production? (36 CFR 219.14(a)(4)) [1].
- Is the land producing commercially usable timber? (FSH 2409.13-21.3)) [2].
- Is irreversible resource damage likely to occur? (36 CFR 219.14 (a)(2)) [1].
- Is there reasonable assurance of adequate stocking within five years after final harvest? (36 CFR 219.14(a)(3)) [1].

Those lands that remain after applying the five standards are termed tentatively suitable timber lands, as shown in **Figure B-2**. Each alternative uses the tentatively suitable timber lands as the starting point for determining the suitable timber lands.

Is the land forested? This criteria listed in 36 CFR 219.14 considers whether a parcel of land is forested or not. CFR 219.14 (a)(1) states: The land is not forest land as defined in §219.3 [1]. 36 CFR 219.3 Forest Land: Land at least 10 percent occupied by forest trees of any size or formerly having had such tree cover and not currently developed for non-forest use. Lands developed for non-forest use include areas for crops, improved pasture, residential, or administrative areas, improved roads of any width, and adjoining road clearing and powerline clearing of any width. Using these definitions for forested and non-forested lands, the GIS database was queried for all non-forested cover types. The results of the query showed a total of 2,282,237 acres of National Forest System lands, with 1,002,652 acres of forested lands.

Is irreversible resource damage likely to occur? This criteria removes lands from timber production if there will be irreversible resource damage to soil productivity or watershed conditions. 36 CFR 219.14(a)(2) states: Technology is not available to ensure timber production from the land without irreversible resource damage to soils productivity, or watershed conditions. Soils may be damaged by erosion, nutrient removal, compaction, and mass movement (landslides). Of these, erosion, nutrient removal, and compaction

may be mitigated on-site, but landslides are difficult to mitigate. Riparian areas and wet soils are special areas, important for a variety of uses, besides timber production. However, under existing technologies, most of the impacts to wet soils and riparian area on slopes less than 40 percent could be mitigated. Winter logging, logging on snow or frozen soils, horse logging, and similar activities could be done while protecting resource values. Since wet soils and riparian areas can technologically be harvested, they were not excluded from the tentatively suitable timber land base.

An assessment of the condition of all sixth-level watersheds on the Forest was conducted by Tony Svatos and Deb Gregg. Factored into this assessment were evaluations of individual landscape processes and resource conditions. This assessment resulted in 72,723 acres of forested land being identified as having the potential for irreversible damage, primarily due to high mass movement potential.

Figure B-1
Timber harvest schedule development

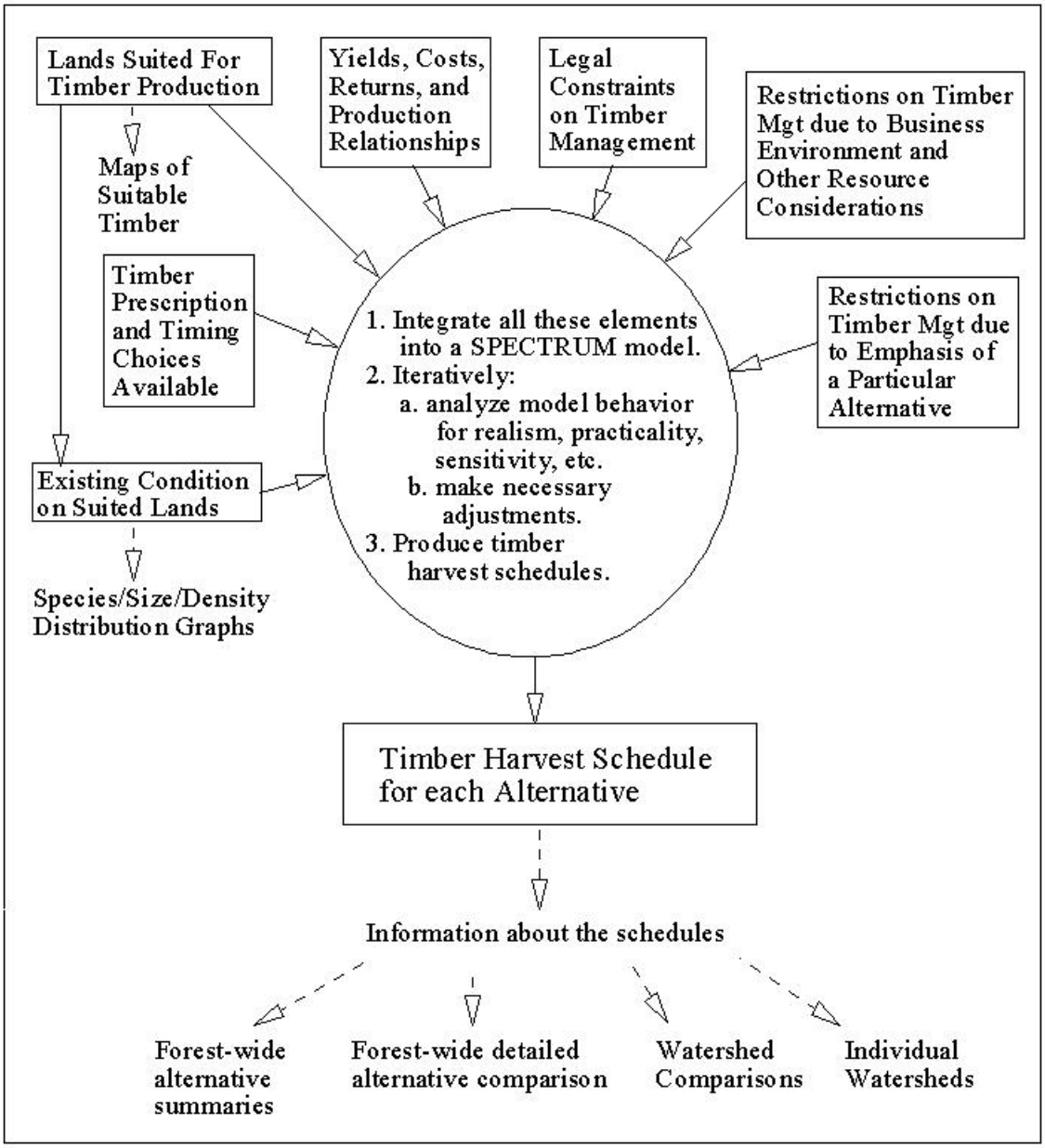
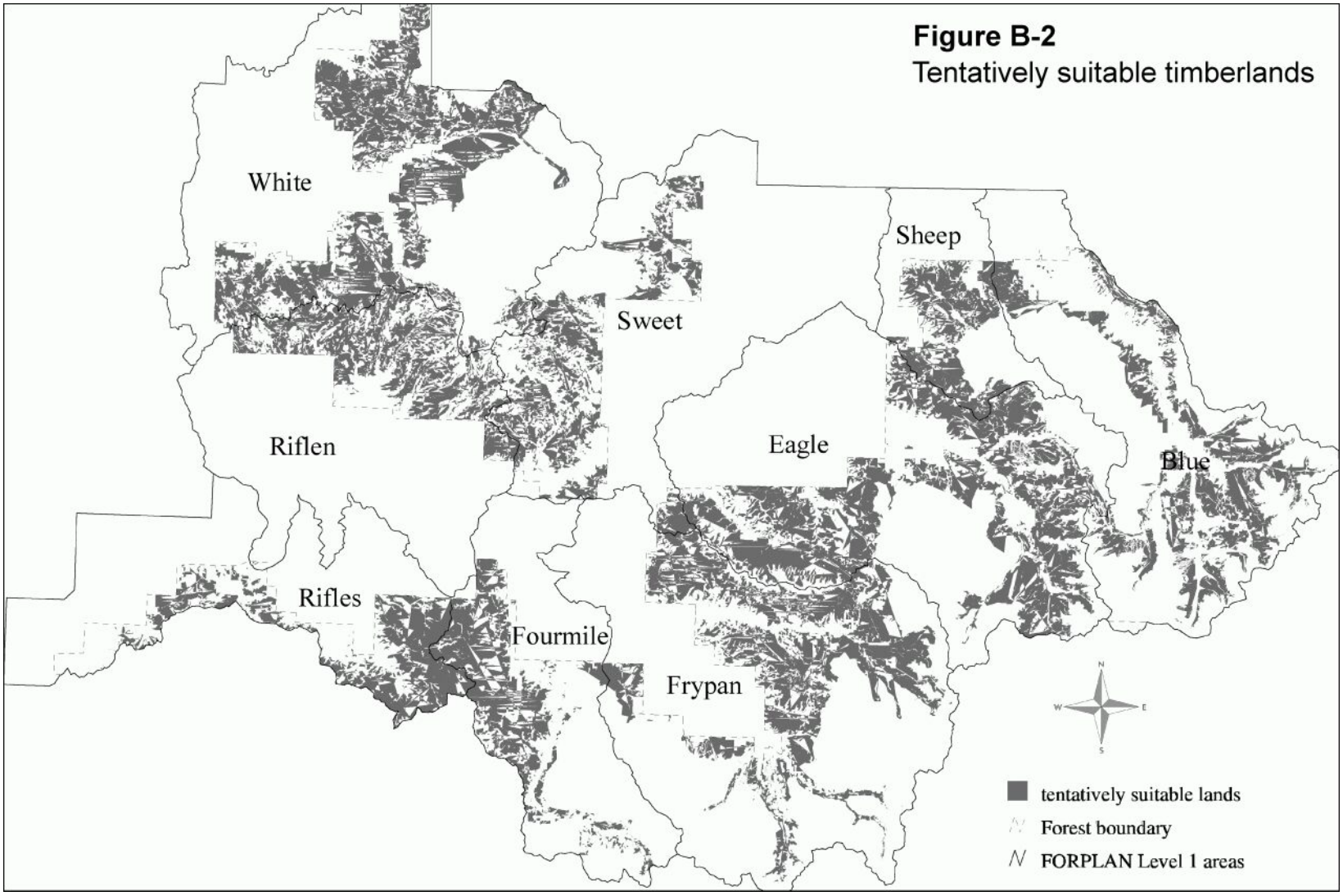


Figure B-2
General location of tentatively suitable timber lands



Is there reasonable assurance of adequate restocking within five years after harvest? This criteria is listed in 36 CFR 219.14(a)(3) [1], which states: There is not reasonable assurance that such lands can be adequately restocked as provided in § 219.27(c)(3) [1]. A forest-wide criteria was developed to identify sites where restocking could not be assured within five years following a final timber harvest [4]. The criteria used to identify lands incapable in regenerating within five years of final harvest were:

- Elevations above 11,200 feet with south and west aspects
- Elevations above 11,400 feet with north and east aspects
- Elevations below 7,800 feet.

From a soils standpoint, this would generally included soil map units having shallow and some moderately deep soils. These soils that do not reforest within five years would include many of the semi-forested soil units and the piñon-juniper units. Approximately 63,105 acres of forested land were identified as having conditions that have inadequate assurance of restocking.

Is the land withdrawn from timber production? This criteria is found in 36 CFR 219.14(a)(4) [1], which states: The land has been withdrawn from timber production by an Act of Congress, the Secretary of Agriculture, or the Chief of the Forest Service. These lands include wilderness, wilderness study areas, and research natural areas (RNA). The Forest has eight wilderness areas: Collegiate Peaks, Eagles Nest, Flat Tops, Holy Cross, Hunter Fryingpan, Maroon Bells-Snowmass, Ptarmigan Peak and Raggeds. In addition, the Forest has one RNA: Hoosier Ridge.

Is the land producing commercially usable timber? The last criteria is based on direction given in FSH 2409.13-21.3 [2], which states: Identify lands that are not capable of producing crops of industrial as unsuitable for timber production. The primary criterion for assigning lands to this category is the fact the species of trees involved are not currently utilized or likely to be utilized within the next 10 years. However, this does not preclude formulating an alternative to display management opportunities should a demand develop.

In summary, of the total national forest acreage, the following lands were eliminated: private, wilderness areas, RNAs, non-forested areas (water, shrub, grass, forb, barren), lands withdrawn for roads and utilities, lands not capable of producing industrial wood (noncommercial species), lands physically unsuitable, and lands with inadequate information. **Table B-1** displays the acreages of these withdrawals.

Table B-1
Suitable timber land (in acres) common to all alternatives

Classification	Withdrawals	2001 plan
Total lands within the National Forest boundary		2,481,950
Private	-195,510	
National Forest		2,286,440
Wilderness areas (749,379) and RNAs (328)	-749,707	
Non-forested land (524,188) and water (9,255)	-533,443	
Forested land		1,003,290
Roads (4,216) and utilities (1,736)	-5,952	
Not capable of producing industrial wood	-16,006	
Physically unsuited (irreversible damage, five-year restocking)	-136,005	
Inadequate information	-0	
Tentatively suitable timber land		845,327
Administratively withdrawn (total 101,344)		
100-foot buffer on roads (28,432) and trails (17,064)	-45,496	
100-foot buffer on lakes and streams	-18,612	
100-foot buffer on developed recreation sites	-5,736	
Old growth in spruce-fir types	-31,500	
Initial suitable timber land common to all alternatives		743,983

Maps were generated to reflect the above criteria. These maps were reviewed by district personnel for significant errors. This process resulted in identification of lands that are tentatively suitable for timber production. The tentatively suitable timber lands are common to all alternatives. The forest had approximately 888,000 acres of tentatively suitable acres during the last planning period, compared to 845,000 in this analysis. Differences are due to refined methods for determination.

Additional administratively withdrawn lands are then removed, including:

- 100-foot buffers on system roads, trails, streams, lakes, developed recreation sites (buffers do not mean there will be no harvest in those areas. They are included to prevent over-estimation of ASQ. Harvest in these areas will be determined through planning for individual projects, in which all applicable standards and guidelines will be considered)
- Old growth in spruce-fir cover types
- Management areas not suitable for timber production, and
- Certain cover types in Management Area 5.45 (spruce-fir, aspen, Douglas-fir).

Lands determined to be suitable for timber production were finalized by the ranger districts. Under Alternative C, 226,000 additional acres were withdrawn from suitable timber land acreage. Alternative C emphasizes only harvesting in previously treated areas. Therefore, the administratively withdrawn acres under Alternative C increased

from 455,000 acres to 681,000 acres while suitable timber lands decreased from 282,000 acres to 56,000 acres.

The acres that yet remain after all lands are removed are the suitable lands for each alternative as shown in **Table B-2** and on maps in the FEIS map packet.

The quantity of suitable acres varies by alternative because the allocation of lands to different management areas varies by alternative. The only management areas that have timber production as a goal (and thus contribute towards ASQ) are 5.12, 5.13, 5.40, 5.43, and 5.45. In these management areas, timber is managed on a regulated basis (scheduled basis). Timber harvest may occur on other management areas in conjunction with achievement of other objectives, but timber production is not a goal for these lands, and they are not included in calculation of the forest timber harvest schedule. **Table B-2** displays the suitable acres by alternative. Acreage breakdowns per Forest Service Manual Washington Office Amendment 2409.13-96-2 are shown in files in the administrative record (titled 'suit_report_<x>.txt').

Existing condition on suited lands

Land stratification is the process of splitting up the suitable timber lands into units that respond similarly to management actions and that have similar management requirements. **Table B-3** shows the attributes that were used for stratification of the suitable timber lands (in Spectrum, the selected attributes are called levels.) Each unique combination of the selected attributes is referred to as a *strata* or *analysis unit*.

The forest Geographic Information System (GIS) was used to delineate analysis areas according to the six attributes. Although this process is mostly automated, it was done iteratively, and adjustments made between iterations so that the resulting analysis areas are realistic, appropriate for timber harvest schedule modeling, and useful for implementation of the harvest schedule. One characteristic of this GIS process is that we end up with numerous very small polygons. These polygons constitute less than one percent of the suitable land base, but if entered into Spectrum, double the model size. Ideally, each polygon of less than 30 acres is added into the most similar analysis area. However, this process is unrealistically tedious. Rather than drop these polygons we elected to lump all polygons of less than 20 acres into a dummy watershed, sum the acres in each species/size/density, and set the management requirements all the same. In this way, analysis could be efficiently done with the Spectrum model, and yet still retain the possible contribution of these acres to the ASQ.

Table B-2
Acreage of suitable timber land by alternative

Classification	Acres
Tentatively suitable timber land common to all alternatives	845,327
Alternative B (additional admin withdrawals total 482,940)	362,387
Alternative C (additional admin withdrawals total 554,276)	291,051
Alternative D (additional admin withdrawals total 401,020)	444,307
Alternative E (additional admin withdrawals total 726,007)	119,320
Alternative F (additional admin withdrawals total 246,407)	598,920
Alternative I (additional admin withdrawals total 754,217)	91,110
Alternative K (additional admin withdrawals total 420,385)	424,942

Table B-3
Land stratification for Spectrum

Level	Description
1 – Watershed	USGS Cataloging Units (fourth-level watersheds). The Roaring Fork Cataloging Unit (14010004) is split into Fryingpan and Fourmile. The Upper Colorado River Cataloging Unit (14010001) is split into Sheephorn and Sweetwater. The Lower Colorado River Cataloging Unit (14010005) is split into Rifle north and Rifle south. The suitable timber acreage in each of these watershed areas is listed in Table B-4.
2 – Development	Developed versus undeveloped, in terms of existing roads
3 – Management area	Management area designation prescribed for the piece of ground by alternative.
4 – Scenic integrity objective	The Scenic Integrity Objective for the piece of ground based on the alternative. Scenic Integrity Objective is a combination of existing scenic integrity and landscape value as determined by the alternative.
5 – Species, size	This level is a concatenation of two items: dominant species and size class, determined using the recently completed Common Vegetation Unit inventory (CVU). Species used were lodgepole pine (LP), Douglas-fir (DF), spruce-fir (SF), and aspen (AS). Size classes were small (7), medium (8), and large (9). There are analysis areas that have almost every combination of the three items.
6	<40% slope versus >40% slope

Table B-4
Suitable acreage in each watershed by alternative

Watershed	Tentatively Suitable	B	C	D	E	F	I	K
Blue	77,851	6,650	31,004	41,954	28,561	46,681	0	33,422
Eagle	150,912	82,949	63,182	94,878	11,955	122,838	15,352	74,406
Fourmile	51,840	27,892	22,133	28,138	9,458	41,924	2,588	31,740
Fryingpan	112,442	38,427	20,428	56,419	6,391	80,300	25,896	48,002
Rifle North	56,374	46,230	14,344	41,219	11,263	52,854	5,230	47,479
Rifle South	47,433	36,065	39,878	38,483	26,965	43,245	9,674	41,247
Sheep	34,800	26,142	19,725	28,437	11,185	34,127	8,792	29,773
Sweet	61,051	22,777	23,251	39,393	2,239	53,835	5,450	45,374
White	137,030	69,593	50,812	68,484	7,889	115,416	15,554	66,328
Zdummy*	1,651	5,657	6,290	6,898	3,409	7,695	2,570	7,167
Totals**	845,327	362,387	291,051	444,307	119,320	598,920	91,110	424,942

**This is a collection of all analysis areas in each of the actual watersheds that are less than 20 acres. See stratification discussion.*
***Slight differences from Table B-2 due to rounding errors.*

Timber prescriptions and timing choices

Spectrum Levels 7 and 8 are used to define approaches to timber management. In the White River model, Level 7 is the silvicultural system (clearcut, shelterwood, and selection) and Level 8 is the variation of the silvicultural system (only used for the selection option; group selection and individual tree mark selection). Clearcutting is an option for all species except spruce-fir. Shelterwood cutting is an option for all species except aspen. Selection cutting is an option for Douglas-fir and spruce-fir only. To achieve a non-declining flow over time, Spectrum must be given flexibility on rotation age. **Table B-5** displays the rotation ages allowed for each species (The entire range of rotation ages shown are 95 to 100 percent of CMAI).

For each analysis area, Spectrum generates columns in the linear programming matrix for every management option/timing choice combination that can be applied to that analysis area. Based on constraints and an objective, Spectrum determines a schedule for cutting that includes specification of the harvest acres, silvicultural system(s), and rotation age(s) to apply to each analysis area.

Table B-5
Prescriptions for timber management in Spectrum

Species	Applicable silvicultural system	Rotation ages available in Spectrum	
		Timber/range management areas	Wildlife management areas
Aspen	Clearcut only	90-180	90-180
Lodgepole	Clearcut, shelterwood	90-200	90-200
Douglas-fir	Clearcut, shelterwood, selection	90-200	200-300
Spruce-fir	Shelterwood and selection only	90-200	200-300

Costs, returns, production functions and yields

Costs, revenues, and production functions for timber-related activities and outputs over the last decade were analyzed to determine the coefficients that should be entered in the timber harvest schedule model. Costs and revenues were inflated to a common base year of 1996. In some cases, data from adjacent national forests and the region were included in the evaluation. A summary of the coefficients included in the model is shown in **Tables A-6, A-7 and A-8**.

Costs, returns, production functions and yields

Sawtimber revenue figures reflect a four-year average of harvest values (revenues actually paid) for sawtimber on the forest inflated to a common base year of 1996. Most harvest on the White River has been tractor logged. The additional cost of yarding, felling and bucking, and overhead in cable logging was determined to be $182/MBF (thousand board feet). The additional cost was included in Spectrum as an activity found only on steep slopes. Helicopter logging costs from several salvage operations in Colorado indicate that helicopter logging costs are $304/MBF above tractor logging.

Costs, returns, production functions and yields

Using stand exam data as input, the Forest Vegetation Simulator (FVS) was used to generate numerous timber yield streams. Yields were generated for different species, age classes and treatment types. Based on review of these predictions of timber yield for variability, consistency, and anomalies, yield streams were selected for inclusion in the timber harvest schedule model. The model explicitly includes yield tables for clearcutting and selection cutting, as shown in **Table B-9**. Yields for shelterwood cutting are generated in the model by taking a proportion of the yields shown in the clearcutting option for a given species/age class/crown density combination. The shelterwood proportions included in the model are based on comparison of the clearcut and shelterwood yield streams produced by FVS, and are shown in **Table B-10**.

Table B-6
Costs and production functions in Spectrum

Item	Cost or revenue	Production relationship
Stand exam		
First entry	$12.47/acre	10 acre/acre harvest
Second entry	$12.47/acre	1.5 acre/acre harvest
Cultural resource Inventory		
First entry	$10.00/acre	1.5 acre/acre harvest
Second entry	$5.00/acre	1.5 acre/acre harvest
NEPA		
Developed areas	$9.08/MBF	1 MBF/MBF harvest
Undeveloped areas	$30.73/MBF	1 MBF/MBF harvest
Appeals	$5.12/MBF	1 MBF /MBF harvest
Sale prep		
Developed areas		
Clearcut	$25.64/MBF	1 MBF/MBF harvest
Shelterwood, group selection	$38.46/MBF	1 MBF/MBF harvest
Individual tree selection	$57.69/MBF	1 MBF/MBF harvest
Undeveloped areas		

Item	Cost or revenue	Production relationship
Clearcut	$29.49/MBF	1 MBF/MBF harvest
Shelterwood, group selection	$44.23/MBF	1 MBF/MBF harvest
Individual tree selection	$66.34/MBF	1 MBF/MBF harvest
Rights-of-way acquisition	$10,000/case	0.06/1 MMBF* (1/16.7 MMBF)
Sale administration		
Clearcut	$38.42/MBF	1 MBF/MBF harvest
All other treatment types	$45.32/MBF	1 MBF/MBF harvest
Law enforcement	$1.76/MBF	1 MBF/MBF harvest
Overhead	$5.04/MBF	1 MBF/MBF harvest
Cable logging (slopes >40%)	$182.00/MBF	0.5 MBF/1 MBF harvest
Helicopter log (slopes >40%)	$304.00/MBF	0.5 MBF/1 MBF harvest
Site prep (in conifer only)		
Clearcut	$150.00/acre	0.25 acre/acre harvest
Shelterwood seedcut	$150.00/acre	0.25 acre/acre harvest
Planting (in conifer clearcut)	$430.96/acre	0.01 acre/acre harvest
Certify regeneration		
Clearcut	$19.67/acre	0.61 acre/acre harvest
Shelter overstory removal	$19.67/acre	0.95 acre/acre harvest
Group or individual tree selection	$19.67/acre	1 acre/acre harvest
Precommercial thinning		
All lodgepole	$110.00/acre	1 acre/acre harvest
All selection	$110.00/acre	1 acre/acre harvest

**MMBF = million board feet*

Table B-7
Road costs and production functions in Spectrum

Item	Cost or revenue	Production relationship
Road local construction		
Developed areas		
First entry	$25,000/mile	0.0036 mile/acre harvest
Second+ entry	$25,000/mile	None
Undeveloped areas		
First entry	$25,000/mile	0.0043 mile/acre harvest
Second+ entry	$25,000/mile	None
Road local construction/preconstruction engineering	$9,000/mile	1 mile/mile road local construction
Road local construction/construction engineering	$6,000/mile	1 mile/mile road local construction
Road local reconstruction		
Developed areas		
First entry	$15,000/mile	0.0027 mile/acre harvest
Second+ entry wildlife management areas	$7,000/mile	0.0052 mile/acre harvest

Item	Cost or revenue	Production relationship
Second+ entry other management areas	$7,000/mile	None
Undeveloped areas		
First entry	$15,000/mile	0.001 mile/acre harvest
Second+ entry wildlife management areas	$7,000/mile	0.0036 mile/acre harvest
Second+ entry other management areas	$7,000/mile	None
Road local reconstruction/preconstruction engineering		
First entry	$6,000/mile	1 mile/mile road local reconstruction
Second+ entry	$2,500/mile	1 mile/mile road local reconstruction
Road local reconstruction/construction engineering		
First entry	$6,000/mile	1 mile/mile road local reconstruction
Second+ entry	$2,500/mile	1 mile/mile rd local reconstruction
Road collector construction	$65,000/mile	4.8 mile in first decade, Alt F only
Road collector construction/preconstruction engineering	$23,000/mile	1 mile/mile road collector construction
Road collector construction/construction engineering	$16,000/mile	1 mile/mile road collector construction
Road collector reconstruction	$55,000/mile	0.003 mile/acre harvest
Road collector reconstruction/ preconstruction engineering	$7,500/mile	1 mile/mile road collector reconstruction
Road collector reconstruction/construction engineering	$7,500/mile	1 mile/mile road collector reconstruction
Road maintenance	$833/mile	0.0054 mile/MBF harvest
Road maintenance engineering	$295/mile	1 mile/mile road maintenance
Road obliteration		
Developed areas wildlife management areas	$2,000/mile	0.0052 mile/acre harvest
Undeveloped areas wildlife management areas	$2,000/mile	0.0036 mile/acre harvest
Non-wildlife management areas	$2,000/mile	None

Table B-8
Returns and production functions in Spectrum

Item	Cost or revenue	Production relationship
Conifer revenues	$210.70/MBF	See timber yields discussion
Aspen revenues	$16.50/MBF	See timber yields discussion
Openings		
Clearcut	—	1 acre for 20 years/acre harvest
Seed cut in shelterwood	—	1 acre for 20 years/acre harvest
Structural stages	—	See structural stage discussion
Snags	—	See snags discussion

Table B-9
List of timber yield tables in Spectrum

Even age

Existing stands*				Regenerated stands
Aspen	**Douglas-fir**	**Lodgepole**	**Spruce-fir**	
AS7_CCE (30)	DF7_CCE (10)	LP7_CCE (70)	SF7_CCE (20)	AS_CCR
AS8A_CCE (70)		LP8A_CCE (100)	SF8A_CCE (120)	DF_CCR
AS8B_CCE (70)	DF8_CCE (110)	LP8B_CCE (100)	SF8B_CCE (120)	LP_CCR
AS8C_CCE (70)		LP8C_CCE (100)	SF8C_CCE (120)	SF_CCR
AS9A_CCE (90)		LP9A_CCE (110)	SF9A_CCE (130)	
AS9B_CCE (90)	DF9_CCE (140)	LP9B_CCE (110)	SF9B_CCE (130)	
AS9C_CCE (90)		LP9C_CCE (110)	SF9C_CCE (130)	

Uneven age

Douglas-fir		Spruce-fir	
DF7_GRP2	Entry 1-4, 20-year interval**	SF7_GRP2	Entry 1-4, 20-year interval**
DF7_GRP4	Entry 1-4, 40-year interval	SF7_GRP4	Entry 1-4, 40-year interval
		SF7_IT2	Entry 1-4, 20-year interval
		SF7_IT4	Entry 2-5, 40-year interval
DF8_GRP2	Entry 1-4, 20-year interval	SF8_GRP2	Entry 1-4, 20-year interval
DF8_GRP4	Entry 1-4, 40-year interval	SF8_GRP4	Entry 1-4, 40-year interval
DF8_IT2	Entry 1-4, 20-year interval	SF8_IT2	Entry 1-4, 20-year interval
DF8_IT4	Entry 1-4, 40-year interval	SF8_IT4	Entry 1-4, 40-year interval
DF9_GRP2	Entry 1-4, 20-year interval	SF9_GRP2	Entry 1-4, 20-year interval
DF9_GRP4	Entry 1-4, 40-year interval	SF9_GRP4	Entry 1-4, 40-year interval
DF9_IT2	Entry 1-4, 20-year interval	SF9_IT2	Entry 1-4, 20-year interval
DF9_IT4	Entry 1-4, 40-year interval	SF9_IT4	Entry 1-4, 40-year interval

**CCE=clearcut existing stands. Shelterwood cut volumes are based on percentages of clearcut volumes as shown in table B-10. Average age at beginning of planning cycle is shown in parenthesis. 7 = small, 8 = medium, 9 = large; ABC is crown density, where A = 0-40%, B = 40-69%, C = 70+%; GRP = group selection (opening size <= 1 1/2 tree height); IT = individual tree selection*

***The decade from the beginning of the planning horizon in which entries begin. There is a separate yield table for each decade of first entry.*

Table B-10
Shelterwood proportions used in Spectrum

Species	Interval between shelterwood cuts (years)	Shelterwood proportions*				
		2-step		3-step		
		Seed	Removal	Prep	Seed	Removal
Lodgepole	10	0.6	0.4	0.3	0.4	0.3
Douglas-fir	20 or 40	0.55	0.45	0.3	0.4	0.3
Spruce-fir	20 or 40	0.55	0.45	0.3	0.4	0.3

**Proportion of the volume shown in the clearcut yield stream that gets taken.*

Costs, returns, production functions and yields

The primary tool used for estimating growth and yield used in the Spectrum model is the FVS model, formerly called Prognosis. FVS is an individual-tree, distance-independent, growth and yield model. It has its structural roots in the Stand Prognosis Model developed by Albert Stage from the Intermountain Research Station. Staff at the USFS Forest Management Service Center in Fort Collins have now calibrated sixteen additional variants of the model to specific geographic areas throughout the West, Midwest, and northeastern United States.

FVS allows the user to calculate estimates of forest stand structure and species composition over time and quantify this information to (1) describe current and future forest stand conditions, (2) simplify complex concepts of forest vegetation into user-defined indices, attributes, etc., and (3) allow the manager to ask better questions about growth and yield of forested stands and complete analyses to answer those questions. FVS uses actual forest stand data selected from the forest's RMRIS database to project growth and yields for future outputs.

The FVS model structure contains modules for growing trees; predicting mortality; establishing regeneration; simulating growth reductions, damage, and mortality due to insects and disease; performing management activities; calculating tree volumes; and producing reports. One of the strengths of the FVS system is its ability to incorporate local growth rate data directly into the simulation results.

There are several steps in building the growth and yield tables. The first step was to stratify the forest. Based on the issues and the availability of data, forested areas were stratified by major cover type, size class, and density. The major cover types used were lodgepole pine, Douglas-fir, Engelmann spruce/subalpine fir, and aspen. Size classes were defined as small, medium, and large. Density classes used were low (less than 40 percent average maximum density), medium (40 to 70 percent average maximum density), and high (greater than 70 percent average maximum density).

The next step was to generate a sample of forest stand data. To have a statistically sound sample, it was determined that 600-forested stands should be selected to represent the forest. A minimum of five stands was set to represent any strata. Six hundred stands were then selected from across the forest by a Sample Stand Selection computer program developed by Dan Greene. Additional stands were selected to complete the minimum stands per strata. There were additional stands selected to fully represent the non-stocked/seedling strata in various cover types.

The inventory data from these stands was then used in the FVS program to show present volumes and predict future growth and yield. Outputs of the FVS program were compared to the outputs of the RMSTAND program. FVS was then calibrated so that outputs were similar to the RMSTAND program. Large tree diameter scale factors were calculated from base FVS runs and inserted into the FVS program for future predictions. Utilization standards within FVS were adjusted to the current standards for the forest. Mortality adjustments were made in FVS to reflect the actual growth patterns shown by the RMSTAND program. Finally, the defect factors used in the RMSTAND program were converted to similar defect factors used in FVS.

Verifications were then made on the FVS outputs. Permanent plot data had previously been remeasured on the forest. The difference in the original plot data and the remeasured plot data was compared to growth predictions of the FVS model. It was found that the

FVS outputs were very accurate to the growth found in the remeasured plots. Average growth data from the original stand exam data was calculated showing +/- one standard deviation of the data around the mean and compared to averages of the same data from the FVS runs. It was found that the predicted values of the FVS runs were within one standard deviation of the actual data.

Standard reports such as summary tables of trees per acre, basal area, cubic foot volume, etc., as well as stand structure and species composition tables, were developed for all stands used in the predictions. Values from these tables were then used to build the yield tables used in the Spectrum.

Openings

It was recognized that the length of time that a harvest is considered to be an opening varies depending on perspective. The watershed, wildlife, and scenery resource specialists determined that, for the purposes of evaluating timber harvest schedules, the production function of one acre of opening for twenty years per acre harvest is adequate.

Structural stages

Two methodologies were available for calculating structural stage on suitable timber lands, an FVS method and a general method. In the FVS method, probable structural stage from projections of stand character are calculated. In the general method, assumptions are made relative to the age distribution of existing timber and the structural stage at various stand ages. These assumptions are represented by the coefficients shown in **Table B-11**, **Table B-12**, and **Table B-13**. The general method was selected for use because it better represents the actual age distribution and structural stage of existing timber.

Snags

The number of dead trees per acre for each silvicultural and rotation age option was calculated along with timber yields using FVS as discussed in the timber yields section above.

Table B-11
Age class distribution of existing conifer stands

	Percent of total acres in the size class in each age class											
	Size 7 (small)				Size 8 (medium)				Size 9 (large)			
	Data from RMRIS			Model	Data from RMRIS			Model	Data from RMRIS			Model
Age	LP	DF	SF		LP	DF	SF		LP	DF	SF	
11-20	0.20		0.13	0.17								
21-30			0.24	0.12			0.03					
31-40			0.10	0.05	0.02		0.03					
41-50	0.02		0.10	0.06	0.03	0.09	0.06					
51-60	0.09		0.10	0.09	0.11	0.01	0.14	0.20	0.04		0.02	
61-70	0.15		0.12	0.13	0.21	0.35	0.16	0.24	0.10	0.02	0.05	
71-80	0.36		0.21	0.38	0.21	0.03	0.16	0.13	0.18	0.09	0.09	
81-90	0.10				0.21	0.03	0.06	0.10	0.19	0.08	0.09	0.31
91-100	0.08				0.09	0.11	0.05	0.08	0.12	0.11	0.10	0.11
101-110					0.05	0.06	0.02	0.25	0.09	0.10	0.10	0.10
111-120					0.07	0.19	0.03		0.04	0.10	0.08	0.07
121-130							0.07		0.04	0.07	0.09	0.06
131-140							0.02		0.03	0.20	0.07	0.04
141-150						0.10	0.01		0.03	0.09	0.05	0.31
151-160						0.03	0.16		0.02	0.05	0.04	
161-170									0.03	0.04	0.05	
171-180									0.03	0.01	0.03	
181-190									0.02	0.02	0.04	
191-200									0.04	0.01	0.02	
201-210										0.02	0.02	
211-220										0.17	0.09	

Table B-12
Age class distribution of existing aspen stands

	Percent of total acres in the size class in each age class					
	Size 7 (small)		Size 8 (medium)		Size 9 (large)	
Age	Data from RMRIS	Model	Data from RMRIS	Model	Data from RMRIS	Model
11-20	0.14	0.14				
21-30	0.27	0.27				
31-40	0.02	0.02				
41-50	0.35	0.35	0.12	0.14		
51-60	0.07	0.22	0.23	0.23	0.05	
61-70			0.32	0.32	0.16	0.21
71-80	0.06		0.16	0.16	0.33	0.33
81-90	0.09		0.10	0.15	0.19	0.19
91-100			0.05		0.15	0.15
101-110					0.10	0.12
111-120					0.02	

Table B-13
Structural stage at various ages

Structural stage	Aspen age	Conifer age
SS1	1-10	1-10
SS2	11-30	11-40
SS3	31-50	41-80
SS4	51-80	81-140
SS5	81-140	151+
	141-200 (conifer SS4)*	
	201+ (conifer SS5)	

**As aspen gets older, it gives way to conifer.*

Development of standard constraints

Various statutory and regulatory requirements must be met when harvesting timber on National Forest System lands, including:

- Non-declining flow and long-term sustained yield, and
- Water quality and watershed protection.

Constraints are included in the model to portray the effect of these requirements. Other constraints are needed to force the harvest schedule model to behave in a manner that reflects the realities of timber management on the forest. Demand for timber products, typical harvest methods, and available budgets are examples of these realities that must be accommodated. And still more constraints are added for resource protection, multiple use coordination, or other reasons, according to the emphasis of each alternative. All constraints included in the model are discussed below.

Non-Declining Flow

The total harvest volume cannot decline from one decade to the next, and the harvest volume in the final decade cannot be less than the long-term sustained yield. These are standard constraints established in the forest planning regulations.

Conifer and aspen flow

In preliminary runs of the model, aspen and conifer harvest sometimes wildly fluctuated from decade to decade. Upon investigation, it was determined that this was not due to faulty model design but rather with the initial age distribution of timber. Even though the legal requirement for non-declining flow applies to the sum of the harvest volume for all species, the timber products industry needs a somewhat steady flow of individual products. A flow constraint on aspen harvest volume is included for this purpose. Because aspen and conifer volumes are linked in the non-declining flow constraint, a flow constraint on one of the two products is sufficient to control flow on both products. The formulation for this flow constraint is that the harvest volume in Decade t+1 must be at least 0.3 of the harvest volume in Decade t, and no more than 1.7 of the harvest volume in Decade t (for example).

Conifer and aspen harvest minimums

Another component to sustaining a timber products industry is to harvest some of each product every decade. Constraints for conifer and aspen harvest minimums were included for this purpose. The Forest Leadership Team selected 0.5 MMBF per year as the standard minimum aspen harvest for all alternatives. The actual conifer minimum used was not deemed critical because it was only applicable in Decades 7-12. The effect of

varying this minimum was not evaluated (3 MMBF was the minimum used in all alternatives).

Aspen harvest maximum

There is limited demand for aspen wood products on the forest primarily because of the distance to processing facilities (Olathe) and the low prices. All alternatives include a ceiling on aspen harvest of 3 MMBF per year for Decades 1-3, however, with a maximum PNV objective function, this constraint was never binding. For Decades 4-30, the ceiling was set to approximately 10 MMBF per year. This allows for the possibility that demand for aspen could eventually increase. The maximum aspen harvest constraint was not included for the maximum timber run for each alternative or for the maximum timber benchmark.

Harvest methods

When planning individual timber projects, certain patterns in the harvest methods selected have emerged. These patterns are a result of interdisciplinary application of forest plan standards and guidelines, and therefore should be included in the harvest schedule model. Harvest method constraints were added to approximate these patterns, as shown in **Table B-14**.

Table B-14
Harvest method constraints

	Percent of harvest to be accomplished by each method							
	Aspen		Lodgepole		Douglas-fir		Spruce-fir	
	Even	Uneven	Even	Uneven	Even	Uneven	Even	Uneven
General method	100	–	100	–	90	10	90	10
Specific method								
Clearcutting	–	–	65	–	5	–	–	–
2-step shelterwood	–	–	10	–	45	–	25	–
3-step shelterwood	–	–	25	–	40	–	65	–
Coppice	100	–	–	–	–	–	–	–
Seed tree	–	–	–	–	–	–	–	–
Group selection	–	–	–	–	–	5	–	5
Individual tree selection	–	–	–	–	–	5	–	5

Species mix

Ninety-eight percent of existing conifer stands are 100 or more years old (sizes 8 and 9). The maximum rotation age allowed in non-wildlife management areas (the majority of acres in most alternatives) is 200 years. The implication of these factors is that somewhere around Decade 6-10, there is essentially no conifer to cut, because the size 8 and 9 had to be cut by age 200. To obtain feasible solutions, it was necessary to allow rotation ages beyond 200 years in order to carry some standing volume into periods 10-15 (200 years is the maximum age stands should be carried to from a timber yield perspective). This was done for Douglas-fir and spruce-fir but not for lodgepole, because lodgepole cannot be carried that long due to severe stand deterioration beyond 200 years.

As a consequence of extending rotation ages for Douglas-fir and spruce-fir, the model tended to harvest nothing but lodgepole in Decade 1. A constraint was added to ensure that both lodgepole and spruce-fir are harvested in Decades 1-3. This is important

because projects are almost always planned in areas with a mixture of species, and ecosystem and/or multiple-use considerations at the watershed level usually call for harvest of some spruce-fir.

Wildlife habitat and water quality

To help ensure that the amount and distribution of timber harvest across the landscape are compatible with wildlife and watershed resources, constraints on the amount of harvest openings allowed within each fourth-level watershed were included. The interdisciplinary team recognized that amount of openings acceptable is variable based on perspective and circumstances. It was agreed that for the purpose of forest-wide ASQ determination, a limit of 30 percent of a watershed in openings would be used.

Scenic integrity

To help ensure that the level and distribution of harvest is feasible considering scenic issues, constraints were included on the openings allowed in area of "low" and "moderate" scenic integrity (less than 10 percent of the moderate scenic integrity areas forest-wide in openings in any decade; less than five percent of the low scenic integrity areas forest-wide in openings in any decade). These percentages were set by the interdisciplinary team.

Harvest on steep slopes and in undeveloped areas

Harvest schedule models, which include economics, tend to defer harvest in areas with lower net revenues till later decades, for example, in areas requiring more road construction, cable logging, or helicopter logging. Flow constraints were added to attenuate this tendency.

Emphasis of particular alternatives

Almost all of the differences between alternatives are accommodated through variation in the lands considered to be suitable for timber harvest. Other differences include:

- In all alternatives except Alternative B, selection cutting in wildlife management areas is done with a 40-year reentry interval.
- In Alternative F, 4.8 miles of collector road construction is scheduled in decade 1.

Budget limitations

- Constraints are included so that the cost of the timber program is no greater than historic and anticipated budget levels.

Runs were made for each alternative for three budget levels: unlimited, the *experienced* budget level, and an *experienced x 1.5* budget level. These three budget levels are shown in **Table B-15**.

Table B-15
Timber budget levels

Run	Budget level (million dollars per year)		
	Unlimited	Experienced	Experienced x 1.5
Alternative B	4.41	2.190	3.291
Alternative C	3.69	0.820	1.234
Alternative D	5.89	1.640	2.468
Alternative E	1.76	0.820	1.234
Alternative F	7.55	3.428	5.142
Alternative I	1.21	0.960	1.440
Alternative K	5.13	1.920	2.880
Alternative T*	8.12	2.44	3.65

**Benchmark runs*

Sensitivity analysis and benchmarks

Model sensitivity was evaluated and discussed in Appendix B of the DEIS. This analysis was not repeated between the DEIS and FEIS for several reasons, including:

- Limited controversy and few challenges on timber analysis process relative to Spectrum modeling
- Public comments and internal review did not reveal significant flaws in the analysis process
- Low expectation of gaining much additional understanding by repeating the sensitivity analysis process

Four benchmark runs were done on the tentatively suitable land base, corresponding to the four runs done for each alternative (see below).

Identification of a timber program for each alternative

Four runs were made for each alternative:

- **Run 1** – objective function of max timber in decade 1 followed by max PNV decades 1-5; aspen harvest minimum of 0.5 MMBF/yr; no limit on budget or aspen harvest. This run establishes a theoretical max timber harvest for the alternative, if economics were to be ignored.
- **Run 2** – objective function of max PNV decades 1-5; aspen harvest minimum of 0.5 MMBF per year; no limit on budget. This run establishes a theoretical maximum ASQ for the alternative.
- **Run 3** – objective function of max PNV decades 1-5; aspen harvest minimum of 0.5 MMBF per year; budget limited to *experienced*. This run establishes the probable max harvest level given a limited budget.
- **Run 4** – objective function of max PNV decades 1-5; aspen harvest minimum of 0.5 MMBF per year; budget limited to *experienced times 1.5*. **This run establishes the ASQ for the alternative** (more discussion below).

Results of Runs 1-4 are shown in **Figure B-5**. The maximum PNV runs (Run 2) can produce almost as much volume as the maximum timber runs (Run 1), and do it more efficiently.

The unlimited budget run for each alternative (Run 2) would normally be used as the upper limit on annual timber harvest in the first decade. However, based on historic green volume offered, green volume sold, and existing mill capacity, the interdisciplinary team and Forest Leadership Team determined that the harvest levels associated with limited budgets were more appropriate for analysis and disclosure of effects.

Mill facilities dependent on green sawtimber volume from the forest extend from Saratoga, Wyoming to Delta, Colorado. The output needed to maintain these facilities is about 30 MMBF of green sawtimber volume, based on analysis from the Routt National Forest plan and analysis of trends over the last ten years. The volume capacity for sawtimber from the White River National Forest for the Routt *timbershed*, adjusted for mill closings, is about 19 MMBF. The local capacity and capacity for mills south of the White River is about 11 MMBF.

The majority of the local purchasers generally do not process green volume. The average green volume offered for sale between 1987-97 was 14.3 MMBF. The average green volume sold between 1987-1997 was 9.1 MMBF. Both offered and sold volumes are substantially lower than the ASQ calculated assuming unlimited budgets, in Alternatives B, D and F.

Mill capacity for green volume from the forest is calculated at 30 MMBF. The ASQ calculated with unlimited budgets exceeds mill capacity in Alternative F (exceeds by about 45 percent) and Alternative B (exceeds by about 15 percent).

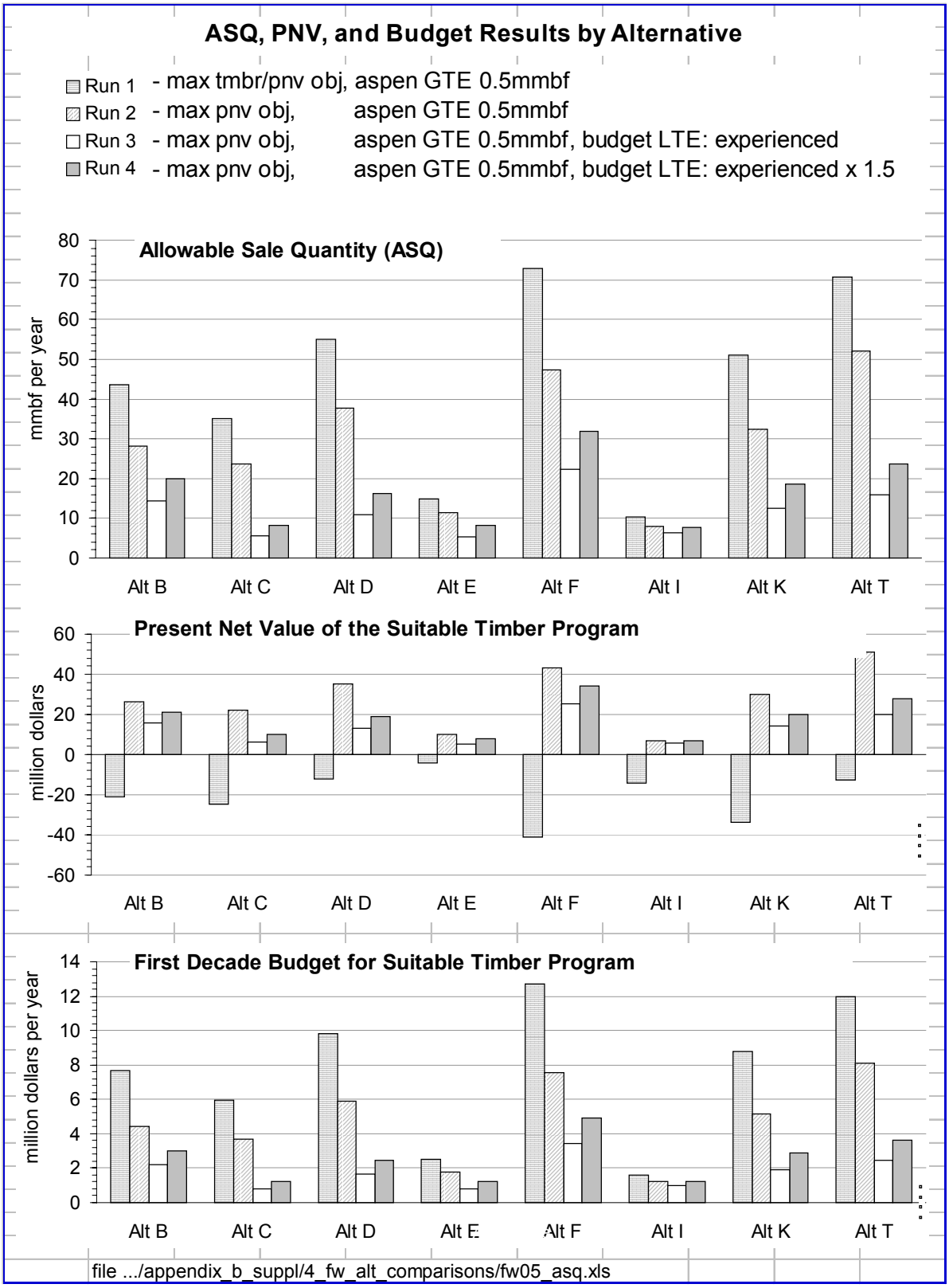
Local purchasers had developed a specialty market drawing upon supplies of dead Engelmann spruce killed during the 1940s spruce beetle epidemic. This group historically has used limited volumes of green timber and is not expected to use increasing volumes in the near future.

Therefore, further ASQ analysis and alternative comparisons were based on the experienced budget and full implementation budget levels, and the environmental consequences section of the FEIS addresses only the effects of these harvest levels.

Actual timber harvest might be less than even the level associated with limited budgets due to:

- Funding being lower than predicted
- Limited timber products industry capacity in the area

Figure B-3
Analysis of timber programs by alternative



- Site-specific analysis of particular timber harvest projects that identify more severe restrictions on timber harvest than were included in the forest-wide harvest schedule analysis
- Decision-maker discretion on balancing resource objectives in particular areas
- National policy on below-cost timber programs

RECREATION ANALYSIS

The recreation management topic revolves around the variety and mix of recreation opportunities that will be provided, taking into account recreation carrying capacities and resource protection measures. There were several processes conducted to analyze the issues associated with the recreation management topic. A summary of these steps follows.

Recreation opportunity Spectrum

The recreation opportunity Spectrum (ROS) is a system for classification of outdoor recreation opportunity environments. Limitations to the ROS data include:

- ROS boundary lines on the maps are estimations and are not exact.
- ROS mapping is not an exact science, and it may be subject to various interpretations.

Existing condition ROS maps and adopted summer and winter ROS maps for each forest plan alternative were developed. Quadrangle maps and ROS overlays from the previous forest plan effort were used as a starting point to produce an existing condition summer ROS map. In combining electronic data analysis with field expertise and common sense, ranger district personnel were able to produce a summer ROS map reflecting management and conditions as of 1997. We felt that conditions had not changed in management strategies affecting ROS since 1997, thus no additional update was done for the FEIS.

The existing forest travel management map and portions of the existing summer ROS inventory such as ski areas, wilderness and areas along interstate or state highways were used as a starting point to produce an existing condition winter ROS map. A winter travel routes and play areas map was created and used as an overlay to identify potential mapping conflicts. In combining these data with field expertise and common sense, ranger district personnel were able to produce a winter ROS map reflecting management and conditions as of 1997.

After alternative maps, depicting a variety of management areas, were produced; district personnel were able to produce adopted summer and winter ROS maps for each alternative. These maps were reviewed with the travel management strategies to identify conflicts between travel management and the ROS. Adjustments were made so that the ROS and travel management strategies were compatible. Detailed process information is available in the project file.

Recreation carrying capacity

Land managers and segments of the public are asking at what point does continued or expanded recreation use cause the experiences that are being sought after to be diminished, and at what point does recreation use cause unacceptable effects on the natural resources of the forest. These questions were addressed through carrying capacity

analysis. One determinant of carrying capacity is ROS classification of a given piece of ground. Limitations to the capacity analysis include:

The capacity figures are forest-wide estimates requiring further site-specific analyses before public, commercial, and semi-institutional use percentages can be determined at the district level. Coefficients used to calculate dispersed capacities are on the following **Table B-15A**.

Table B-15A
Maximum use and capacity levels

ROS class – physical feature measured	Recreation use coefficients[1] Very low	Low	Moderate	High
Pristine – area-wide[2]	1	2	7	25
Primitive – on trails[3]	1	2	6	7
Semi-primitive non-motorized – on trails	2	3	9	11
Semi-primitive motorized – on roads & trails[3]	2	3	9	11
Roaded natural – on roads & trails	15	23	68	83
Roaded modified – on roads & trails	15	23	68	83
Rural – on roads & trails	21	32	95	116

Notes: *[1]The range of coefficient levels is base on the vegetation's ability to screen users. Very low and low apply to rock, mountain grass, and clearcuts 1-20 years old. Moderate applies to mountain grass, mature and pole-sized ponderosa pine, mature aspen, shelterwood cuts 90 to 120 years old, and clearcuts 80-120 years old. High applies to mature and pole-size spruce, pole-size aspen and clearcuts 20-80 years old. [2]Area-wide coefficients are based on People at One Time (PAOT) per 1,000 acres. [3]On trail and road coefficients are based on PAOT/mile of trail or road.*

Developed recreation (excluding downhill ski areas) capacities are compiled within the Infrastructure database. Dispersed recreation capacities for summer/fall and winter/spring are compiled using a GIS environment with review and analysis by ranger district personnel. Detailed process information is available in the project file.

Use, demand and needs analyses

Recreation use. Use information was taken from the 1997 Infrastructure report. It was determined that this one-year snapshot of use data was more accurate that using an average of 3 years data because a concerted effort was made by the forest in 1997 to collect more detailed and accurate use figures than had been done the two previous years. Much of the information was provided by District personnel with the use of road and trail traffic counts, trailhead vehicle counts, personal surveys, trailhead registers, Colorado Division of Wildlife (CDOW) data for big game hunting, personal contacts during hunter and other patrols, permittee use reports, and campground concessionaire reports. It is recognized that some of this data lacks credibility in that statistical evaluation has been limited.

Use projections. Reported recreation use for 1997 was used as a starting point. Use reported by districts was lumped into 3 zones across the forest by similarity of user origin. Each use type was calculated separately by INFRA classification. The 1997 use levels were further divided into estimates for resident and non-resident participants. Projections for non-resident use rate increases came from a variety of research and other

documents with use projections for a specific use. Where no documented research was available, use rate increases for a similar type use were used. Use rate increases for resident use came from projected population increases in the counties on the forest associated with the zones. Each use was then projected out to 3 periods—year 2000, year 2010 and year 2020. All data is available in the project file.

Future needs. Developed recreation needs were determined by applying the 40 percent utilization rule to each sites' theoretical capacity and comparing these with projected future use in years 2010 and 2020. Dispersed recreation needs were determined by comparing current winter and summer theoretical capacities to projected future use in years 2010 and 2020. Information from Cordell (et. al. 1990 and 1993) regarding future outdoor recreation demands was also incorporated. All of the above data is available in the project file.

Economic analysis

To complete the Economic Impact and Efficiency Analysis, current (year 2000) and projected (year 2010) recreation use by alternative was estimated for:

- Summer mechanized use
- Winter non-motorized use
- Summer motorized use
- Winter motorized use
- Summer non-motorized/mechanized use
- Hunting big game
- Hunting small game
- Fishing
- Viewing wildlife
- Developed recreation use

This use data was displayed forest-wide as well as by zone. The regional economist defined three zones on the forest: the Eagle, Holy Cross, and Dillon Ranger Districts Zone; the Rifle, Sopris, and Aspen Ranger Districts Zone; and the Blanco Ranger District Zone.

Use projections incorporated data described above. In determining future demand (by alternative) for some categories, an assumption was made that a minimum of 20 percent of the ROS setting had to be affected in order to change demand. Detailed use information is available in the Recreation Economic Analysis section of the project file.

Resident/nonresident ratios for each category of use were made using BLM data, CDOW data, forest developed use data, and professional judgment. Specific ratios for each category and rationale on how they were derived are available in the Recreation Economic Analysis information located in the project file.

Unit cost data for activities such as trail maintenance or developed (PAOT) construction and reconstruction was derived from the budget analysis process. These costs are available in the recreation budget analysis spreadsheets located in the project file.

Budget analysis

The final step in the process was to determine just how much could be accomplished with two different budget levels. This analysis includes a realistic three-year average budget level (referred to as the *experienced budget*) and a *full implementation* budget level (experienced budget times 1.5). At the experienced level, budgets are constrained to the

forest's FY98-00 average budget expenditures. At the full implementation level, budgets are constrained to no more than 150 percent of the experienced budget level. In FEIS Volume 2, Chapter 2, the Supplemental Table 14 displays budget costs by alternative.

Using professional judgment, the recreation budget was divided into its corresponding cost centers according to the theme of each alternative. Recreation's portion of road closure costs by alternative was subtracted from its original allocations. The road costs that were funded were proportional to other recreation programs being funded. Capital Investment Program dollars were not incorporated into the constrained budgets. Detailed recreation budget analysis spreadsheets are available in the project file.

In this analysis, activities include developed site construction and reconstruction, dispersed site rehabilitation or reconstruction, trail maintenance and construction/reconstruction, and administration of recreation special use permits. In Chapter 2, the Supplemental Table 16 displays activity measures and outputs by alternative.

ECONOMIC, AND LOCAL GOVERNMENT IMPACT ANALYSES

The purpose of this portion of Appendix B is to provide interested readers with additional details regarding the social and economic analyses. This section does not provide sufficient information to replicate the analysis. For that level of detail, the companion specialist reports contained in the administrative record should be consulted.

The Models

Economic effects to local counties were estimated using an economic input-output model developed with IMPLAN Professional 2.0 (IMPLAN). IMPLAN is a software package for personal computers that uses the latest national input-output tables from the Bureau of Economic Analysis, secondary economic data at the county level from a variety of public sources, and proprietary procedures to develop an input-output model for a study area. The software was originally developed by the Forest Service and is now maintained by the Minnesota IMPLAN Group, Inc (MIG).

Two data sources were used in developing the White River National Forest models. The most recent data available from MIG are for 1998. The State of Colorado, Department of Local Affairs, Division of Local Governments, Demography Section (CDS) has been working closely with counties in the White River planning area to establish mutually agreed-upon estimates of population, employment and personal income for current conditions (1999) and projections out to 2020. Employment estimates for 1999 were used to calibrate the IMPLAN models. This was done using ouput per employee and similar ratios from MIG with employment estimates from CDS.

Only one model was developed for the DEIS. Several public comments suggested that a single model was not sufficient to understand impacts on a more local level. Concurring with these comments, three additional models were developed for the planning area. One model was developed which included all six counties (6-county): Eagle, Garfield, Lake, Pitkin, Rio Blanco, and Summit. This model was updated from the DEIS by using the most recent available data. Another model was developed for the area most impacted by the Front Range. This one included Eagle, Summit, and Lake counties (ESL). A third model was developed for the Roaring Fork Valley and associated Colorado Valley. This one included Garfield and Pitkin counties (GP). The last model included only Rio Blanco County. The delineation of model areas was based primarily on including the primary

labor markets with local economic centers. The 3-county area of Eagle, Summit, and Lake counties is recognized by the Colorado Department of Labor as one "labor market area." Garfield and Pitkin counties do not carry the same designation from the state, but operate in a similar manner. Rio Blanco County is very different from the rest of the area and does not have a strong, well-defined commuting element to its local economy. Although Rio Blanco County is distinct from the multi-county areas and modeled separately, this analysis position should not be understood as classifying the county as a relatively self-contained, functional economy.

Dependency Analysis

The IMPLAN model was used to assess the economic dependencies of the White River National Forest planning area. Economic dependency is a way of assessing the strength of regional or local economies. Regional economies generally depend most on their exports to sustain local income and employment. Based on this data, it is reasonable to estimate economic dependency by examining an area's export base.

The export base analysis done for this EIS measured the total contribution of one sector or industry to the economy. The total contribution (direct, indirect, and induced) was determined by multiplying the export and federal government portions of final demand by the Type SAM output multiplier. The results were then compared with the planning area's total economic output.

The role of tourism in the economy relied upon both data from CDS and MIG. CDS employment data was for direct tourism effects only. To permit a more comprehensive examination of tourism, multipliers from the IMPLAN models were applied. Multipliers of total employment (direct, indirect, and induced) per employee of direct employment for numerous retail and service sectors were examined. Representative multipliers were then selected for this analysis.

Forest Contribution and Economic Impact Analyses

Impact analysis describes what happens when a change in final sales (e.g. exports and residents) occurs for goods and services in the model region. Changes in final sales are the result of multiplying production data (e.g., head months of grazing or recreation visitor days (RVDs) of recreation) times sales. Economic impacts were estimated for 2010 using the best available production and sales data. Retail margins were accounted for in the analysis. The source of each are listed in the next section.

Impacts to local economies are measured in two ways: employment and labor income. Employment is expressed in jobs. A job can be seasonal or year-round, full-time or part-time. Jobs represent the annual average of 12 monthly estimates. There is no seasonality in this measure.

Seasonality is of great importance to a tourism-based economy, and is often the basis for other social indicators. Seasonal employment was determined by isolating winter-only (or summer-only) activities in the models, identifying the months during which the activities occur, and then converting the annual averages to seasonal monthly averages. This provided a better base from which to estimate housing impacts to communities.

The income measure used was labor income expressed in 1999 dollars. Labor income includes both employee compensation (pay plus benefits) and proprietors income (e.g. self-employed).

The most critical time for housing issues in the ESL and GP subareas is winter. Affordable housing is the crux of the problem. To estimate alternative impacts on affordable housing, two methodologies were employed. The first, in a study for the Roaring Fork Valley by RRC Associates (1999), provided a way to estimate number of households from jobs. The second, in a study for the Summit Housing Authority by the Housing Collaborative, LLC (2001), provided a way to relate household incomes in Summit County with the probability of having a "housing cost burden." Households having a "housing cost burden" are those that spend more than 30 percent of their gross income on rent or mortgage. This is nationally accepted definition. The relationships from each study were incorporated into a spreadsheet, and were applied to the change in employment as estimated using the IMPLAN models. Conversations with Gary Severson, Executive Director of the Northwest Colorado Council of Governments, suggested that affordable housing impacts may serve as a suitable proxy for other community services.

CUMULATIVE EFFECTS

Projections of employment and income to 2020 are made by CDS. These projections implicitly incorporate some level of forest management, and that level was assumed to be Alternative B, or the "no action" alternative. Whether each alternative would increase, decrease, or not affect the projections is the purpose of the cumulative effects analysis. The projections for 2010 were used for this analysis. These projections provided a context for understanding alternative impacts. A full description of cumulative effects was provided in Chapter 3.

DATA SOURCES

The planning area models were used to determine total consequences of dollar, employment, and income changes in selected sectors. Because input-output models are linear, multipliers or response coefficients need only be calculated once per model and then applied to the direct change in final demand. A specially-developed spreadsheet entitled "FEAST" (Forest Economic Analysis Spreadsheet Tool) was used to apply the model results to each alternative. Specifications for developing response coefficients and levels of dollar activity are stated below.

TIMBER

Sales Data – Sales data was determined by using timber values multiplied by estimated production levels for each alternative.

Use of the Model – There is no significant sawmill industry in the planning area. While there are a few very small mill operations in the area, only the logging sector was modeled. All timber production was run through the logging sector, then assumed to be transported to mills in either Wyoming or Montrose County.

The model showed that for every $1 million of total timber production in the 6-county model, $920,000 of logs are exported and generate impacts throughout the economy. This relationship was applied to the total sales data for each alternative.

Estimates of employment for mills outside the planning area attributable to logs from the White River National Forest were taken from analyses done for forest plan revision for the Arapaho-Roosevelt National Forest and for past TSPIRS reports.

GRAZING

Sales Data—The best available data for agriculture is found in the *1992 Census of Agriculture*. Total farm livestock inventory from Tables 14 and 17 were multiplied by 12 months to provide an estimate of total animal months in the model area. Animal months of grazing on forest land were provided from forest permit records. A proportion of forest animal months to total animal months was calculated. Sales per head month were determined by dividing total sales in the Range Cattle sector by cattle head months and in the Sheep, Lamb & Goats sector by sheep head months.

Use of the Model—The six-county model showed that for every $1 million of total production, $900,000 of cattle are exported and generate impacts throughout the economy. For every $1,000,000 of total sheep production, $970,000 of sheep are exported. Therefore, 90 percent of cattle sales and 97 percent of sheep sales attributable to production on the forest will cause local economic effects.

SKIING

Expenditure Data—Detailed expenditure information for Colorado skiers is difficult to obtain. The best available public data has been collected by RRC Associates, Inc. in Boulder, Colorado. RRC recently prepared three documents that were valuable in estimating skier expenditures for the planning area: 1996/97 Profile of Colorado Skiing prepared for Colorado Ski Country USA (RRC Associates, 1998), Economic Analysis of United States Ski Areas 97/98 prepared for the National Ski Areas Association (RRC Associates, 1999), and North Lake Tahoe Visitor Profile Study—Summer 1998 prepared for the North Lake Tahoe Chamber of Commerce. From these documents and conversations with RRC, expenditure profiles per skier day for both day and destination skiers were estimated. All but the Lake Tahoe study is public information available from the organizations listed above. Expenditures per skier-day were estimated to be $49 for day use and $184 for destination use in 1998 dollars. All expenditures were estimated on a skier-day basis.

Use of the Model—$1 million of expenditures for both day and destination skiers were run through the model. The results were then incorporated into a spreadsheet where they were multiplied by total expenditures for each alternative. Only non-local skiing expenditures (tourism export) use is considered for impact analysis.

OTHER RECREATION & WILDLIFE/FISH

Expenditure Data—Surveys of recreationists expenditures for different kinds of recreation activities have been collected by Forest Service researchers over many years. PARVS is the Forest Service data base which holds national recreation expenditure

information. This information has been organized for use in IMPLAN by the Washington Office (Alward, 1998). The expenditures were distributed among different industries according to recreationist spending patterns. The results were then converted to visitor-days. One visit is defined as a visit by one person of any duration for a single day. Recreation use data was converted to a visits by using ratios provided by the White River National Forest recreation staff. National expenditure profiles for non-residents expenditures within 50 miles of the activity site were used for estimating impacts from all recreation except for wildlife-related recreation.

There were two recreation activities where more detailed expenditure data is available. Public comments indicated a desire to separately identify the impacts from snowmobiling. A recent study in Wyoming (Taylor, 1995) surveyed snowmobilers and developed expenditure profiles. Mountain biking is a tremendously popular activity that may be distinct from other dispersed recreation activities in terms of expenditure patterns. Few studies are available nationally, however one from Wisconsin was believed to suitably represent biking expenditure patterns on national forest lands (Sumathi, 1997). In both cases, the studies were converted for use with the IMPLAN models and applied to non-local recreation use.

The Colorado Off-Highway Coalition recently contracted with Hazen and Sawyer (2001) to develop expenditure patterns for several kinds of motorized activities on national forests in Colorado. A draft copy of that study was graciously made available to the Forest Service. Examination of the study results revealed that expenditures for motorized dispersed activities from PARVS were amazingly similar to those from the Colorado study. Because the PARVS data were already in the proper form for use with IMPLAN and they provided results comparable to the local study, the PARVS data were used for motorized dispersed recreation.

The U.S. Fish & Wildlife Service periodically conducts a national survey to obtain, among other information, data on recreation expenditures for hunting, fishing, and other wildlife-related recreation. This information is available by state. These expenditures profiles were also organized for use in IMPLAN by the Washington Office (USDA-Forest Service, 2001). Expenditures were collected on a "per trip" basis, but converted to a visit basis for use in IMPLAN. Expenditure profiles for non-resident expenditures in Colorado were used for estimating impacts from wildlife-related recreation.

Use of the Model—$1 million of expenditures for three categories of recreation (developed, dispersed motorized, & dispersed trail use) were run through the model. The results were then incorporated into FEAST where they were multiplied by total expenditures for each category for each alternative. Only non-local recreation use (a tourism export) is considered for impact analysis.

FEDERAL EXPENDITURES & EMPLOYMENT

Expenditure Data – Planners applied budget constraints to every alternative. This budget constraint was used to estimated total forest expenditures, some of which had local economic effects. Total forest obligations by budget object code for FY 1998 through 2000 were obtained from the National Finance Center and used to constrain total forest expenditures. The proportion of funds spent by program varied by alternative according to the theme for that alternative. Forest Service employment was estimated by

the forest staff based on examination of historical Forest Service obligations. Although the relationships vary by program, an average of $520,000 was spent locally for every $1 million of non-salary Forest Service expenditures.

Use of the Model – To obtain an estimate of total impacts from Forest Service spending, salary and non-salary portions of the impact were handled separately. Non-salary expenditures were determined by using the budget object code information noted above. This profile was run through the model for non-salary expenditures per one million dollars, and the results multiplied by total forest non-salary expenditures. FEAST was again used to make the calculations. Local sales to the federal government are treated in the same manner as exports.

Salary impacts result from forest employees spending a portion of their salaries locally. IMPLAN includes a profile of personal consumption expenditures for several income categories; the average compensation for an employee on the White River National Forest fell in the category of $30,000-$39,999. For every $1 million of Forest Service salaries, $726,000 was spent locally.

REVENUE SHARING – 25% FUND PAYMENTS

Expenditure Data – Until September 30, 2001, Federal law required that 25% Fund Payments be used for only schools or roads or both. A split of 50 percent for schools and 50 percent for roads was used. One profile of expenditures was developed from wihtin the 6-county model for 1) the highway construction sector and 2) local educational institutions. Because counties can choose to continue payments under this formula, traditional payments were analyzed. Should counties choose fixed payments under the new law, the impacts would not vary by alternative. The impact of the fixed payment was not calculated.

Use of the Model – The national expenditure profile for state/local government education (schools) and local model estimates for road construction (roads) are provided within IMPLAN. $1 million of each profile was used to obtain a response coefficient for these Forest Service payments to impact area counties. Sales to local government are treated in the same manner as exports.

OUTPUT LEVELS

Output levels for each item listed above can be viewed in various FEAST spreadsheet files contained in the administrative record. These amounts are also located in the corresponding resource sections of the FEIS.

Financial and Economic Efficiency Analysis

Financial efficiency is defined as how well the dollars invested in each alternative produce revenues to the agency. Economic efficiency is defined as how well the dollars invested in each alternative produce benefits to society. Present Net Value (PNV) is used as an indicator of financial and economic efficiency.

Quick-Silver, a public domain Windows-based program, was used to calculate PNV over a 50-year period. A 4 percent discount rate was used.

The financial values for skiing were based on experienced revenues (actual returns to the Federal Treasury). Revenues for grazing are set by law. Economic values were based on either actual revenues or on a willingness to pay evaluation. These economic values were developed by the SPRA staff of the Washington Office and updated to current values by the regional office of the Rocky Mountain Region. As discussed in the FEIS, willingness-to-pay estimates for non-use values (scenery, existence values, bequest values, etc) have not been established by the agency, and are therefore excluded from this analysis. All values are in 2000 dollars. The table below displays the economic values and revenues that were used for each resource. Detailed costs were not developed for this analysis. Total budgets were assumed to be fully spent for each alternative.

Table B-16
Economic Benefits and Financial Revenue Values

Activity	Unit	Economic Benefit	Financial Value
Downhill Ski	Skier-Day	$54.72	$1.00
Developed Rec	RVD	$8.99	$0.00
Disp. Motor Rec	RVD	$11.56	$0.00
Disp. Nonmotor Rec	RVD	$12.84	$0.00
Big Game Hunting	RVD	$66.77	$0.00
Small Game Hunting	RVD	$47.51	$0.00
Fishing	RVD	$78.76	$0.00
Nonconsumptive Wildlife	RVD	$59.27	$0.00
Grazing – Cattle & Sheep	AUM/HM	$10.24	$1.35
Timber	MBF	See Timber, Appendix B	See Timber, Appendix B

STAKEHOLDER AND DEMOGRAPHICS ANALYSES

In recent years, the amount and level of conflict over natural resource issues has increased substantially. As a result, much attention has been devoted to increasing our understanding of the dynamics of these conflicts, what they mean for stakeholders and natural resource managers, and what can be done to help managers and stakeholders better understand each other and work together to find ways to resolve, or better yet head off, conflicts before they occur. One approach found in the literature involves the development of a hierarchical model that considers stakeholder values, objectives attitudes, and behaviors (VOAB, Shields, 2000). In this model, the stakeholder's values are the highest and most stable of the four items; stakeholders' objectives are a proxy for their values; these objectives influence the stakeholder's attitudes, which in turn influence the stakeholder's behaviors.

The following focuses on stakeholder objectives for the White River National Forest for three reasons:

- Stakeholder objectives provide a good proxy for stakeholder values, and these values often underlie the positions stakeholders take on forest management issues.
- Attributes are variables that can be associated with objectives and can be used to measure the level of achievement of the associated objective.
- For each forest plan alternative, the level of achievement of stakeholder objectives can be estimated by determining the values of the attributes.

As an example, suppose one objective relates to range of opportunity for motorized recreation. Attributes associated with this objective could include miles of high and low clearance roads and miles of motorized trails.

Keeney (1992) defines an objective as a statement of what one desires to achieve and as being characterized by having a context (in this case, national forest management), an object (something that can be acted upon), and a direction of preference. An objective must address a single issue (e.g. amount of land allocated to roadless management), and that issue must have a sense of preference (e.g. more is better than less). In addition, the issue must have one or more variables associated with it that are measurable (e.g. number of acres allocated to roadless management), and it must be something that responds to management.

Key questions that must be answered include: what are the stakeholder objectives for the White River National Forest, how well are these objectives met by any given plan alternative, and what are the consequences of each alternative for each stakeholder group? Another important question relates to the characterization of White River National Forest stakeholders. Collectively, the answers provide information that is useful in implementing a collaborative approach to planning because they help in understanding stakeholders, where they are coming from, and what they want from the White River National Forest.

Three types of data or information have been used to characterize stakeholders and their objectives: (1) statistical analysis of three existing surveys of Colorado National Forest stakeholders, (2) content analysis of public comments on the DEIS and draft plan, and (3)

results from six stakeholder group public meetings held on February 6, 7, and 12, 2001. The primary use of the first two sources of information was to characterize White River National Forest stakeholders and their objectives. The stakeholder meetings were then used to validate the information collected from the first two sources. This latter information was also used to identify the objectives to be tracked in order to illustrate the consequences of the alternatives to different stakeholders.

Three Surveys

Under ideal circumstances, a survey designed expressly to assess White River National Forest stakeholders would have been developed and implemented. Because this was not possible, existing survey data was utilized. Three completed surveys were used in the analysis. The following is a brief description of each, presented not in the order they were implemented, but rather, in the order that helps clarify what each one will contribute to the White River National Forest stakeholder analysis.

The first survey (556 respondents, 467 usable for this analysis) was administered by mail in 1998 by the Colorado School of Mines to self-identified stakeholder groups with an interest in the Pike and San Isabel National Forest. The interest groups consisted of the Colorado Mountain Club (CMC), the Colorado Off-Highway Vehicle Club (COHVCO), and a group of senior citizens (SENIORS). This survey (PSI) was designed to look at stakeholder values, objectives, attitudes, beliefs, and behaviors all within the context of the Pike and San Isabel National Forest. The survey contained sets of questions designed to address each of these items, as well as a number of socio-demographic questions. Table 1 shows the set of 31 objectives questions utilized in this survey. Most respondents for the PSI survey live near the Pike or San Isabel National Forests, and are members of one of three stakeholder groups, the Colorado Mountain Club (CMC), the Colorado Off-Highway Vehicle Club (COHVCO), and a group of senior citizens (SENIORS). These respondents were predominantly from the southern Colorado Front Range area and their stakeholder group affiliations were known. This analysis focused on the set of 31 objectives questions (**Table B-17**) and 11 socio-demographic questions (**Table B-18**).

The second survey (AR) was also administered by the Colorado School of Mines and was conducted in 1997. The survey instrument was mailed to 800 individuals on the Arapaho-Roosevelt National Forest planning mailing lists and there were 402 respondents (352 usable for this analysis). The survey was sent to individuals but not to businesses, government agencies, trade groups, or other groups. This survey contained the same sets of objectives questions as the PSI survey (**Table B-17**), and the same set of demographics questions (**Table B-18**). Most respondents for the AR survey lived near the Arapaho-Roosevelt National Forest; however, stakeholder group affiliations, if any, were not known. These respondents were predominantly from the northern and central Colorado Front Range. Because this sample was from the population of all stakeholders on the Arapaho-Roosevelt National Forest mailing lists, the responses were almost certainly from a broader collection of stakeholder groups than was the case for the PSI survey.

The third survey was the Colorado Survey (CS), commissioned by the White River National Forest and conducted by Colorado State University in 1995. It was developed and administered to gain knowledge about Colorado residents' values, attitudes, and behaviors relative to the Forest Service management. Questions in the survey addressed a number of issues including forest values, general aspects of forest use and management, wilderness and roadless areas, control of national forests, and a number of socio-demographic variables.

While the CS had a number of purposes, characterization of stakeholder objectives was not one of them. Therefore, in order to use this data set, it was necessary to determine which questions were appropriate objectives questions. Seventeen questions were deemed suitable (**Table B-19**).

Table B-17
Objectives Questions in the Pike San Isabel and Arapaho Roosevelt Surveys

1) Putting the funds collected from public land users to use in the local public land district.
2) Increasing the amount of public land acres managed as wilderness areas.
3) Reopening roads which have had off-highway vehicle interest in the past to motorized use.
4) Building new roads that are accessible to conventional automobiles (including wilderness areas).
5) Increasing the number of campgrounds in the area.
6) Designating more trails specifically for walkers and hikers.
7) Reducing the number of days that someone can stay at campgrounds during the busy seasons.
8) Improving four wheel drive roads so that they can be accessible to conventional automobiles.
9) Limiting the number of commercial permits (i.e., for outfitters) issued by the public land agencies.
10) Minimizing erosion due to overuse of tributaries (i.e., creeks and streams) in the watershed.
11) Maintaining grazing fees at levels which provide economic incentives for ranchers to continue ranching.
12) Promoting natural flows to protect cold-water fishery resources.
13) Restricting commercial (i.e., mining, timber, grazing) use if trails and roads are severely overused and degraded.
14) Restricting recreational use if trails and roads are severely overused and degraded.
15) Protecting wilderness areas and their biological resources as the first priority.
16) Providing more recreational infrastructure (i.e., camping areas, toilet facilities, trails, and parking) when and where needed.
17) Adding more lands to the public domain.
18) Providing education for private property owners concerning wildlife habitat management plus fire safety and prevention.
19) Minimizing the number of new roads added to the current system of roads on public lands.
20) Maintaining affordable lumber prices by allowing additional timber harvesting.
21) Limiting population growth in communities adjacent to public lands.
22) Minimizing additional development of resorts (i.e., ski areas, conference centers).
23) Providing information to all public land users concerning potential damage from both motorized and non-motorized recreation (i.e., agencies should visit organizations, work with volunteer/recreational groups).
24) Providing more clearly defined information about uses of public lands (i.e., wilderness experience, motorized experience, watershed issues) by encouraging people to visit agency offices.
25) Eliminating commodity development (i.e., timber, mining, grazing) on public lands with considerable recreational resource values.
26) Requiring resource companies (i.e., mining, timber, grazing) to restore the land to its natural state after use.
27) Increasing fees charged to industry users (i.e., mining, timber, grazing).
28) Increasing the government percentage received from public land concessionaires (i.e., RV campgrounds).
29) Charging fees to visitors using public land resources.
30) Consolidating public land agencies involved with land management.
31) Using resources to restore damaged high alpine trails (i.e., revegetate, restrict use to designated trails).

Table B-18
Demographic Questions for the Pike San Isabel and Arapaho Roosevelt Surveys

1) Please identify *your* age group.
_____18 to 25 years of age
_____26 to 34 years of age
_____35 to 44 years of age
_____45 to 54 years of age
_____55 years and older

2) Please identify *your* gender
_____Female _____Male

3) Please check the category which best fits your educational background.
_____Some high school
_____High school graduate
_____Some college
_____College graduate
_____Postgraduate work
_____Postgraduate degree
_____Other (please specify_____)

4) Please check the category that best fits your occupational status
_____Professional/Technical
_____Student
_____Trade worker
_____Office worker
_____Homemaker
_____Athletic clubs/leagues
_____Agriculture
_____Self-employed
_____Unemployed
_____Retired
_____Other (please specify _____)
_____Other (please specify_____)

5) Please check the category which best fits your household income level per year.
_____less than $15,000
_____$15,000 to $24,999
_____$25,000 to $34,999
_____$35,000 to $49,999
_____$50,000 to $74,999
_____$75,000 and over

6) Please specify your proximity to public lands (National Forest System lands and Bureau of Land Management lands).
_____less than 1 mile
_____1 to 10 miles
_____11 to 20 miles
_____21 to 50 miles
_____more than 50 miles
_____Other (please specify_____)
_____Don't know

7) Please identify the national forest which is closest to where you live. If you do not know the name of the national forest, please specify the town or city in which you reside.
_____Arapaho National Forest
_____Grand Mesa National Forest
_____Gunnison National Forest
_____Pike National Forest
_____Rio Grande National Forest
_____Routt National Forest
_____Roosevelt National Forest
_____San Isabel National Forest
_____San Juan National Forest
_____Uncompahgre National Forest
_____White River National Forest
_____Town or City

8) Do you or any of your immediate family directly depend on the public lands for your *economic* livelihood (i.e., commercial guide, timber industry, ranching, etc.)?
_____Yes _____No

9) How long have you resided in this area?
_____less than 1 year
_____from 1 to 2 years
_____from 3 to 5 years
_____from 6 to 10 years
_____greater than 10 years

10) Please identify the zip code of your primary residence.

11) Please identify the national forest which you use the most. If you do not know the name of the national forest, please specify the town or city closest to the area which you use.
_____Arapaho National Forest
_____Grand Mesa National Forest
_____Gunnison National Forest
_____Pike National Forest
_____Rio Grande National Forest
_____Routt National Forest
_____Roosevelt National Forest
_____San Isabel National Forest
_____San Juan National Forest
_____Uncompahgre National Forest
_____White River National Forest
_____Town or City

Table B-19
Objectives Questions From the Colorado Survey

1) More importance should be placed on keeping national forests healthy than on helping people use them in ways they want.
2) Camping, skiing, and other recreation should be expanded in national forests even if that means less timber is harvested.
3) We should support the economic health of Colorado's small towns by harvesting some trees for lumber.
4) Threatened and endangered species in national forests should be protected even if there are negative economic impacts on people.
5) National forests and other federal land should be the primary places where we protect threatened and endangered species.
6) Areas of national forests with no roads should be kept roadless.
7) All remnants of historical value on national forests (like old mining towns) should be preserved.
8) National forest lands should have more and better roads so more people can enjoy the forests.
9) More national forest land should be set aside as designated wilderness.
10) Restore all national forests in Colorado to their natural state and prohibit all use of them.
11) Expand the amount of congressionally designated wilderness.
12) Expand the amount of land to be retained as roadless area.
13) Dismantle some man-made facilities (ski areas, lake resorts, large campgrounds) to return these areas to their natural state.
14) Decrease the amount of grazing.
15) Increase timber harvests in areas less suitable for wildlife.
16) Increase the number of trees grown and cut for lumber.
17) Let all lightning-caused fires burn to restore the natural balance of the forest.

Data for the CS (960 responses, 886 usable for this analysis) were obtained from a random sample of 1800 potential respondents purchased from a commercial sampling firm. Individuals living along the Colorado Front Range as well as those living in other mountain counties of the state were sampled. Most of the demographics questions in the CS survey differed from those in the PSI and AR surveys; however a few were comparable, as will be discussed later.

Respondents for the CS were widely distributed across the western two thirds of the state, with roughly 35 percent of them living near the White River National Forest, as defined by the six county White River National Forest Economic Impact Area (Eagle, Garfield, Lake, Pitkin, Rio Blanco, and Summit counties). Many of the other respondents lived along the Colorado Front Range, thus providing some overlap with the area sampled in the PSI and AR surveys. Like the AR survey, information was not collected on respondent's affiliation with stakeholder groups; however, the sample can reasonably be expected to contain representatives of several groups. Unlike either the PSI or AR surveys, and potentially very important is the fact that the sample frame used in the CS was comprised of a broader class of residents than just those either identified as members of a specific stakeholder group (PSI), or interested enough in national forest issues to have been placed on a mailing list (AR). Thus, the CS likely includes responses from people who may care a lot about what goes on the White River National Forest, but have not become engaged enough in the issues to be identified with a particular stakeholder group or be included on a mailing list. These are people who may have been largely unrepresented in the White River National Forest debates, at least prior to the comment period for the draft plan and DEIS.

Most of the demographics questions in the CS survey differed from those in the PSI and AR surveys; however, 7 questions were comparable and are presented in Table B-20.

Table B-20
Socio-demographic Questions in Colorado Survey Comparable to Those in the Pike San Isabel and Arapaho Roosevelt Surveys

1) Are you? _____ Male _____ Female.
2) How old are you? _____Years.
3) Generally, what kind of work do you do? *(Please check one)*

____Technical, Administrative Support	____ Machine Operator or Inspector
____Skilled Technician	____Military
____Sales or Service	____Laborer
____Agriculture, Forestry, Fisheries	____Specialty or Professional
____Precision or Production Craftsman	____Executive or Managerial
____Private Household Services	____Retired
____Protective Services	____Other, Please Specify

4) How long have you lived in Colorado? _____Years
5) About how much formal education have you completed?

_____Grade school	_____Some college
_____Some high school	_____College degree
_____High school degree	_____Some graduate school
_____Technical/Vocational school	_____Graduate degree

6) What was your approximate family income from all sources in 1994?

_____Less than $10,000	_____$51,000 to $75,000
_____$10,000 to $15,000	_____$76,000 to $90,000
_____$16,000 to $25,000	_____$91,000 to $100,000
_____$26,000 to $32,000	_____$101,000 to $125,000
_____$33,000 to $37,000	_____Over $125,000
_____$37,000 to $50,000	

7) What county do you reside in? _____County

A Comparison of the Three Data Sets

As noted previously, the ideal situation for analyzing White River National Forest stakeholder objectives is to have a data set drawn from White River National Forest stakeholders and designed to identify their objectives. While none of the data sets we are working with completely meet these specifications, in combination they do allow for an analysis that provides a good proxy for the ideal situation. The reason for this is a combination of the areas in which the respondents live in the three surveys, the way in which each respondent sample was constructed, and the two sets of objectives questions utilized. In addition, the socio-demographics questions that are included in all three surveys (**Table B-20**) will facilitate comparisons of results across the surveys.

Most respondents for the PSI survey live near the Pike or San Isabel national forests (**Table B-21**), and are members of one of three stakeholder groups, the Colorado Mountain Club (CMC), the Colorado Off-Highway Vehicle Club (COHVCO), and a group of senior citizens (SENIORS). These respondents are predominantly from the southern Colorado Front Range area and their stakeholder group affiliations are known. The set of objectives questions utilized was designed to elicit stakeholder objectives and therefore, results in a good characterization of stakeholder objectives for members of three stakeholder groups who come from areas near the PSI.

Most respondents for the AR survey live near the Arapaho-Roosevelt National Forest (**Table B-21**). However, this survey was distributed to a random population of people in the Arapaho-Roosevelt National Forest areas and therefore, group affiliations were not

known. These respondents are predominantly from the northern and central Colorado Front Range. Because this sample is from the population of all stakeholders on the Arapaho-Roosevelt National Forest mailing lists, the objectives will be those of members of a broader collection of stakeholder groups than is the case for the PSI survey.

Respondents for the CS are widely distributed across the western two thirds of the state (**Table B-21**), with roughly 35 percent of them living near the White River National Forest, as defined by the six county White River National Forest Economic Impact Area (Eagle, Garfield, Lake, Pitkin, Rio Blanco, and Summit counties). Many of the other respondents live along the Colorado Front Range, thus providing some overlap with the area sampled in the PSI and AR surveys. Like the AR survey, information was not collected on respondent's affiliation with stakeholder groups, so the sample can reasonably be expected to contain representatives of several groups. Unlike either the PSI or AR surveys, and potentially very important is the fact that the sample frame used in the CS was comprised of a broader class of residents than just those either identified as members of a specific stakeholder group (PSI), or interested enough in national forest issues to have been placed on a mailing list (AR). Thus, the CS likely includes responses from people who may care a lot about what goes on the White River National Forest, but have not become engaged enough in the issues to be identified with a particular stakeholder group or be included on a mailing list. These are the people who may have been largely unrepresented in the White River National Forest debates, at least prior to the comment period for the draft plan and DEIS.

As noted above, the objectives questions are different for the CS than for the other two surveys. While this is clearly not ideal, it offers two advantages. First, there is considerable overlap on two key issues, roadless area management/roads, and wilderness management, and lesser overlap on other issues such as ski area development and recreation such as camping and hiking. Second, the two lists of objectives questions collectively comprise a more complete set of stakeholder objectives than does either list alone.

Table B-21
Survey Respondents by County

County	Colorado Survey	PSI Survey	AR Survey	Totals
Adams	22	11	3	36
Alamosa	30	2	0	32
Arapahoe	1	22	13	36
Archuleta	4	0	0	4
Boulder	0	2	86	88
Chaffee	29	95	1	125
Clear Creek	0	0	8	8
Conejos	12	0	0	12
Custer	0	1	0	1
Delta	8	0	0	8
Denver	56	14	29	99
Dolores	2	0	0	2
Douglas	0	5	4	9
Eagle	11	0	0	11
El Paso	0	219	5	224
Elbert	0	1	1	2

Table B-21 continued

County	Colorado Survey	PSI Survey	AR Survey	Totals
Fremont	0	4	1	5
Garfield	262	0	2	264
Gilpin	1	0	4	5
Grand	1	1	20	22
Gunnison	2	2	1	5
Hinsdale	4	0	0	4
Jackson	0	0	2	2
Jefferson	15	49	22	86
Lake	0	12	0	12
La Plata	66	0	1	67
Larimer	43	0	93	136
Mesa	104	0	2	106
Mineral	1	0	0	1
Moffat	1	0	0	1
Montezuma	5	0	3	8
Montrose	41	0	0	41
Morgan	0	0	1	1
Ouray	11	1	0	12
Park	10	0	2	12
Pitkin	6	0	0	6
Pueblo	0	4	2	6
Rio Blanco	5	0	0	5
Rio Grande	19	0	0	19
Routt	1	0	0	1
Saguache	1	0	0	1
San Miguel	5	0	0	5
Summit	35	0	1	36
Teller	0	16	0	16
Weld	50	0	14	64
Other Non-CO	0	1	31	32
Totals	**864**	**462**	**352**	

Cluster Analysis

In the PSI and AR surveys, all questions were based on a 7-point Likert scale with one being 'not important at all' and seven being 'very important.' For the CS, a 7-point Likert scale was also used. For questions one through nine, the scale was defined from one (strongly disagree) to seven (strongly agree), while for questions 10 through 17 the scale ranged from one (extremely unlikely to vote for) to seven (extremely likely to vote for).

Cluster analysis was selected as the primary analysis tool for all three surveys. This technique groups respondents into categories (clusters) based on how similarly they respond to a set of questions. It is designed to answer two questions: how many clusters are there, and which observations belong to each cluster? There are many different procedures and algorithms one may use for cluster analysis. The technique is very empirical as different methods can lead to very different groupings or clusters (Afifi and Clark, 1990). Therefore, in addition to carefully considering the numerical results that a cluster analysis yields, it is important to examine the clusters themselves to make sure they make sense within the context of the problem under investigation. Clustering methods fall into two categories, hierarchical and nonhierarchical clustering, according to

the approach used to assign the data observations to clusters. For this study, Ward's minimum-variance method was used, which is a hierarchical approach. Unfortunately, there is no "best" answer to either of the above questions. In order to validate the results, the data were also analyzed using the cubic clustering criterion (CCC), semi-partial R squared (SPRS), Pseudo F and Pseudo T statistics, and k-means clustering, all of which supported the conclusions arrived at using Ward's method.

The data was clustered based on responses to the 31 objectives questions in the PSI and AR surveys (**Table B-22**), and responses to the 17 objectives questions in the CS (**Table B-23**). As the tables show, two clusters resulted for all three data sets. Mean responses for each question and cluster are given in the tables, as well as the number of respondents in each cluster. Because of the empirical nature of cluster analysis, in addition to carefully considering the numerical results that a cluster analysis yields, it is important to examine the clusters themselves to make sure they make sense within the context of the problem under investigation. This was done by looking at both the objective questions with greatest agreement and disagreement by cluster and survey, and by examining the average responses for selected demographics questions to characterize the respondents in each cluster.

Mean responses for the PSI survey (**Table B-22**) for each cluster and paired t-tests on the mean responses were computed for each question. Twenty-nine of the possible 31 comparisons were statistically significant at the 99 percent level of confidence. This means that it is 99 percent certain that the mean score for Cluster 1 differs significantly from the mean score for Cluster 2 for the 29 questions. Of the two remaining objectives questions, question 1 (Putting all the funds collected from the public land users to use in the local public land district) was significant at the 95 percent level, and question 5 (Increasing the number of campgrounds in the area) was not significant at all, implying that respondents in both clusters are in close agreement (which in this case means that each cluster feels that the issue is of only medium importance).

Mean responses for the AR survey (**Table B-23**) for each cluster and paired t-tests on the mean responses were computed for each objectives question. According to the group t-tests for Cluster 1 and 2, the means for 27 of the possible 31 comparisons were statistically significant at the 99 percent level of confidence. This means that it is 99 percent certain that the mean score for Cluster 1 differs significantly from the mean score for Cluster 2 for the 27 questions. Of the four remaining objectives question comparisons, one was significant at the 85 percent level—question 5 (Increasing the number of campgrounds in the area) with a mean for Cluster 1 of 3.51 and for Cluster 2 of 3.85. The mean responses of the other three questions were not statistically different from each other, which implies that both clusters are in close agreement. These three questions are: question 1 (Putting the funds collected from public land users to use in the local public land district), with a mean of 5.55 for Cluster 1 and 5.44 for Cluster 2; question 16 (Providing more recreational infrastructure when and where needed), with a mean of 4.42 for Cluster 1 and 4.53 for Cluster 2; and question 30 (Consolidating public land agencies involved with land management), with a mean of 4.70 for Cluster 1 and 4.49 for Cluster 2.

Mean responses for the CS (**Table B-24**) for each cluster and paired t-tests on the mean responses were computed for each question. All paired comparisons were significantly different at the 99.9 percent level of confidence. Therefore, it is 99.9 percent certain that the mean responses are different between clusters for all 17 questions.

Looking at these results, note that in each survey the larger cluster assigns greatest importance to more environmental/conservation concerns while the smaller cluster tends to assign greatest importance to more human use issues (See Chapter 3 of the FEIS for more details on this). The rest of the analysis was devoted to examining the clusters themselves. This was done in two ways—first by looking at the objectives question with greatest agreement and disagreement by cluster (see the Social Data Section of Chapter Three of the FEIS), and second by using the distribution of responses to selected demographics questions to characterize the respondents in each cluster.

Table B-22
Mean Responses to Objectives Questions by Cluster for the PSI Survey

Objectives Question	Mean Response, Cluster 1 (191 Resp.)	Mean Response, Cluster 2 (276 Resp.)
1) Putting the funds collected from public land users to use in the local public land district.	6.25	5.99
2) Increasing the amount of public land acres managed as wilderness areas.	2.13	5.71
3) Reopening roads which have had off-highway vehicle interest in the past to motorized use.	6.54	3.02
4) Building new roads that are accessible to conventional automobiles (including wilderness areas).	3.03	2.20
5) Increasing the number of campgrounds in the area.	3.76	3.90
6) Designating more trails specifically for walkers and hikers.	3.16	5.71
7) Reducing the number of days that someone can stay at campgrounds during the busy seasons.	3.83	4.83
8) Improving four wheel drive roads so that they can be accessible to conventional automobiles.	1.54	2.09
9) Limiting the number of commercial permits (i.e., for outfitters) issued by the public land agencies.	4.49	5.41
10) Minimizing erosion due to overuse of tributaries (i.e., creeks and streams) in the watershed.	4.53	6.36
11) Maintaining grazing fees at levels which provide economic incentives for ranchers to continue ranching.	4.90	4.30
12) Promoting natural flows to protect cold water fishery resources.	5.14	6.20
13) Restricting commercial (i.e., mining, timber, grazing) use if trails and roads are severely overused and degraded.	4.97	6.52
14) Restricting recreational use if trails and roads are severely overused and degraded.	3.59	6.22
15) Protecting wilderness areas and their biological resources as the first priority.	3.32	6.36
16) Providing more recreational infrastructure (i.e., camping areas, toilet facilities, trails, and parking) when and where needed.	4.28	4.74
17) Adding more lands to the public domain.	4.27	5.78
18) Providing education for private property owners concerning wildlife habitat management plus fire safety and prevention.	5.20	6.21
19) Minimizing the number of new roads added to the current system of roads on public lands.	3.96	5.96
20) Maintaining affordable lumber prices by allowing additional timber harvesting.	3.95	2.88
21) Limiting population growth in communities adjacent to public lands.	3.80	4.95
22) Minimizing additional development of resorts (i.e., ski areas, conference centers).	4.79	5.61
23) Providing information to all public land users concerning potential damage from both motorized and non-motorized recreation (i.e., agencies should visit organizations, work with volunteer/recreational groups).	5.75	6.40
24) Providing more clearly defined information about uses of public lands (i.e., wilderness experience, motorized experience, watershed issues) by encouraging people		

to visit agency offices.	5.52	6.03
25) Eliminating commodity development (i.e., timber, mining, grazing) on public lands with considerable recreational resource values.	4.23	5.74
26) Requiring resource companies (i.e., mining, timber, grazing) to restore the land to its natural state after use.	6.44	6.88
27) Increasing fees charged to industry users (i.e., mining, timber, grazing).	4.87	6.01
28) Increasing the government percentage received from public land concessionaires (i.e., RV campgrounds).	3.62	4.51
29) Charging fees to visitors using public land resources.	3.32	4.81
30) Consolidating public land agencies involved with land management.	4.30	5.18
31) Using resources to restore damaged high alpine trails (i.e., revegetate, restrict use to designated trails).	4.53	6.42

Table B-23
Mean Responses to Objectives Questions by Cluster for the AR Survey

Objectives Question	Mean Response, Cluster 1 (194 Resp.)	Mean Response, Cluster 2 (158 Resp.)
1) Putting the funds collected from public land users to use in the local public land district.	5.55	5.44
2) Increasing the amount of public land acres managed as wilderness areas.	6.27	2.53
3) Reopening roads which have had off-highway vehicle interest in the past to motorized use.	1.70	4.21
4) Building new roads that are accessible to conventional automobiles (including wilderness areas).	1.27	2.55
5) Increasing the number of campgrounds in the area.	3.51	3.85
6) Designating more trails specifically for walkers and hikers.	5.53	3.56
7) Reducing the number of days that someone can stay at campgrounds during the busy seasons.	4.45	3.87
8) Improving four wheel drive roads so that they can be accessible to conventional automobiles.	1.35	2.00
9) Limiting the number of commercial permits (i.e., for outfitters) issued by the public land agencies.	5.40	3.87
10) Minimizing erosion due to overuse of tributaries (i.e., creeks and streams) in the watershed.	6.56	4.92
11) Maintaining grazing fees at levels which provide economic incentives for ranchers to continue ranching.	3.07	4.88
12) Promoting natural flows to protect cold water fishery resources.	6.47	4.67
13) Restricting commercial (i.e., mining, timber, grazing) use if trails and roads are severely overused and degraded.	6.48	4.34
14) Restricting recreational use if trails and roads are severely overused and degraded.	6.33	4.40
15) Protecting wilderness areas and their biological resources as the first priority.	6.54	3.47
16) Providing more recreational infrastructure (i.e., camping areas, toilet facilities, trails, and parking) when and where needed.	4.42	4.53
17) Adding more lands to the public domain.	5.84	3.18
18) Providing education for private property owners concerning wildlife habitat management plus fire safety and prevention.	6.18	5.11
19) Minimizing the number of new roads added to the current system of roads on public lands.	6.52	3.89
20) Maintaining affordable lumber prices by allowing additional timber harvesting.	1.92	4.32
21) Limiting population growth in communities adjacent to public lands.	5.28	3.09
22) Minimizing additional development of resorts (i.e., ski areas, conference centers).	6.25	4.12

23) Providing information to all public land users concerning potential damage from both motorized and non-motorized recreation (i.e., agencies should visit organizations, work with volunteer/recreational Cluster).	6.25	5.15
24) Providing more clearly defined information about uses of public lands (i.e., wilderness experience, motorized experience, watershed issues) by encouraging people to visit agency offices.	5.45	4.84
25) Eliminating commodity development (i.e., timber, mining, grazing) on public lands with considerable recreational resource values.	5.73	3.09
26) Requiring resource companies (i.e., mining, timber, grazing) to restore the land to its natural state after use.	6.86	5.44
27) Increasing fees charged to industry users (i.e., mining, timber, grazing).	6.59	4.09
28) Increasing the government percentage received from public land concessionaires (i.e., RV campgrounds).	5.79	4.11
29) Charging fees to visitors using public land resources.	5.30	4.07
30) Consolidating public land agencies involved with land management.	4.70	4.49
31) Using resources to restore damaged high alpine trails (i.e., revegetate, restrict use to designated trails).	6.26	4.69

Table B-24
Mean Responses to Objectives Questions by Cluster for the Colorado Survey

Objectives Question	Means Cluster 1 (576 Resp.)	Means Cluster 2 (310 Resp.)
1) More importance should be placed on keeping national forests healthy than on helping people use them in ways they want.	6.13	4.89
2) Camping, skiing, and other recreation should be expanded in national forests even if that means less timber is harvested.	3.88	3.01
3) We should support the economic health of Colorado's small towns by harvesting some trees for lumber.	4.12	5.23
4) Threatened and endangered species in national forests should be protected even if there are negative economic impacts on people.	5.17	2.88
5) National forests and other federal land should be the primary places where we protect threatened and endangered species.	5.47	4.02
6) Areas of national forests with no roads should be kept roadless.	6.15	4.37
7) All remnants of historical value on national forests (like old mining towns) should be preserved.	5.40	4.64
8) National forest lands should have more and better roads so more people can enjoy the forests.	2.62	3.79
9) More national forest land should be set-aside as designated wilderness.	5.67	2.86
10) Restore all national forests in Colorado to their natural state and prohibit all use of them.	2.34	1.28
11).Expand the amount of congressionally designated wilderness.	5.44	2.05
12) Expand the amount of land to be retained as roadless area.	5.44	2.69
13) Dismantle some man-made facilities (ski areas, lake resorts, large campgrounds) to return these areas to their natural state.	3.82	2.00
14) Decrease the amount of grazing.	4.38	2.35
15) Increase timber harvests in areas less suitable for wildlife.	3.29	4.96
16) Increase the number of trees grown and cut for lumber.	3.42	5.34
17) Let all lightning-caused fires burn to restore the natural balance of the forest.	4.15	3.20

COLORADO SURVEY CLUSTER RESPONDENTS DEMOGRAPHICS RESULTS

The purpose of this analysis is to identify any demographic patterns that hold up across all conservation/preservation leaning clusters, and all human use leaning clusters. Only the seven questions shown in **Table B-20** were considered in this analysis, as they are the only ones that are comparable across all three surveys. The first demographic question is gender and the results are presented in **Table B-25**. The first thing we can see from this table is that in all clusters in all surveys, the majority (60 percent) of respondents were male. However, conservation leaning clusters in all three surveys have an appreciably higher percentage of females (43 percent) as opposed to human use leaning clusters (20 percent).

Table B-25
Percentage of Respondents by Survey, Cluster, and Gender

Gender	Colorado Survey		PSI Survey		AR Survey		Average
	Cluster 1**	Cluster 2	Cluster 1	Cluster 2**	Cluster 1**	Cluster 2	
Male	56.00%	72.00%	91.15%	58.76%	66.67%	81.41%	60.60%
Female	44.00%	28.00%	8.85%	41.24%	33.33%	18.59%	39.40%
Totals	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
**Indicates environmental/conservation leaning cluster							

Next, average age is shown in **Table B-26**. Because of differences in the age question across surveys, the averages given are exact only for the Colorado Survey, and are interpolations for the other two surveys. In the case of the Colorado survey, respondents in the conservation leaning Cluster 1 are younger by an average of seven years. The reverse is true for the PSI survey, with respondents in the conservation leaning Cluster 2 averaging seven years older. This is due to the fact that most of the seniors are members of this cluster. Finally, in the AR survey, the average ages are the same for both clusters.

Table B-26
Average Ages by Survey and Cluster

	Colorado Survey		PSI Survey		AR Survey		Average
	Cluster 1**	Cluster 2	Cluster 1	Cluster 2**	Cluster 1**	Cluster 2	
Average Age	46	53	47	54	49	49	50
***Indicates environmental/conservation leaning cluster*							

Respondents were asked to specify their field of work. The CS occupation question was similar (see **Table B-24**) but not the same as that for the other two surveys. However, it was possible to combine the responses as shown in **Table B-27**. The first thing to note is that for all surveys and all clusters, except Cluster 2 in the PSI survey, over half of the respondents were either professional/technical or trade worker/skilled technicians. Cluster 2 of the PSI survey had nearly 50 percent in those categories, but also had 35 percent retired respondents. In the Colorado and AR surveys, a greater percentage of

respondents are in professional/technical positions in the environmental/conservation leaning cluster than in the human use leaning cluster. In the PSI survey, the majority of retired respondents belong to the environmental/conservation leaning cluster while the reverse is true for the other surveys, especially the CS.

Table B-27
Job Classification Percentages by Survey and Cluster

Job	Colorado Survey		PSI Survey		AR Survey		Average
	Cluster 1**	Cluster 2	Cluster 1	Cluster 2**	Cluster 1**	Cluster 2	
Professional/ technical	37.66	20.85	51.04	43.84	57.59	50.97	43.66
Trade worker/skilled technician	38.72	31.92	10.42	3.62	4.19	6.45	15.89
Office worker	5.96	3.91	2.60	2.90	4.19	0.65	3.37
Agriculture, forestry, fisheries	6.81	8.47	0.52	0.00	1.57	3.87	3.54
Retired	2.55	31.27	17.71	35.14	15.71	16.13	19.75
Other (includes students, unemployed, homemaker, self-employed, and military)*	8.30	3.58	17.71	14.50	16.75	21.93	13.80
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00
***Due to category discrepancies in the different surveys, the 'other' category contains many categories that should fall alone.**							
****Indicates environmental/conservation leaning cluster**							

The next question addressed respondent education levels (**Table B-28**). Here many similar patterns can be seen. A significant majority of respondents in all clusters in all surveys have some college education, if not a degree. The more environmental-conservation leaning clusters in all three surveys had higher percentages of respondents with at least one college degree. Conversely, in all three surveys, the human use leaning clusters had a higher percentage of respondents with some college, but no college degree.

Table B-28
Education Percentages by Survey and Cluster

Education	Colorado Survey		PSI Survey		AR Survey		Average
	Cluster 1**	Cluster 2	Cluster 1	Cluster 2**	Cluster 1**	Cluster 2	
Some schooling prior to HS degree	4.54	5.52	0.52	2.17	0.52	1.29	2.43
High school degree	12.57	20.45	15.10	12.68	1.05	9.68	11.92
Some college	26.00	33.12	30.73	21.74	10.99	14.84	22.90
College degree	27.75	14.94	32.29	19.20	21.99	31.61	24.63
Some graduate school	6.98	5.52	6.77	13.41	18.85	14.84	11.06
Graduate degree	15.88	8.44	13.54	30.43	46.60	27.10	23.67
Other (includes technical/vocational school)	6.28	12.01	1.05	0.37	0.00	0.64	3.39
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00
****Indicates environmental/conservation leaning cluster**							

Summary data on respondent incomes are shown in **Table B-29**. Across all surveys and clusters, the highest percentage of respondents (24.55 percent) fell into the $50,000-$74,999 income range. However, looking at each survey individually, the results are different. A far greater percentage of respondents to the CS had incomes below $25,000 than was the case for either of the other surveys. The reverse was true for incomes greater than $50,000. In fact, only the $35,000-$49,999 class had comparable percentages of respondents across all clusters and surveys.

Because of differences in the 'length of residence in Colorado' question across surveys, the data are difficult to compare across surveys. For the CS, Cluster 1 respondents averaged 23 years of residency in the state, while Cluster 2 respondents averaged 31 years. For the other two surveys, respondents in all clusters averaged over 10 years of residency.

Table B-29
Percentage of respondents by Income Level by Survey and Cluster

Income	Colorado Survey		PSI Survey		AR Survey		Average
	Cluster 1**	Cluster 2	Cluster 1	Cluster 2**	Cluster 1**	Cluster 2	
< $15,000	16.64	9.82	2.14	6.13	3.74	3.36	6.97
$15,000-$24,999	17.77	20.70	6.99	11.11	8.56	4.70	11.64
$25,000-$34,999	20.23	24.91	13.98	21.84	11.23	12.08	17.38
$35,000-$49,999	20.98	18.60	18.28	19.92	19.25	18.12	19.19
$50,000-$74,999	14.93	20.70	30.65	20.31	30.48	30.20	24.55
>$75,000	9.45	5.26	27.96	20.69	26.74	31.54	20.27
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Notes:

***Indicates environmental/conservation leaning cluster*

Table B-30 shows respondent county information. This varied among the surveys, which is to be expected as the AR and PSI survey respondents tended to live near their respective national forests. A high number of CS respondents were from Garfield and Mesa counties. The PSI survey had a large percentage of Chaffee, El Paso, and Jefferson county respondents. And the AR survey had a high number of respondents from Boulder and Larimer counties. About 5 percent of the respondents from each survey were from Denver County.

Table B-30
County Percentages by Survey and Cluster

County	Colorado Survey		PSI Survey		AR Survey		Average
	Cluster 1**	Cluster 2	Cluster 1	Cluster 2**	Cluster 1**	Cluster 2	
Adams	2.82%	1.95%	5.24%	0.37%	0.52%	1.27%	2.03%
Alamosa	2.65%	4.89%	0.52%	0.37%	0.00%	0.00%	1.40%
Arapahoe	0.18%	0.00%	9.42%	1.48%	4.64%	2.53%	3.04%
Archuleta	0.53%	0.33%	0.00%	0.00%	0.00%	0.00%	0.14%
Boulder	0.00%	0.00%	1.05%	0.00%	33.51%	13.29%	7.98%
Chaffee	3.00%	3.91%	17.28%	22.88%	0.00%	0.64%	7.95%
Clear Creek	0.00%	0.00%	0.00%	0.00%	1.55%	3.16%	0.79%
Conejos	0.88%	2.28%	0.00%	0.00%	0.00%	0.00%	0.53%
Custer	0.00%	0.00%	0.00%	0.37%	0.00%	0.00%	0.06%
Delta	0.88%	0.98%	0.00%	0.00%	0.00%	0.00%	0.31%
Denver	7.05%	5.21%	5.76%	1.11%	10.31%	5.70%	5.86%
Dolores	0.35%	0.00%	0.00%	0.37%	0.00%	0.00%	0.12%
Douglas	0.00%	0.00%	2.09%	0.00%	0.52%	1.90%	0.75%
Eagle	1.41%	0.98%	0.00%	0.00%	0.00%	0.00%	0.40%
El Paso	0.00%	0.00%	28.27%	60.89%	1.55%	1.27%	15.33%
Elbert	0.00%	0.00%	0.00%	0.37%	0.52%	0.00%	0.15%
Fremont	0.00%	0.00%	1.05%	0.74%	0.52%	0.00%	0.38%
Garfield	29.28%	31.27%	0.00%	0.00%	1.03%	0.00%	10.26%
Gilpin	0.00%	0.33%	0.00%	0.00%	1.55%	0.64%	0.42%
Grand	0.18%	0.00%	0.52%	0.00%	4.64%	6.96%	2.05%
Gunnison	0.18%	0.33%	1.05%	0.00%	0.00%	0.63%	0.36%
Hinsdale	0.18%	0.98%	0.00%	0.00%	0.00%	0.00%	0.19%
Jackson	0.00%	0.00%	0.00%	0.00%	0.00%	1.27%	0.21%
Jefferson	1.76%	1.63%	19.37%	4.43%	6.19%	6.33%	6.62%
Lake	0.00%	0.00%	2.62%	2.58%	0.00%	0.00%	0.87%
La Plata	7.58%	7.49%	0.00%	0.00%	0.52%	0.00%	2.60%
Larimer	7.58%	3.26%	0.00%	0.00%	23.20%	30.38%	10.74%
Mesa	11.82%	12.05%	0.00%	0.00%	1.03%	0.00%	4.15%
Mineral	0.00%	0.33%	0.00%	0.00%	0.00%	0.00%	0.05%
Moffat	0.18%	0.00%	0.00%	0.00%	0.00%	0.00%	0.03%
Montezuma	0.53%	0.65%	0.00%	0.00%	1.03%	0.64%	0.47%
Montrose	3.70%	6.51%	0.00%	0.00%	0.00%	0.00%	1.70%
Morgan	0.00%	0.00%	0.00%	0.00%	0.00%	0.64%	0.11%
Ouray	1.41%	0.98%	0.00%	0.37%	0.00%	0.00%	0.46%
Park	1.23%	0.98%	0.00%	0.00%	0.52%	0.64%	0.56%
Pitkin	1.06%	0.00%	0.00%	0.00%	0.00%	0.00%	0.18%
Pueblo	0.00%	0.00%	1.57%	0.37%	0.52%	0.64%	0.52%
Rio Blanco	0.35%	0.98%	0.00%	0.00%	0.00%	0.00%	0.22%
Rio Grande	1.76%	2.93%	0.00%	0.00%	0.00%	0.00%	0.78%
Routt	0.18%	0.00%	0.00%	0.00%	0.00%	0.00%	0.03%
Saguache	0.00%	0.33%	0.00%	0.00%	0.00%	0.00%	0.05%
San Miguel	0.88%	0.00%	0.00%	0.00%	0.00%	0.00%	0.15%
Summit	4.41%	3.26%	0.00%	0.00%	0.00%	0.64%	1.38%
Teller	0.00%	0.00%	4.19%	2.95%	0.00%	0.00%	1.19%
Weld	6.00%	5.21%	0.00%	0.00%	1.03%	7.59%	3.30%

Table B-30 continued

County	Colorado Survey		PSI Survey		AR Survey		
Cluster 1**	Cluster 2	Cluster 1	Cluster 2**	Cluster 1**	Cluster 2	Cluster 1**	Cluster 2
Other Non-CO	0.00%	0.00%	0.00%	0.35%	5.16%	13.28%	3.13%
Totals	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
**Indicates environmental/conservation leaning cluster							

Discussion of Demographic Results

Demographic comparisons are made somewhat more difficult because of differences in survey questions as well as differences in how the survey samples were drawn. For example, it was noted above that the Colorado Survey had considerably greater proportions of respondents in trade worker/skilled technician professions, in the less than $35,000 income brackets, and in the no college degree education categories than did either the PSI or the AR surveys. This may be due to the fact that CS respondents were drawn from the population of all residents in the counties sampled while the PSI and AR samples were drawn from members of specific stakeholder groups (PSI) or forest planning mailing lists (AR). It seems that the PSI and AR respondents had a higher income, were more educated (and perhaps older) people, and perhaps these demographic characteristics are over-represented in these lists compared to the population as a whole.

Some conclusions can, however, be drawn from the demographic results. First, in all three surveys the proportion of female respondents is significantly higher in the environmental/conservation leaning clusters than in the human use leaning clusters. Second, in all clusters in all surveys, there is a significant number of respondents who work in professional/technical occupations. Third, in all three surveys, more respondents hold at least one college degree in the environmental/conservation leaning clusters than is the case in the human use leaning clusters. One last interesting result is that in the Colorado Survey, a significant majority of retired respondents fall into the human use leaning cluster, while the reverse is true for the PSI survey. In the AR survey, the split is much closer, but a majority falls into the environmental/conservation leaning cluster.

Respondents were asked to specify their field of work. For all surveys and all clusters, except Cluster 2 in the PSI survey, over half of the respondents were either professional/technical or trade worker/skilled technicians. Cluster 2 of the PSI survey had nearly 50 percent in those categories, but also had 35 percent retired respondents. In the Colorado and AR surveys, a greater percentage of respondents are in professional/technical positions in the environmental/conservation leaning cluster than in the human use leaning cluster. In the PSI survey, the majority of retired respondents belong to the environmental/conservation leaning cluster while the reverse is true for the other surveys, especially the CS.

The next question addressed respondent education levels. A significant majority of respondents in all clusters in all surveys have some college education, if not a degree. The more environmental/conservation leaning clusters in all three surveys had higher percentages of respondents with at least one college degree. Conversely, in all three surveys, the human use leaning clusters had a higher percentage of respondents with some college, but no college degree.

In terms of income, across all surveys and clusters, the highest percentage of respondents (24.55 percent) fell into the $50,000-$74,999 income range. However, looking at each survey individually, the results are different. A far greater percentage of respondents to the CS had incomes below $25,000 than was the case for either of the other surveys. The reverse was true for incomes greater than $50,000. In fact, only the $35,000-$49,999 class had comparable percentages of respondents across all clusters and surveys.

SUMMARY OF CLUSTER RESULTS

In this project, sets of response data from three surveys investigating stakeholder objectives for the management of the Arapaho-Roosevelt National Forest, the Pike and San Isabel National Forest, and the White River National Forest, all in Colorado, were analyzed. Cluster analysis was used to analyze the responses and this resulted in two cluster groupings of respondents in each survey. The larger cluster of respondents in each survey tended to be the more environmental/conservation-oriented group. They more strongly supported management policies and activities that protect or restore ecosystems, such as increasing the amount of land managed as wilderness, restricting activities that damage the land and its resources, keeping roadless areas roadless, eliminating development on public lands, and designating more trails for hikers and walkers. The second and smaller cluster grouping for each survey more strongly supported management policies and activities that promote resource use and consumption. They had more interest in allowing access for off-highway vehicle use, harvesting timber and promoting grazing, and, in general supporting activities that enhance economic well being. In all three surveys, respondents in both clusters supported objectives relating to sustaining national forest ecosystems.

Finally, it should be noted that despite the differences between clusters within each survey, there are many areas of agreement. First, respondents in all clusters care very deeply about how national forests in Colorado are managed. Second, most if not all respondents feel that sustaining wildland ecosystems is very important, with disagreement primarily arising over how this should be done and what the nature and amount of human activities consistent with ecosystem sustainability are. Third, most respondents recognize that there are many classes of forest users and that they all have a right to pursue legitimate activities. Fourth, many respondents in all surveys and clusters feel that public education about wildland management issues is very important.

WHITE RIVER AND NON-WHITE RIVER COUNTIES

One final aspect of the Colorado Survey data was examined, that of differences in responses between those living in the six county White River economic impact area (Garfield, Summit, Eagle, Lake, Rio Blanco, and Pitkin counties), and those living outside the area. This was done by identifying original cluster membership for all respondents in this area and for all respondents in the other counties represented in the sample. No difference could be identified between respondents from the two areas. For the complete sample (886 respondents), 576 (65.01 percent) of the respondents belong to Cluster 1 and 310 (34.99 percent) belong to Cluster 2. A total of 567 respondents were from the non-White River National Forest counties and of these, 369 (65.08 percent) belong to Cluster 1 and 198 (34.92 percent) belong to Cluster 2. The remaining 319 respondents come from White River National Forest counties and 207 (64.89 percent) belong to Cluster 1 and 112 (35.11 percent) belong to Cluster 2. Therefore, the

distribution of respondents by cluster is almost identical within and outside of the White River National Forest economic impact area.

Similarities Between Clustering Results and Public Comments on the Draft Forest Plan and DEIS

The draft forest plan, DEIS, and appendices were released for public review and comment in August 1999 for 90 days, a comment period that was eventually extended an additional six months to May 9, 2000. Over 14,000 individual responses were received from a diverse array of stakeholders and interested parties from around the country. This set of responses was subjected to a detailed content analysis by an agency content analysis team (CAT). The results of this analysis are summarized (CAT Executive Summary 2000), and information from this summary will be used here. The White River National Forest Land Management Planning web page contains a link to this summary.

It is important to note that this collection of responses is not a statistically valid sample and that content analysis, unlike the cluster analyses described above, is not a statistically-based technique. Nor are the responses necessarily explicit expressions of stakeholder objectives, although many of them are certainly motivated by these objectives and their underlying stakeholder values. Because content analysis is extremely useful for summarizing large collections of comments and for identifying patterns or major themes of responses with regard to the issues raised, it can shed at least anecdotal light on stakeholder objectives as they are expressed in these responses. These response patterns across a large number of respondents can provide useful information on what is important to many of the stakeholders that responded during the comment period.

One of the most interesting patterns the White River National Forest comment period responses exhibit is the grouping of many responses into two or three general positions on several of the key issues. Many of the responses relate to one of three alternatives described in the DEIS, these being C, D, or I. Grouping into three positions occurs on some issues where the three alternatives are significantly different from each other. As an example, advocates of Alternative I believe that Alternative D calls for too much active management on the White River National Forest and does not go far enough to protect ecosystems, while advocates of Alternative C believe that Alternative D is too restrictive, especially in regards to motorized and developed recreation.

On the other hand, there are a number of issues, including stakeholder valuation of forest resources and perceptions of the role of government, where:

> *"In general, those who support Alternative I or D and those who support Alternative C fall into two camps . . ."*

Often there is a fundamental lack of agreement over which activities are compatible with each other and with preserving the environment, as well as over the appropriate mix and amount of acceptable activities. As the summary states:

> *"It is clear that the preferred public land management approach of each group is rooted in basic differences in viewpoint and values regarding the utility and highest public benefit of National Forest System natural resources."*

The report also notes that:

> *"Those favoring Alternative I tend to see National Forest System lands as whole ecosystems which intensive human activity disrupts. . . . protecting the White River National Forest consists in minimizing human disturbance and mimicking natural processes. . . . Active management activities are thus often viewed as unnecessary and unwise meddling in complex natural systems that humans do not yet fully understand. . . . They believe intact forest ecosystems should be protected for their own intrinsic value, for the benefit of wildlife, and for the non-commodity benefits public lands offer to humans. . . . Those who favor Alternative I see the forest as an ecosystem whose long-term functioning is best preserved by restoring natural disturbance regimes such as fire, insec,t and disease cycles. . . . According to many proponents of both Alternative D and I, satisfying human desires for forest resources must take second place to satisfying the equal human need for natural forest ecosystems . . ."*

On the other hand:

> *"While they value many similar forest characteristics, advocates of Alternative C perceive proper management of National Forest System lands differently. . . . They also see national forests in terms of the resources they offer for human use, but identify a very different set of primary uses. Many of these users do express significant concern for the environment. However, they feel that negative impacts of human activity have been greatly exaggerated. . . . Those supporting Alternative C tend to see national forests as natural systems whose health is often threatened by unmanaged natural processes. They tend to favor a utilitarian or agricultural model whereby human ingenuity and modern timber management can maximize forest health for human benefit. . . . For these people, protection consists of managing these lands for sustainable resource extraction, controlling fire, and fighting insect and disease outbreaks aggressively."*

In many ways the two groups of respondents whose positions are outlined above resemble the two clusters of stakeholders identified in each of the three surveys. Advocates of alternatives D or I are clearly more environmentally or conservation oriented and clearly have objectives for the White River National Forest with the same orientation. Advocates for Alternative C or its variants are more human use oriented and clearly have objectives consistent with that orientation.

However, despite the differences between the two groups, there are areas of agreement. First, respondents in both groups care very deeply about how the White River National Forest is managed. Second, respondents in both groups feel that sustaining wildland ecosystems is very important, with disagreement primarily arising over how this should be done and what the nature and amount of human activities consistent with ecosystem sustainability are. Third, most respondents recognize that there are many classes of forest users and that they all have a right to pursue legitimate activities. These are very similar to the areas of agreement between cluster respondents in the surveys.

SUMMARY OF STAKEHOLDER OBJECTIVES

When one thinks of the number of stakeholder groups that have organized as part of the debate over White River National Forest management issues, it may be surprising that when objectives of individual respondents are analyzed, only two clusters are defined. However, this is not inconsistent with the results of other studies that have looked at objectives (Martin, et. al., 2000). In terms of natural resources, these authors point out:

> "The fundamental basis for conflict is differing preferences, manifested primarily in three areas:
>
> (1) the allocation of lands between commodity and non-commodity uses;
>
> (2) the allocation of lands between motorized and non-motorized uses; and
>
> (3) the different emphases of multiple-use management and ecosystem management.

Note how (1) each of these sources of conflict are represented by two positions, and (2) how all three sources manifest themselves in the questions having greatest agreement and disagreement in **Tables A-31**, **A-32**, and **A-33**. Martin et al., describe the three bases for conflict in terms of stakeholder preferences, but preferences are closely tied to objectives, as the authors point out. Both the cluster results and the content analysis results seem consistent with this, especially when the nature of the objectives questions included in the surveys is considered.

It is also true that in a values, objectives, attitudes, and behaviors construct, specificity increases as one moves from values to objectives to attitudes and, finally, to behaviors (Shields, 2000).

In many cases for the survey results, affiliation with a given stakeholder group is closely related to an individual's behaviors. Therefore, because behaviors are more specific than are objectives and preferences, there are more than two stakeholder groups. However, when stakeholder group respondents are asked to consider their objectives, these results suggest that they aggregate into a smaller number of groups or clusters. This is evident in the PSI survey, where there are three stakeholder groups aggregating into two clusters. Had other stakeholder groups been included in the PSI survey, results with the AR and Colorado Survey as well as those of other studies suggest that the two cluster pattern would still hold, with one larger environmental/conservation leaning cluster, and one smaller human use leaning cluster.

RESULTS OF STAKEHOLDER GROUP MEETINGS

The next step in this process involves validation of White River National Forest stakeholders' objectives and then using these objectives for the analysis to link objectives to plan alternatives. Validation was accomplished at a series of six stakeholder group public meetings held on February 5, 6,and 12, 2001, in Glenwood Springs, Avon, and Denver, Colorado. While these were public meetings and therefore open to anyone, each one focused on objectives validation with a selected group of stakeholders. In the order the meetings were held, these groups were: motorized recreation, non-motorized recreation, government and other interests, ski interests, environmental/conservation interests, and second homeowners. All meetings were attended by two note-takers, and

the first product of these meetings was a complete set of notes on the results of the objectives validation for all groups.

The first step in linking these objectives to plan alternatives involved the organization of each group's objectives into what is known as an objectives hierarchy (Keeney, 1992), one for each group. An objectives hierarchy is a more detailed method for presenting a set of objectives than the simple lists discussed so far. In an objectives hierarchy, there are three categories of objectives, based on their specificity. The most general objectives are called strategic objectives, while somewhat more specific objectives are referred to as fundamental objectives, and the most specific are called means objectives in that they are the means for accomplishing the higher order, more general objectives. In a hierarchy, objectives are organized in an outline or nested format, with each strategic objective being listed at the top level of the outline or hierarchy; with all associated fundamental objectives at the next level, and with all associated means objectives being listed at the next level of the outline.

The process for developing these hierarchies began with the meeting notes. Using an iterative process, the statements in the notes were successively screened base on the following criteria:

1) Does the statement describe an objective?

2) Is the objective something that falls in the White River National Forest sphere of influence?

3) Does the objective relate to an issue that the White River National Forest has the authority to address?

4) Is the objective a strategic, a fundamental, or a means objective?

Tables A-31-36 contain the six final hierarchies, one for each stakeholder group. Once stakeholders objectives are characterized using the objectives hierarchies in **Table 31**, the next step is to identify attributes that reflect or measure variables that either represent the means objectives directly, or that can at least serve as proxies. The predicted levels of achievement of these attributes under any plan alternative provide estimates of how well the corresponding objectives are satisfied by the alternative under consideration. The results of this analysis provide the basis for answering the third question given above. Once this task is completed for each alternative under consideration, it is possible to determine how each stakeholder group makes out under each alternative. See Chapter 3 of the FEIS for details on this analysis.

Table B-31
Motorized Recreation (MR) Stakeholder Objectives

STRATEGIC OBJECTIVE MR-1:	
The freedom to recreate as one chooses, which has the benefits of family doing this together and enjoying the forest and teaching respect and pass on responsible use of the forest	
MEANS OBJECTIVES UNDER STRATEGIC OBJECTIVE MR-1:	
Objective	**Attribute**
MR-1-1:-Include end use objectives: the value	Number of hardened campsites

of a given route must include such considerations as other recreation opportunities, scenery, wildlife viewing, etc along the route.	Number of scenic overlooks Number of fishing opportunities For each trailhead, by season: number of parking spaces number of restroom facilities
MR-1-2:-Recreation opportunities not in crowded areas (do not herd users into one area).	Miles of complete trail loops Number of designated snowmobile areas Number of signs Miles of trails by: associated opportunities, degree of difficulty, and access
MR-1-3:-Have adequate trailheads and signing so people understand what's expected of them. People need to understand what the rules are and provide education.	Miles of complete trail loops For each trailhead, by season -- number of parking spaces
MR-1-4:- Improved recreation management by increasing the presence of FS in the field—e.g. a volunteer trail host program or camp host that serves to educate and take information to law enforcement officers.	-Number of signs -Total number of man-hours devoted to increasing forest service presence in the field
STRATEGIC OBJECTIVE MR-2:	
Recognize the personal values and benefits of motorized recreation to individuals and society. Included are solitude, religious experience, shared social experience, release of stress, physical challenge, integrity of family.	
MEANS OBJECTIVE UNDER STRATEGIC OBJECTIVE MR-2:	
Objective	**Attribute**
MR-2-1:-Recognize history of motorized recreation use on public lands--These things have been going on for 40+ years involving family and grandparents teaching grandchildren what they once did.	-Definition by type of facility -Narrative on user-created illegal trails

Table B-32
Non-motorized Recreation (NMR) Stakeholder Objectives

STRATEGIC OBJECTIVE NMR-1:	
Provide adequate opportunities for quality non-motorized recreation	
MEANS OBJECTIVES UNDER STRATEGIC OBJECTIVE NMR-1:	
Objectives	**Attributes**
NMR-1-1:-Providing high-quality non-motorized recreation opportunities by incorporating separation of uses, opportunities for solitude, and desirable settings. Comments: This objective should include: Separate high traffic use/high density non-motorized use areas from motorized and other non-motorized areas Separate horse/bike/foot users, especially in summer Separate motorized from non-motorized uses Separation should not mean exclusive use The ability to separate uses should be retained Separation should be by trail Multiple-use of trails Trails outside of wilderness are open to all non-motorized users	-Summer: number of travel routes managed to separate uses number of foot and horse and mechanized trail miles number of acres in each ROS class -Winter: number (or acres) of non-motorized areas acres in each ROS class -Acres in each scenic integrity class -Measurement of land area a certain distance from road or trail
NMR-1-2:-Access points in desirable locations Comments: This objective should include: Separate uses at access points by user group or by creating new ones or more appropriate ones (there is not a desire to increase access points) Improve or increase access points that are more usable by a variety of users	-Number accessible by public transport -Number of access points made more usable by a variety of users
NMR-1-3:-Education and enforcement (historic values, signing, self-regulation, access point information)	-Number of education contacts -Number of incidents of non-compliance and complaints -Number of Sign-in/Sign-out stations
NMR-1-4:-Provide non-motorized areas in different ecosystems-at various elevations	-Ratio of non-motorized acres to total acres in each ecosystem/elevation should be the same for all ecosystems

	all ecosystems. - Matrix of ROS (SPNM) by ecosystem
NMR-1-5:-Everything is closed unless signed as opened winter policy should match summer policy	-Forest-wide standards and guides in plan
NMR-1-6:-Recognize high activity or use areas (sacrifice zones); concentrate high impacts in existing developed areas instead of creating new ones	-Number of users within permit areas -Miles of trails within permit boundaries -Number of events in permit areas -Number of acres devoted to non-permitted concentrated use
NMR-1-7:-Be willing to set and enforce limits on recreation use	-Permitted use (lottery or reservation system) -Establish carrying capacity of total use -Ratio of permitted use to total public use
STRATEGIC OBJECTIVE NMR-2:	
Protect/enhance ecosystem integrity	
MEANS OBJECTIVES UNDER STRATEGIC OBJECTIVE NMR-2:	
Objectives	**Attributes**
NMR-2-1:-Protect biodiversity	-Number of species -Watershed condition classes -Bird counts -Viability assessment -Number or acres of Research Natural Areas -Measure wetlands and riparian zones using a graded system
NMR-2-2:-Avoid conflict with environmental objectives when establishing recreation management schemes	-Monitor for changes in species viability and diversity
NMR-2-3:-Recommend more wilderness	-Acres recommended for wilderness
NMR-2-4:-Trailhead toilet facilities at heavily impacted areas	-Number of toilets at each trailhead -Measure water quality at trailheads

Table B-33
Government/Other Interests (GOI) Stakeholder Objectives

STRATEGIC OBJECTIVE GOI-1:	
Maintain/Improve Quality of Life	
FUNDAMENTAL OBJECTIVE GOI-1-1 UNDER STRAT. OBJECTIVE GOI-1:	
Economic prosperity (including tourism) Comments: This objective is inclusive of the following concepts- Economic diversity Economic sustainability Focus on sub-area within the forest (e. g. Pitkin County vs. Rio Blanco County)	
MEANS OBJECTIVES UNDER FUNDAMENTAL OBJECTIVE GOI-1-1:	
Objectives	**Attributes**
GOI-1-1-1:-Maintain watershed purposes of the forest	-Water quantity: Ratio of sublimation to run-off Number of times minimum in-stream flows are not met Acre-feet of yield (history) Compare historic yield with demand by type of water use -Water quality: Number of stream segments on 303(d) list
GOI-1-1-2:-Maintain economic health of businesses/communities north of I-70 (that depend on commodities from the White River National Forest)	-Number of people known at the local bar -Number of ranches
GOI-1-1-3:-Continued stable and viable forest utilization for historic/traditional uses	-Number of open allotments -Number of grazing permits -Acres under grazing permits -Number of sawmills -Number of ranches -Number of acres converted from agriculture to other uses -Acre-feet of water converted from agricultural

	to other uses -Number of acres under conservation easements -Number of golf courses -Acres of huntable/watchable wildlife winter habitat -Survey of visitors and their expectations -Recreation opportunities measures: Miles of trail by type of use Number of trailheads Number of campsites
GOI-1-1-4:-Sustain cultural heritage	-Number of working (not hobby) ranches and acres used for agricultural purposes -Acres of land in agricultural uses
GOI-1-1-5:-Maintain or improve the social & economic health of communities near the forest	-Ratio between average wage and cost-of-living -By season for the following: Wages Housing availability Housing cost Commute times -Non-market related income, wages, housing, and commute times ("non-market" refers to amenity-based activity) -Direct, indirect, and induced economic effects for employment, income, etc -Healthy community benchmarks and measurements (done by Colorado Trust, Healthy Mountain Communities, etc) -Economic impacts separated by locally-generated v. nationally generated activities (e.g. interest rates, international markets, world events) -County expenses resulting from tourism activities -Local government revenues & expenses for services associated with tourism and other forest uses (develop a ratio)

FUNDAMENTAL OBJECTIVE GOI-1-2 UNDER STRAT. OBJECTIVE GOI-1:	
Ecological prosperity Comments: This objective is inclusive of the following concepts-ecosystem health, ecological sustainability, bio-diversity	
MEANS OBJECTIVES UNDER FUNDAMENTAL OBJECTIVE GOI-1-2:	
Objectives	**Attributes**
GOI-1-2-1:-Enhancement/protection of biodiversity	-Number of indicator species -Relationship further from trail of animal life -Environmental protection/sustainability measure: Number of environmentally-sensitive sites Number of such site near recreation areas Number of species (flora/fauna) Percent of habitat lost -Noise, air and water pollution levels -Water quality: -Number of stream segments on 303(d) list -Acres of reclaimed/restored land after use
GOI-1-2-2:-Protection of scenic vistas	-Air quality (e.g. ppm)
FUNDAMENTAL OBJECTIVE GOI-1-3 UNDER STRAT. OBJECTIVE GOI-1:	
Improve harmony between levels of governments Comments: This objective is inclusive of the following concepts- Complementary land use goals/zoning of adjacent lands. Complementary programs of public education & responsibilities.	
MEANS OBJECTIVES UNDER FUNDAMENTAL OBJECTIVE GOI-1-3:	
Objectives	**Attributes**
GOI-1-3-1:-Improve the relationship between Forest Service and local governments by working together where there are common or affected interests. This includes such things as:	-Number of agreements (e.g. MOUs, intergovernmental agreements) -Number of parties involved with agreements (e.g. MOUs, intergovernmental agreements)

Permitted ski area on forest lands and development on adjacent private lands Fuel loads on forest lands and high population areas on adjacent private lands	-Monitoring implementation of forest-wide standards -Compare forest plan management prescription with county zoning master plans, following example in Building Bridges Project

Table B-34
Ski Interests (SI) Stakeholder Objectives

STRATEGIC OBJECTIVE SI-1:	
Ensure that the activities of all ski and snowboarding[1] interests on the white river national forest is sustainable; that is, the needs and expectations of resort employees, resort owners, recreation visitors, and other service providers are met, now and in the future. Other important aspects of sustainability include: Competitiveness (both within the U.S. and outside—world markets) Career opportunities in local labor markets Each resort season must be recognized as a different market No resort should "go under" Resorts provide concentrated & managed recreation use, relieving use in more dispersed areas Capital requirements Lease structure of permits Large resorts v. small resorts (reflected in wage differences) All the stakeholders are tied together under sustainability—community, recreation visitor, resort, environment, 2nd homeowner.	

[1] Hereafter, "ski" and "skiing" includes snowboarding, telemark skiing, etc.

FUNDAMENTAL OBJECTIVE SI-1-1 UNDER STRATEGIC OBJECTIVE SI-1	
Lease and permit provisions that allow the industry to be competitive with ski industries elsewhere, including such things as being able to expand to meet demands for different classes of users in an affordable way.	
MEANS OBJECTIVES UNDER FUNDAMENTAL OBJECTIVE SI-1-1	
Objectives	**Attributes**
SI-1-1-1: Separation of uses, e.g. snowmobilers & cross-country skiers, snowboarders & alpine.	-Acres by use -Acres by level of difficulty -Number of access points
SI-1-1-2:- Forest plan predictability and flexibility	-Response time by the Forest Service to act on permit, plan amendments, etc.
FUNDAMENTAL OBJECTIVE SI-1-2 UNDER STRATEGIC OBJECTIVE SI-1:	
Provide a broad mix of quality recreation opportunities, both ski and non-ski related, in all seasons and throughout the forest. Important aspects of this include: Access Quality customer service which encourages return recreation visits Responding to changes in skier trends and demands Adapting to demographic changes Physical/mental health of visitors --that rejuvenates them, makes them happier, and in a place they want to be Quality of the experience Opportunity to ski in a variety of terrains Recreation experience in both summer and winter activities (snowshoe, snowboard, mountain bikes, etc.)	
MEANS OBJECTIVES UNDER FUNDAMENTAL OBJECTIVE SI-1-2:	
Objectives	**Attributes**
SI-1-2-1:-Provide a variety of safe skiing experiences	-Skier density -Aging demographics -Demand -Acres of back country non-motorized use

	-Number of back country access points - -Variety of access tools including snowcoaches, snowcats, and helicopters -Number of accidents -Number of rescues
SI-1-2-2:-Meeting the demands of the public for hut experience	-Number of requests for reservations -Number of requests fulfilled
SI-1-2-3:-Increasing managed summer and winter recreation opportunities in permit areas (to remove pressure elsewhere)	-Number of visits by equipment type -Number of employees - Snowmaking
SI-1-2-4:-Provide for a broad range of skier experiences or preferences	- Acres of scenic integrity of auxiliary facilities -Capacity (facilities, restaurants, etc) -Skiers/Acre (density of skiers) -Number of Skier Days -Number of Peak Days -Affordability by the skier/visitor (ability to participate) -Terrain diversity—concentrated and backcountry and non-condensed use—look at number of acres and type and by season -Visitor concentration or utilization rates for each type of recreation use – by season, by type, by use
FUNDAMENTAL OBJECTIVE SI-1-3 UNDER STRATEGIC OBJECTIVE SI-1:	
Ensure the social/economic sustainability of communities and their business components around the White River National Forest	
MEANS OBJECTIVES UNDER FUNDAMENTAL OBJECTIVE SI-1-3:	
Objectives	**Attributes**
SI-1-3-1:-Maintain/enhance economic viability of community	-Diversity of ski areas providing a variety of price points or market segmentation -Availability of housing for: Resort employees Other employees in community -Cost of living or consumer price index for core mountain communities

SI-1-3-2:-Allow access to permit areas year 'round	-Recreation use in permitted ski areas other than alpine skiing
FUNDAMENTAL OBJECTIVE SI-1-4 UNDER STRATEGIC OBJECTIVE SI-1:	
Ensure the ecological sustainability of the White River National Forest	
MEANS OBJECTIVE UNDER FUNDAMENTAL OBJECTIVE SI-1-4:	
Objectives	**Attributes**
SI-1-4-1: Manage the forest to preserve scenic, wildlife and other environmental values	-Number of wildlife in permit area -Number of wildlife adjacent to permit area -Acres of scenic integrity on the White River National Forest

Table B-35
Environmental/Conservation Interests (ECI) Stakeholder Objectives

STRATEGIC OBJECTIVE ECI-1:	
Maintain/enhance ecologic integrity with all parts and processes at all scales across jurisdiction boundaries.	
FUNDAMENTAL OBJECTIVE ECI-1-1 UNDER STRAT. OBJECTIVE ECI-1	
Maintain/enhance viable populations of all species**.**	
MEANS OBJECTIVES UNDER FUNDAMENTAL OBJECTIVE ECI-1-1	
Objectives	**Attributes**
ECI-1-1-1:-Presence of lynx in the ecosystem.	-Acres of suitable lynx habitat
ECI-1-1-2:-Managing habitat for native, threatened, endangered, and sensitive species	-Acres of suitable habitat for T&E species -Population surveys & trends -Configuration of habitat in terms of adjacency and configuration to avoid isolation of habitat
ECI-1-1-3:-Ensure physical separation of bighorn sheep from domestic sheep	-Acres of management area designated for Bighorn Sheep and Acres of management area designated for sheep allotments
ECI-1-1-4:-Better defined suitability of land for livestock grazing	-Evaluation of non-livestock uses compared to livestock grazing—include both economic and ecological measures (use available measures)

FUNDAMENTAL OBJECTIVE ECI-1-2 UNDER STRAT. OBJECTIVE ECI-1:	
Manage transportation on the forest in a way that protects/enhances ecosystem integrity	
MEANS OBJECTIVES UNDER FUNDAMENTAL OBJECTIVE ECI-1-2:	
Objectives	**Attributes**
ECI-1-2-1:-Roadless area protection	-Miles of non-system motorized routes in roadless areas -Annual reporting of changes in miles of non-system motorized routes -Changes in number of acres of roadless areas
ECI-1-2-2:-Develop and implement an effective and enforceable travel management plan	-Effective and enforceable travel mgt plan—need to reinforce closed unless signed open -Miles of road decommissioned
FUNDAMENTAL OBJECTIVE ECI-1-3 UNDER STRAT. OBJECTIVE ECI-1:	
Preserve/enhance the ecological integrity of water resources	
MEANS OBJECTIVES UNDER FUNDAMENTAL OBJECTIVE ECI-1-3:	
Objectives	**Attributes**
ECI-1-3-1:-Maintain the integrity of streams and rivers flowing out of and thru the forest, especially in terms of by-pass flow protection, maintenance and restoration;	-Number of special use permits that maintain minimum stream flows - Establish minimum stream flows required in a wide-range of streams to maintain health of stream and riparian areas downstream of diversions—an optimal minimum not just a bare minimum
ECI-1-3-2:-Work with water users affected more by by-pass flows that they can live with as well that is not going to create an economic hardship—not as worried about larger entities (Aurora can stop watering a golf course for a day)	-Number of water users collaborated with over instream flows
FUNDAMENTAL OBJECTIVE ECI-1-4 UNDER STRAT. OBJECTIVE ECI-1:	
Monitoring and evaluate ecosystem and watershed health and integrity throughout the White River National Forest.	
MEANS OBJECTIVES UNDER FUNDAMENTAL OBJECTIVE ECI-1-4:	
Objectives	**Attributes**
ECI-1-4-1:-Monitor and evaluate status of key ecosystem and watershed indicators	-Feet of disturbed stream bank that triggers further evaluation

	-Annual breeding bird surveys, across all habitats -Road density (miles/acre) of open, closed, and decommissioned routes -Miles of non-system motorized routes in roadless areas -Annual reporting of changes in miles of non-system motorized routes -Changes in number of acres of roadless areas -Acres of noxious, exotic, and non-native plant species -Acres of naturally occurring fires -Number of viable populations -Acres of suitable habitat by species -Acres of wildlife corridors
ECI-1-4-2:-Identifying and protecting unique ecological values	-Number of sites identified by Colorado National Heritage Program that are protected
ECI-1-4-3:-Maintain or increase acres of old growth	-Number of acres of old growth by ecotype
ECI-1-4-4:-Institute a forest-wide fire management plan	**-Plan developed**
ECI-1-4-5:-Institute a forest-wide insect plan)	**-Plan developed**
FUNDAMENTAL OBJECTIVE ECI-1-5 UNDER STRAT. OBJECTIVE ECI-1:	
Manage for recreation opportunities that are within the limits of ecosystem sustainability	
FUNDAMENTAL OBJECTIVE ECI-1-5 UNDER STRAT. OBJECTIVE ECI-1:	
Objectives	**Attributes**
ECI-1-5-1:-Provide opportunities for wildlife-based recreation within the limits of ecosystem sustainability.	-Number of opportunities available -Acres or areas where carrying capacity has been established
ECI-1-5-2:-Provide opportunities for non-wildlife-based, dispersed recreation within the limits of ecosystem sustainability.	**-Number of opportunities available** -Acres or areas where carrying capacity has been established
ECI-1-5-3:-Conduct research on the ecological impacts from all recreation and use the results to guide future recreation management	-Number of research studies addressing ecological impacts of recreation

Table B-36
Second Homeowners (HO) Stakeholder Objectives

STRATEGIC OBJECTIVE HO-1:	
Preserve forest as close to its natural state as possible	
MEANS OBJECTIVES UNDER STRATEGIC OBJECTIVE HO-1:	
Objectives	**Attributes**
HO-1-1:-Keep it quiet and provide recreation opportunities not available in town	-Miles of trail system by type of use (horse vs. foot traffic vs. motorized, etc.) -Numbers of recreation users (restrict) -Distance from access
HO-1-2:-Provide as much wilderness as possible—keep it the way it is knowing it's going to change anyway	-Acres of proposed wilderness
HO-1-3:-Protect water resources for natural habitat	-Acres of watershed condition improved, maintained or enhanced
HO-1-4:-Prevent destruction of forest land and wilderness areas that could not be restored—destruction means things such as clear cutting and paved parking lots	-Density of roads and trails (miles/acre)—with some areas being high, others low -Acres of clearcut - Acres of roadless -Constrain the building of new trails, particularly in roadless areas—be selective on which roadless areas may have trails—avoid sprawl
HO-1-5:-Recognize different uses of the forest and keep them separate, e.g. motorized from non-motorized recreation	-Miles of trail system by type of use (horse vs. foot traffic vs. motorized, etc.)
HO-1-6:-Forest should play a key role in providing wildlife corridor migration and preventing habitat fragmentation	Acres of wildlife corridors on forest
MO-1-7:- Maintain and enhance habitat for species viability	-Acres of suitable habitat by species - -Number of viable Populations

SCENERY ANALYSIS

The scenery management analysis process involved identifying scenic components as they relate to people, mapping these components, and assigning a value for aesthetics. This aesthetics value provides information to planning teams to assist them in making decisions relative to scenery as a part of ecosystems. The steps in the process were:

- Develop landscape character descriptions.
- Describe scenic attractiveness.
- Determine landscape visibility in terms of concern level and relative visibility.
- Identify scenic classes based on landscape visibility and scenic attractiveness.
- Identify existing scenic integrity.
- Produce a composite scenery base map by merging scenic classes and existing scenic integrity.
- Propose scenic integrity levels to use as a guide for management.

Landscape character description

A *landscape character description* is a description of the combinations of the scenic attributes that make each landscape identifiable or unique. The descriptions represent the combination of the human elements (heritage and the social ties to the landscape) with the physical characteristics that define the flora and fauna. Landscapes, through their character, create a *sense of place*, and the descriptions were an attempt to capture this sense to depict an image of an area.

Landscape character descriptions were written at the *subsection* level of the National Hierarchy of Ecological Units. The components of the descriptions include:

- Landform/geomorphology
- Soil taxa
- Potential natural vegetation
- Climatic factors
- Waterform
- Special or distinctive features
- Communities
- Man-made elements
- Transportation
- Level of disturbance
- Level of remoteness/solitude
- Primary recreation activities
- Cultural landscape themes
- Wildlife and fisheries

The subsections for which landscape character descriptions have been developed are:

- M331Ig Gore/Mosquito Ranges
- M331Ip Indian Peaks/ Williams Fork Mountains
- M331Hj Lower Roaring Fork Valley
- M331Hg Grand Hogback
- M331Hd Flat Tops
- M331Hf Eagle Valley

- M331Hh Hard Scrabble
- M331Hi Divide Plateau Creeks Upland
- M331Ik Sawatch Range
- M331Iw Elk Mountains

The descriptions were written in an interdisciplinary format with a core team consisting of a soil scientist, heritage resource manager, social/economics specialists, fisheries biologist, and landscape architect, along with ranger district recreation staff. This document is included in Appendix P of FEIS Volume 3.

Scenic attractiveness

The landscape character description provided a frame of reference for defining *scenic attractiveness* classes, which were developed to determine the relative scenic value of lands within a particular landscape character. Scenic attractiveness was used as the primary indicator of the intrinsic scenic beauty of a landscape and of the positive responses it evokes in people. It helped to identify landscapes that are valued for scenic beauty, based on commonly held perceptions of the beauty of landform, vegetation pattern, composition, water characteristics, land-use patterns, and cultural features. The scenic attractiveness inventory was developed from two different scale levels of data: a broad scale using landtype associations (LTA) and site-specific scale.

LTAs, as depicted in the National Hierarchy of Ecological Units, are landscape planning scale units. The general size range is 100s to 1000s of acres. An LTA characterizes topography, landform patterns, and features including: characteristic landforms, rock features, geologic composition, and geomorphic processes, soil, and potential natural vegetation communities, climate zone, and elevation. Local landform patterns become apparent at this level in the ecological hierarchy, and differences between delineations are usually obvious to on-the-ground observers.

The LTA scale is at the *experiential* level for human interaction in the ecosystem. Each LTA was analyzed for scenic attractiveness attributes. Data that is more site-specific was used to verify the LTA scale results (vegetation species mixes, slope classes, topography, landform, and water features of lakes and streams). The site-specific scale data was combined with landform data of the LTAs, using the forest's geographic information system.

There are three scenic attractiveness categories:

- *Class A – Distinctive*: Areas where landform, vegetation patterns, water characteristics, and cultural features combine to provide unusual, unique, or outstanding scenic quality. These landscapes have strong positive attributes of variety, unity, vividness, mystery, intactness, order, harmony, uniqueness, pattern, and balance.
- *Class B – Typical:* Areas where landform, vegetation patterns, water characteristics, and cultural features combine to provide ordinary or common scenic quality. These landscapes have generally positive, yet common attributes of variety, unity, vividness, mystery, intactness, order, harmony, uniqueness, pattern, and balance.
- *Class C – Indistinctive:* Areas where landform vegetation patterns, water characteristics and cultural features have low scenic quality. Often water and rock form of any consequence are missing in Class C landscapes. These

landscapes have weak or missing attributes of variety, unity, vividness, mystery, intactness, order, harmony, uniqueness, pattern, and balance.

The two scenic attractiveness classes used in the forest plan revision process were Class A (Distinctive) and Class B (Typical). The scenic attractiveness inventory did not depict any Class C areas for the forest planning process. Some on-forest Class C components were identified using the site-specific scale data, however, not in quantities sufficient to delineate at the forest planning level scale. Although applying the inventory process to lands adjacent to the forest would have produced the Class C areas at the forest plan revision scales, the forest did not undertake to inventory off-forest lands.

Landscape visibility

Landscape visibility was composed of two parts: human values as they relate to the relative importance to the public of various scenes, and the relative sensitivity of scenes based on distance from an observer.

Human values that affect perceptions of landscapes were derived from constituent analysis. Constituent analysis served as a guide to perceptions of attractiveness, helped identify special places, and helped to define the meaning people give to the landscape. Constituent analysis led to a determination of the relative importance of aesthetic to the public. This importance was expressed as a concern level. Sites, travelways, special places, and other areas were assigned a Concern Level value of 1, 2, or 3 to reflect the relative high, medium or low importance.

Concern levels

A forest-wide team was formed to identify Concern Levels for forest travel routes as part of the constituent analysis process. The team used the guidelines from the Scenery Management System (SMS) handbook to derive the Concern Levels. Road and trails have been rated as a Concern Level 1 or 2, primary and secondary respectively, as defined in the SMS handbook. Seldom Seen Areas were assigned Concern Level 3. This system was also applied to travelways outside of the Forest that provide views into the forest. Adjacent Bureau of Land Management lands were also given a Concern Level rating. Other aspects of the constituent analysis process include holding public open house meeting for the forest plan. Scenery was included as a recreation issue at the open houses, and the recreation taskforce work sessions. The public was invited to comment on issues relating to scenery.

Relative sensitivity

Seen Areas and Distance Zones were mapped from these Concern Level areas to determine the relative sensitivity of scenes based on their distance from an observer. The Distance Zones used were:

- Foreground – up to 1/2 mile from observer
- Middleground – 1/2 to 4 miles from the observer
- Background – 4 miles from the observer to the horizon

Topographic and elevation information from digital elevation models of the forest were used to determine Seen Areas. Vegetation was not considered in the Seen Area analysis. Seldom Seen Areas are areas not seen from travel routes. These areas are assigned a Concern Level 3, and may occur in any Distance Zone or Scenic Attractiveness class.

Scenic classes

Scenic Classes represent the relative landscape value by combining Scenic Attractiveness Classes, Concern Levels, and Relative Sensitivity. Generally, Scenic Classes 1 and 2 have high public value, Classes 3-5 have moderate value, and Classes 6 and 7 have low

value. The forest does not have any Class 6 or 7 areas. Nearly 95 percent of the forest has a high public value for scenery.

Existing scenic integrity

The Landscape Character Description was used as a reference for defining Existing Scenic Integrity (ESI). Existing Scenic Integrity indicates the degree of intactness and wholeness of the landscape character, or conversely, a measure of the degree of visible disruption. A forest-wide interdisciplinary approach was taken to inventory the existing scenic integrity. Existing Scenic Integrity was expressed and mapped in terms of Very High, High, Moderate, Low, Very Low, and Unacceptably Low. These ESI ratings were first developed in areas shown in the Historical Activities theme of the geographic information system. Ratings were then developed for all areas of the forest landscape.

Proposed scenic integrity levels by alternative

The Scenic Classes and the Existing Scenic Integrity Levels inventories were merged together to create the composite scenery base map. This combination of inventories is the existing condition of the forest in terms of the Scenery Management System. This provided the framework for analyzing the environmental consequences for the various forest plan alternatives.

The Scenic Integrity Levels (SILs) proposed for each alternative were based on the theme of the alternative, management areas, and the composite scenery base map. Each management area has a range of SILs that have been defined by the forest plan interdisciplinary team. This was done to ensure that the Scenic Integrity Levels would be compatible with the desired condition of each Management Area. The Scenic Integrity Level varied in acreage by alternative, based on Management Area acreages.

When the selected alternative is chosen, the proposed scenic integrity levels of that alternative become scenic integrity objectives that will serve as a guide for implementation of management areas.

Natural-appearing landscapes

The general public prefers a natural appearing forest setting. A range of natural-appearing landscapes occur across the alternatives. The *Landscape Aesthetics: A Handbook for Scenery Management* (FSH701) describes several situations that relate human well-being to quality of natural-appearing landscapes. Following are some of the citations from the handbook:

> "Research indicates that people receive 87% of their information about the world through their eyesight alone."
>
> "High quality scenery, especially scenery with natural-appearing landscapes, enhances people's lives and benefits society."
>
> "The social dimension has many aspects, but one of importance for public lands is recreation. Ecosystems as recreational settings greatly affect the quality and effectiveness of the recreation experience. A key attribute of recreation settings is the quality of aesthetics. Direct contact with natural appearing settings and attractive cultural features that offer a sense of diversity, order, and wholeness are highly valued for their ability to stimulate the senses and nurture the mind."

"People are concerned about the quality of their environment, including aesthetic values of landscapes, particularly scenery and spiritual values. People need natural-appearing landscapes to serve as psychological and physiological 'safety valves,' for these reasons:

- The world's urban population pressures are increasing
- Technology is rapidly advancing
- Demands for goods and services are increasing
- Peoples lives are becoming more complex
- Urban pressures are demanding more land for development
- Once plentiful natural-appearing landscapes are becoming more scarce.

"The benefits of high-quality scenery are numerous despite the fact that a dollar value is seldom assigned to it except in regard to real estate appraisals and areas with major tourism influences."

"It can be concluded that scenery management benefits people who are recreating, traveling for business, or are otherwise passing through wildland environments."

ROADLESS AREA ANALYSIS

The analysis process for this issue is discussed in Appendix C.

WILD, SCENIC, AND RECREATIONAL RIVERS ANALYSIS

The process for analyzing Wild, Scenic, and Recreational Rivers began with a review of related laws, policies, handbooks and other forest planning efforts. To be found eligible for designation as one of these river types, the river must be "free flowing" and have at least one river-related value considered to be "outstandingly remarkable."

In order identify rivers to evaluate, databases were reviewed to determine the total number of rivers and their length on the forest. An interdisciplinary team discussed methods for identifying which rivers to study in more detail. It was decided that the following sources would be used to build the list of potentially eligible rivers:

- The Colorado Gold medal fisheries streams.
- Rivers listed on the national rivers inventory.
- Rivers listed on the American Rivers list.
- Rivers that the Colorado Environmental Coalition had identified in a letter of November 8, 1991.
- Rivers that supported significant populations of Colorado River cutthroat trout.

In addition, at public scoping meetings, people were asked if there were other rivers that should be evaluated. These sources produced a list of 77 rivers that would be run through the second phase of evaluations. The 77 rivers were subjected to a more detailed evaluation to determine if they were eligible for designation.

The method utilized the most knowledgeable Forest Service employees to assign a subjective rating of rarity or uniqueness to detailed descriptors of required values or resources. The rater was usually the expert in the resource or value being rated. This usually required involving several different people and skills in rating a single river.

Fifty-three specific factors were evaluated for eight resources for each river (fisheries, wildlife, geologic, scenic, historic and cultural, recreation, hiking and camping, and scenic driving). These ratings were then summarized for all 77 rivers and the summaries taken to the forest leadership team. Using these data and personal knowledge, a cutoff point of 80 percent in the ratings was established, below which a value would not be considered outstandingly remarkable. The results were added into the Wild and Scenic Rivers theme of the forest geographic information system and associated spreadsheet.

SCENIC BYWAYS

The U.S. Forest Service Scenic Byway program was developed to highlight outstanding scenic drives on the national forests and surrounding lands. Driving for pleasure is the single biggest recreational activity on the national forests, surpassing camping, fishing, hunting and other recreational pursuits.

When the 1984 Forest Plan was prepared, there were no scenic byways on the White River National Forest and no management prescriptions for this designation. Three scenic byways have since been established on the Forest since that time. The byways are the West Elk Loop Scenic and Historic Byway, Flat Tops Trail Scenic and Historic Byway, and Top of the Rockies Scenic and Historic Byway. About 3 percent (61 miles) of the total state system is located within the Forest boundary. A management plan has been prepared for the Top of the Rockies Byway. As opportunities arise, plans will be prepared for the other byways that designate management constraints for their associated resources.

In some alternatives additional acres were allocated to the 4.23 Scenic Byway management prescription. This prescription will maintain the scenic quality of the corridor.

SPECIAL INTEREST AREAS ANALYSIS

Special Interest Areas (SIAs) can be identified as forest plan management areas that do not require congressional designation. SIAs are managed to protect or enhance their unusual characteristics. Management emphasis is on protecting or enhancing areas of unusual characteristics, and where appropriate, developing and interpreting for public education or recreation.

Typically, special interest areas have been designated as botanical, geological, historical, paleontological, scenic, or zoological areas. These areas may also be designated to protect and managed threatened, endangered, and sensitive species; other elements of biological diversity; or for their emotional significance, scenic values, or public popularity.

Areas were recommended for management as special interest areas by the public and by Forest Service personnel. The special interest areas vary by alternative depending on the theme of each alternative.

WILDLIFE ANALYSIS

The wildlife analysis for the FEIS consisted primarily of:

- Selection of management indicator species,
- Interior habitat evaluation,
- Habitat connectivity evaluation,
- Road and trail density determinations,
- Elk habitat effectiveness evaluation, and
- Lynx viability assessment.

Management indicator species

Management indicator species (MIS) have been used in one form or another over the last 30 years as a biological monitoring tool to suggest whether or not changes in wildlife populations have been occurring in response to anthropogenic influences on landscapes (McLaren et al. 1998). During the 1980s, the Forest Service promoted MIS analysis as a technique for evaluating effects of management proposals. The basic idea of MIS analysis is to limit the scope of analysis to an individual species that represents a suite or guild of species that have similar habitat requirements. By providing sufficient habitat for an indicator species, habitat for the suite would also be provided, thereby providing greater protection for more than just one species.

The goal of MIS analysis is to identify where vegetation conditions exist on the landscape that might not provide for viable wildlife populations. Such analysis would highlight where management prescriptions or land allocations might be in conflict with conservation responsibilities. In addition, Noss and Cooperrider (1990) described management indicator species analysis as the most important process component for establishing a monitoring program, and that management indicator species analysis has utility in adaptive management programs for forest management.

Noss (1990) and Hunter (in McLaren et al. 1998) have suggested using a *coarse filter/fine filter* approach to address biological diversity. The coarse filter concept uses certain large-bodied wildlife and broad ecosystems, while the fine filter approach uses certain plants, small-bodied animals, and forest structural components. Management indicator species analysis is a fine filter approach.

Simberloff's paper on single species management (1998) points out some pitfalls that occur when allowing a single species to act as a surrogate for other similar species. First, there is little consensus on what an indicator is supposed to indicate, and even when agreement is reached, there is little consensus on which species would be the most appropriate. He has suggested that *keystone* species might be a better approach to addressing biological diversity, an approach which melds single species and ecosystem management into one concept (Simberloff 1998).

The National Forest Management Act of 1976, the National Environmental Policy Act of 1970, and Forest Service Manual 36 CFR 219.19 direct agencies to consider fish and wildlife resources when preparing or revising land management plans. These and other statutes and regulations require the agency to maintain habitats for viable populations of existing native and desired nonnative vertebrate species in sufficient numbers and distribution of reproductive individuals to ensure their continued existence in the planning area (in this case, White River National Forest). The manual also requires the agency to select management indicator species to estimate the effect each alternative has

on fish and wildlife habitats, and its subsequent effect on wildlife populations, vegetation communities, and other ecological components.

Management indicator species were selected based on a model developed by McLaren et al. (1998) used in a province of Ontario, Canada. McLaren evaluated species as to their suitability for use as an indicator species by looking at the biology of the animal, methods available for monitoring, and regulatory status of the species. These criteria were viewed as hierarchical, with biological being the most important and status the least.

The biological criteria were largely based on how responsive a species is to forest management, but consists of several factors, in combination:

- *Species plasticity* – For a species to qualify within the biological criteria, it must be dependant on a specific habitat and be sensitive to changes in that habitat. Most species have specific habitat requirements. However, some species are generalized in their habitat requirements and can mold to a variety of conditions. These species are considered "plastic" and are not suitable for use as indicators. The coyote (*Canis latrans*) is an example of plastic species.
- *Typical causes of population change* – It is important to avoid using species where changes in populations are often not directly related to forest management, but rather other causes.
- *Size of home range* – Noss (1990) noted that the selection of management indicator species must account for scale, since forest management can affect specific sites as well as entire landscapes. In addition, the hierarchy theory suggests that to observe an effect on one species at one scale requires assessing change at the next larger scale (McLaren et al. 1998). Therefore, species should be selected that reflect a range of home range sizes, so that responses to forest management at all scales can be evaluated. Several authors (Harestad and Brunnel 1979) suggest that body size is correlated to home range size. To this end, species were pooled by body size as they relate to three different spatial scales: stand, forest, and landscape.
- *Life history requirements* – Use of resident species over migratory ones can help focus managers attention to species that are truly affected by local forest management actions and not the result of effects at a distant breeding ground. This is not to discount the importance of maintaining breeding habitat for migratory species or that population trends can differ between short-distance or long-distance migrants.
- *Trophic level* – There should be indicator species which are representative of each of the trophic levels, carnivores, omnivores, and herbivores, with some consideration to the degree of specialization within a feeding strategy (for example, insectivore or vertebrate predator within the broad carnivore grouping).
- *Degree of specialization a species has to a particular habitat* – Monkkonen and Welsh (1994) suggest that species requiring large expanses of coniferous or deciduous forests without specializing within those forests are highly susceptible to changes at the broad scale. Other species may be more keyed to certain components of the forest stand, such as those that require large dead trees or where feeding behaviors are a result of some vertical stratum. Highly specialized species may or may not be appropriate for use as a management indicator species.

The methods criteria ensured that survey and monitoring techniques are available and implementable to address questions related to specific forest management practices. McLaren et al. (1998) used the methods criteria for designing a monitoring program and for evaluating the availability of tools to provide reasonable estimates of changes in population sizes. Since most forest species are hard to observe, sampling methods must lead to a reasonable degree of success of finding the species, since samples with a large number of zeros can lead to wide confidence intervals (McLaren et al. 1998). Cochran (in McLaren et al. 1998) suggested that the problem of unequal distribution might be overcome by a stratification of the sampling effort. He cautions that before one launches into a long term monitoring effort, that strict attention to the details of sampling is considered thoroughly.

Some authors (Walters and Holling 1992, Noss and Cooperrider 1994) report that a monitoring program should have adequate controls to ensure that changes in species abundance can be attributed to the effects of the management action, and are not the result of some other factor, such as climate change. It is important to note that although controls may be available for small-bodied animals at the stand and forest scale, such controls may not be possible at the landscape scale. It is important that forest or other representative landscape vegetation types be available in some type of reserve system so that they may serve as a benchmark to compare the effects of the forest activity (Rowe 1972).

Cost-effectiveness is an important consideration of any long-term monitoring program. Selecting a sampling protocol that yield valid results that are cost-effective are important considerations when designing the overall monitoring program.

The status criteria was a mix of legally mandated requirement and guidelines emphasizing the importance or value placed on certain species by the public. Threatened, endangered, proposed, sensitive, or public-featured species must be considered as indicator species. In addition, using species held in high esteem by certain segments of the public, such as the game species, to discuss the effect of changes in the landscape is often more effective than using less known species.

Table B-37 displays the species selected as management indicator species. **Table B-38** displays species that were considered but not selected.

Interior habitat

Interior habitat conditions on the Forest were analyzed by delineating distinct habitat patch groupings, using the common vegetation database (CVU), and then doing fragmentation analysis with the FRAGSTAT model. **Table B-37** identifies the breakdown of CVU data into the categories needed for FRAGSTAT input. Structure Code 5 (Frag Code 5) areas were used to build a core habitat map. Frag Code 5 represents Structural Stages 4b, 4c, and 5. Normally, only 4c and 5 would be used in the core habitat analysis, however, since 4b is a component of the Frag Code 5 mapping, it is also be displayed in the analysis.

Table B-37
Management indicator species

Community	Trophic Level	Species	Scale*
Foothills (shrub/grass)	Herbivore (foliage)	Elk	Stand, Forest
Late-successional conifer	Carnivore	Pine Marten	Stand, Forest
	Insectivore	Three-toed Woodpecker	Stand
Interior forest	Insectivore	Brown Creeper	Stand
Younger seral forest	Herbivore (foliage)	Snowshoe Hare	Stand
Alpine riparian (willow)	Omnivore	White-tailed ptarmigan	Stand
Aspen	Insectivore	Red-naped Sapsucker	Stand
	Insectivore	Purple Martin	Stand
Sagebrush	Insectivore	Brewers Sparrow	Stand
Deciduous riparian	Insectivore	Yellow warbler	Stand
Piñon-juniper	Herbivore (foliage)	Elk	Stand, Forest
	Insectivore	Plumbeus Vireo	Stand
Mixed shrub	Herbivore (foliage)	Elk	Stand, Forest
	Insectivore	MacGillivary's Warbler	Stand
Grasslands	Insectivore, Herbivore (foliage)	Horned Lark	Stand
	Insectivore	American Pipit	Stand
Rock and water	Insectivore	Black Swift	Micro-scale
Caves	Insectivore	Townsend's Big-eared Bat	Micro-scale
Cliffs	Carnivore	Peregrine Falcon	Micro-scale

Note:

** Stand = 25-2,500 acres; Forest = 2,500-25,000 acres; Landscape > 25,000 acres.*

A value of 65 meters was used to identify and model interior forest habitat. In the central-southern Rocky Mountains, this distance is roughly one and half to two tree heights for most coniferous species. Only frag-code 5 polygons (deciduous and conifer core habitat) need to be buffered 65 meters inward to depict the area shown as core habitat. The other patch codes were disregarded for this analysis.

Fourth code watersheds on the forest were used as the basic analysis unit to run the FRAGSTAT modeling against the vegetation classification. Two different vegetation data sets were used to run the FRAGSTATS model against the 4th Code watersheds. The first data set excluded the use of patch code 27, and the second data set included patch code 27. By using the two data sets in combination, a comparison of the effects on patch size can be made, with and without considering roads, railroads, utility corridors. The data output stream from FRAGSTATS, along with the development of an interior habitat map, provide the basis for discussion related to the effect the various alternatives have on patches, and hence interior forest habitats.

Table B-38
Species considered but not selected as management indicators

Species	Rationale for dropping from consideration
Green-tailed Towhee	Other species selected to cover similar community characteristics
Virginia Warbler	Other species selected to cover similar community characteristics
Southern Red-backed Vole	Other species selected to cover similar community characteristics
Pygmy Shrew	Habitat generalist
Dwarf Shrew	Habitat generalist
Whooping Crane	Pass-over migrant, uncommon on forest
Boreal Owl	Other species selected to cover similar community characteristics
Common Loon	Pass-over migrant, uncommon on forest
Merlin	Effects of management practices difficult to assess
Sandhill Crane	Other species selected to cover similar community characteristics
Pygmy Nuthatch	Not selected, very few acres on forest in this conifer type
Hairy Woodpecker	Other species selected to cover similar community characteristics
Mule Deer	Other species selected to cover similar community characteristics
White-faced Ibis	Pass-over migrant, uncommon on forest
Ferruginous Hawk	Typically lower elevation, uncommon on forest
Wilson Warbler	Other species selected to cover similar community characteristics
Golden-crowned Kinglet	Other species selected to cover similar community characteristics
Dusky Flycatcher	Habitat generalist

Habitat connectivity

The same distinct habitat patch groupings used for the interior habitat analysis were used as a starting point for habitat connectivity analysis. The patch codes were then grouped into four distinct classes:

- Class one displays all conifer forest types (Douglas-fir, spruce-fir, and lodgepole pine) in structural stages 3a, 3b, 3c, 4a, 4b, 4c and 5.
- Class two covers all deciduous forest types (aspen and cottonwood) in structural stages 3a, 3b, 3c, 4a, 4b, 4c and 5.
- Class three outlines all the shrub cover types (piñon/juniper, grass, sagebrush, rabbitbrush, and other shrubs) and the seedling-sapling component from the deciduous and conifer components (structural stage 2).
- Class four is the open components that either lack vegetation or rarely have it. This class is barren areas and the open corridors created from road, utility, and railroad corridors.

Table B-39
Habitat patch groupings using the CVU database

Patch code	Species group	Species	Structure code	Structure stage
1	df	Douglas-fir	1 – Seed/sapling	2
2	df	Douglas-fir	2 – Sapling/Pole	3a
3	df	Douglas-fir	3 – Sapling/Pole	3b, 3c
4	df	Douglas-fir	4 – Mature	4a
5	df	Douglas-fir	5 – Mature/Old Growth	4b, 4c, 5
6	sf	Spruce fir	1 – Seed/sapling	2
7	sf	Spruce fir	2 – Sapling/pole	3a
8	sf	Spruce fir	3 – Sapling/pole	3b, 3c
9	sf	Spruce fir	4 – Mature	4a
10	sf	Spruce fir	5 – Mature/old growth	4b, 4c, 5
11	as	Aspen	1 – Seed/sapling	2
12	as	Aspen	2 – Sapling/pole	3a
13	as	Aspen	3 – Sapling/pole	3b, 3c
14	as	Aspen	4 – Mature	4a
15	as	Aspen	5 – Mature/old growth	4b, 4c, 5
16	lp	Lodgepole pine	1 – seed/sapling	2
17	lp	Lodgepole pine	2 – Sapling/pole	3a
18	lp	Lodgepole pine	3 – Sapling/pole	3b, 3c
19	lp	Lodgepole pine	4 – Mature	4a
20	lp	Lodgepole pine	5 – Mature/old growth	4b, 4c, 5
21	cw	Cottonwood	All structural classes	All
22	pj	Piñon-juniper	All structural classes	All
23	ba	Barren	Not applicable	
24	gr	Grass	Not applicable	
25	sr	Sagebrush/rabbitbrush	Not applicable	
26	sh	Shrubs	All	
27	n/a	Road/utility/etc	From timber suitability	

Note:

**Lumping of Structural Stage 4b into the Patch Code 5 (mature/old growth) designation may skew the results slightly, since most interior habitat analyses typically use 4c and 5 classifications.*

A forest-wide map of these four classes was the basis for analyzing potential landscape connectivity. Other elements were then factored into the analysis, including:

- A recreation impact map for the forest was constructed using the land allocation status for Management Areas 8.21 (developed recreation complexes), 8.25 (ski-based resorts) and 8.31 (aerial transportation corridors).
- Lands allocated to utility corridors (Management Area 8.32) were incorporated into the overall connectivity map analysis.
- Major road systems occurring on the forest were incorporated into the overall connectivity map analysis.
- Areas where forest roads or trails may impact or impede animal movement across landscape where identified using a *moving windows* procedure (discussed briefly below).

This analysis resulted in identification of areas that are allocated to Management Areas 1.41 (core areas) and 3.55 (corridors connecting core areas). These management areas allocate lands to maintain connected habitats across the forest for protecting migration and dispersal areas.

Road and trail density

Road density is calculated by dividing the total miles of open road by the total square miles in an analysis area, resulting in an average road density. While average road density provides meaningful information on the effectiveness of habitat for some species, such as big game, it is completely meaningless for other species such as amphibians. Even when used for evaluating the habitat effectiveness for big game species, the utility of average road density is limited because large unroaded areas within the analysis areas skew the calculation and dilute the potential effects of the roads.

Generally, trail density as an index is rarely used, but rather, other measures are used such as length, use level, human use difficulty level, and user type (motor bike, motorized, cross country skiing, hiking, pack and saddle trail). These more typically used measures do little to enhance our knowledge about effects to wildlife resources, such as direct habitat loss and fragmentation, or indirect factors related to disturbance and displacement.

The Interagency Grizzly Bear Committee (IGBC) taskforce, the Pacific Northwest Region (Region 6 - Draft Road Analysis Protocol), and Rio Grande National Forest (Region 2) have developed some protocols for assessing motorized access and travel management issues on National Forest System lands. These protocols have been compiled and modified to address road- and trail-related issues on the forest. The process can be adapted to fit the needs of any resource specialist trying to assess the effects of road density. Using this methodology has the following benefits:

- The system provides a spatial overview of road density using increment classes of one mile. The user can see where road and trail density is highest within an analysis area, and where the high density occurs in relationship to fish and wildlife habitats, and other sensitive areas (such as highly erodible soils).
- Scale can be easily varied in the system to provide road and trail density data for a variety of resource management needs. For example, in a given analysis area, multiple data queries can display the percentage of key elk calving areas with greater than 2.0 miles/square mile of road or motorized trail; the percentage of amphibian habitat with zero miles/square mile of road; and the percentage of wolverine or lynx habitats with greater than 1.0 miles/square mile of roads or trails.

The following definitions and procedures used to calculate road and trail densities are applicable generally forest-wide, but may be modified when used during site-specific analysis. Site-specific decisions for meeting revised forest plan management area allocations and ROS classes are being prepared by a separate Road and Travel Management Interdisciplinary Team.

For wildlife analysis, road and trail terminology is used as follows:

- Road – All created or evolved routes that are greater than 500 feet long that are reasonably and prudently drivable in a motorized vehicle licensed for use on public highways.
- Open road – A road without restrictions on motorized vehicle use (Classified in the Travel Management System (TMS) as road maintenance levels 2-5.)
- Motorized trail – all created or evolved access routes that do not qualify as a road that are used by motorized vehicles.
- Open motorized trail – A trail open to motorized use without any restrictions.
- Restricted motorized trail – A trail where motorized use is restricted seasonally or yearlong. Motorized vehicle use may be legally restricted. Other uses such as hiking, mountain biking (mechanized), or pack and saddle are generally the dominant uses, collectively, in some combination, or as a single use.

(NOTE: If road and trail density are to be determined where the issue is motorized use only, then those roads and trails having such use would be used in the calculation. If the concern were strictly hydrological, then all roads and trails (except obliterated) would be included in the density calculation. Roads that meet the combined definitions for "obliterated and decommissioned" are not to be considered in determining road density for other applications.)

The central element of road and trail density calculation procedure was a *moving window* GIS procedure. In a *moving windows* analysis, each pixel (square unit of land) is assigned an access route density value based upon the roads and trails within the surrounding one square mile. The square mile is the *window* surrounding a pixel. Starting in the upper left corner, the first pixel is assigned an access route density value based upon its surrounding 1 square mile window; the program moves over 1 pixel and assigns this next pixel a density value based upon its surrounding 1 square mile window; move over 1 pixel and that pixel is assigned a density value; and so forth until the entire file has been analyzed pixel by pixel. This is then be summarized as the proportion of a given analysis area in various road density classes. For moving windows analysis the same GIS software was used for all comparative analysis of outputs, to ensure consistent evaluation. The forest used ARC/Info Grid (615) and the road density AML obtained from Host=R06B, Staff=IR, Drawer=ARC, Folder=LIBRARY, Object=ROADDENSITY.TAR.

Particulars of the road and trail density evaluation conducted for this analysis include:

- The scale of analysis areas delineated varied based on the species being evaluated. An area that encompasses several thousand acres and spans multiple sub-watersheds may be appropriate for road density analysis for wolverine. In contrast, a 200-acre plot within a unique drainage may be an appropriate scale for effects analysis on a rare amphibian species.
- The window shape was a CIRCLE with an area of one square mile.
- The size of the pixels was one acre. With a decrease in pixel size, processing time increased exponentially and accuracy was not greatly improved.
- Density was calculated by 1) summing the lengths of the roads and trails within each pixel within the window and then dividing by the size of the window, or 2) using the GRID LINEDENSITY function (in ARC/Info version 7.1+).

- For accurate calculation of densities, it was necessary to include all the roads and trails within at least 0.6 miles of the outer boundary of the analysis area.
- Access route maps were developed by identifying and categorizing all roads and trails in the analysis area(s) as 1-open road, 2-open motorized trail, 3-open mechanized trail, and 4-open to any use.

Access categories used for this analysis were (defined via a remap table):

< 0.1 miles per square mile
0.1 to 0.5 miles per square mile

(Management area 5.43) 0.5 to 1.0 miles per square mile

(Management areas 3.21 and 5.45) 1.1 to 2.0 miles per square mile

(Management area 5.4) > 2.0 miles per square mile

Elk habitat effectiveness

Vegetation communities of certain character are habitat for elk. The effectiveness of these elk habitats in supporting elk populations was evaluated using the Habitat Capability Model (HABCAP) originally developed by Richard Holthausen for the Rocky Mountain Region of the Forest Service. The HABCAP model provides estimates of the capability of habitats to support wildlife based on the mix vegetation cover types and structure present in an area. Hoover and Willis's (1984) *Managing Forested Lands for Wildlife* (Chapters 3, 7, and 8) documents the basis for the different elements in the HABCAP model (see also the HABCAP Documentation and Users Guide No. 011090 (not dated). The program is menu driven for vegetation cover type and wildlife indicator species.

Primary assumptions of the HABCAP model include:

- Carrying capacity is based on forage,
- The ability of animal to utilize forage is modified by cover and roads (elk only),
- Acres providing forage and cover are not necessarily mutually exclusive, and
- Animals have a limited ability to compensate for differing quality and quantity of cover and forage.

The HABCAP model utilizes 14 cover types and 45 indicator species. A specific depiction of the cover types and structural stages are described on page III-5, and indicator species on page III-3 of the draft HABCAP Documentation and Users Guide. The forest used 12 out of the 14 cover types, and 10 out of 45 indicator species.

In the HABCAP model, the geometric mean is used to combine feeding and cover indices into an overall habitat capability index, as a way of displaying the ability of animals to compensate for less than optimum cover, provided the value of the area for forage is sufficiently high. Since the geometric mean produces smaller values than the arithmetic, it is considered a more conservation and incomplete approach for reflecting compensation (Suring 1985). Biologically, there appears to be a threshold at which the animal can no longer compensate, no matter what the value of forage, however, that threshold has not been established (USDA 1981).

Areas used for analysis should be large enough to contain seasonal home ranges of the most mobile indicator species. Using a large enough area allows the model to analyze and portray cumulative effects of all management actions and natural process that would affect a species seasonal home range (USDA 1981). HABCAP was applied to diversity

units that were generally based on fourth code watersheds, varying in size from 5,000 to 20,000 acres (on the forest, fourth code watersheds vary from 714 to 650,212 acres, and DAUs vary from 230,101 to 1,269,968 acres).

The CDOW has six data analysis units (DAUs) covering lands managed by the Forest (units E6, E12, E13, E14, E15 and E16). These comprise a total of 4,108,803 acres, of which 1,842,027 acres occur on National Forest System lands. These individual data analysis units were merged with the forest's Common Vegetation Unit polygons and forest road and trail system information to develop a model that would depict availability or change in habitat effectiveness with the different alternatives. Data derived from forest vegetation and road layers were plugged into the HABCAP model and a progression of model runs by alternative were generated based on projected timber harvest (acres of cover type and structure changed) and through road management objectives (increases or decrease in roads). The model outputs were displayed in terms of an elk habitat effectiveness index.

The forest used HABCAP to display differences among the various management alternatives being considered within the forest plan revision. The IBM-PC version of the HABCAP model, written in GWBASIC, was used to estimate capability at a single point in time. The current versions of the model do not have the capability of simulating habitat changes over time. However, if the link to the forest Structure Simulator Model (FSSIM) is ever completed, then the model will have the capability over time to allow for modeling of cumulative effects.

Elk security blocks were identified using the vegetation and road data layer merged with the DAU management areas. The vegetation information was manipulated as follows:

- Conifer cover types were put into one data set and aspen cover types into another.
- Conifer and aspen cover types that did not meet 3C, 4A, 4B, 4C and 5 structural stage requirements were eliminated from the data sets.
- Adjacent similar cover type polygons were merged, to reduce the potential bias of applying an acreage size limitation to potential security areas. For example, if a 100-acre 3C conifer stand was next to a 150-acre 4C conifer stand, and an acreage requirement of greater than 250 acres was applied for establishing security areas, then neither polygon would be selected. In reality, in combination, these stands would indeed provide the necessary conditions to meet the security habitat. And thus, looking only at individual polygons and not their juxtaposition would result in under-estimation of the acres of security available.
- A buffer factor for open roads was applied that sets up the data to compare the various road management effects by alternative on elk security.

Recreation use trends, primarily big game hunting, were examined for effects on elk security habitat.

Analysis for elk security habitat can be refined during project planning by considering topography and exact locations of timber harvest and road construction. Process limitations prevented adding topography into the analysis at the forest planning level, and likewise, at the forest planning level, locations of timber harvest and road building are only generalized.

Lynx viability assessment

Many have described the close relationship between habitat quality and population viability (Belovsky 1987, Shaffer 1987, Thomas 1994). Roloff and Haufler (1997) designed a process for establishing population viability planning objectives based on habitat potentials. They used a form of habitat suitability index (HSI) modeling as the assessment tool, and *Lynx canadensis* was the subject species. The Forest used this process for evaluating lynx habitat viability across the planning area.

Although most HSI modeling has been performed at the scale of the species life history requirements, the effects of spatial scale on the effectiveness of habitat is an important consideration (Van Horne and Wiens 1991, Roloff 1994). Many support the notion that HSI models should be applied to spatial scales that are biologically meaningful at the organism scale (Roloff 1994, Ruggerio et al. 1994), however there is no consistent rational associated with spatial scale and model applicability.

The basis for the habitat suitability index modeling conducted was the use of grid-based GIS technology to sample allometric home ranges across the landscape. Each grid cell represented the center of an allometric home range. The allometric area surrounding a grid cell was evaluated for structural and spatial habitat requirements, and each grid cell was assigned an HSI value. The results were a series of grid cells, each containing an HSI value that provided a spatial trend of habitat quality (Maurer 1994). HSI values were combined by 0.10 increments to form a habitat contour map for the viability analysis. The scores of the HSI values were a depiction of the within-allometric-home-range structural and spatial requirements (Roloff and Haufler 1997).

The lynx viability assessment used the same patch code designation as that set up for the fragstats analysis. **Table B-40** outlines the patch codes, species, structure codes, and habitat suitability index codes used in the lynx viability assessment. The values assigned to the patch codes were based on based on a review of the literature (snowshoe hare and lynx) and structural stage estimates for supplying hare and lynx habitat.

Table B-40
Lynx habitat suitability index values

Patch code	Species group	Structure code	Habitat suitability index
1	Douglas-fir	1	.90
2	Douglas-fir	2	.70
3	Douglas-fir	3	.50
4	Douglas-fir	4	.60
5	Douglas-fir	5	.90
6	Spruce-fir	1	.90
7	Spruce-fir	2	.70
8	Spruce-fir	3	.50
9	Spruce-fir	4	.60
10	Spruce-fir	5	.90
11	Aspen	1	.70
12	Aspen	2	.50
13	Aspen	3	.40
14	Aspen	4	.50
15	Aspen	5	.70
16	Lodgepole pine	1	.60
17	Lodgepole pine	2	.50
18	Lodgepole pine	3	.60
19	Lodgepole pine	4	.80
20	Lodgepole pine	5	.90
21	Cottonwood	All	.20
22	Piñon-juniper	All	.20
23	Barren	Not applicable	.10
24	Grass	Not applicable	.40
25	Sagebrush/rabbitbrush	Not applicable	.20
26	Shrubs	All	.40
27	Road/utility/etc.	Not applicable	.10

FRAGMENTATION ANALYSIS

Many components of ecological capability are dependant on spatial configuration of landtypes (Forman and Godron 1986, Harris 1984, Urban 1987). In this analysis, landscape patterns in areas that have had significant human influences were compared to patterns found in more undisturbed landscapes, to identify problem areas and management direction or actions which would improve ecological function relative to numerous management goals, such as preservation of species, recruitment of late-successional forest, improvement in habitat connectivity, and perpetuation of natural landscape diversity (composition, structure, and function).

Four spatial pattern attributes were analyzed for 13 managed areas and 16 reference areas, using the FRAGSTATS computer model (McGarigal and Marks 1995):

- Landtype distribution,
- Average patch size,
- Amount of edge, and
- Distance between patches.

Assumptions and limitations of this analysis include:

- The effects of roads in terms of fragmentation are not included (road density is discussed in the Wildlife section).
- This was a forest plan level analysis. For individual projects, additional analysis may be necessary.
- It was difficult to locate landscapes that have not been affected by human activities. The reference areas selected are those areas that have had the fewest human impacts over the past 80 years.
- It was assumed that reducing the differences in landscape patterns between intensively managed landscapes and landscapes which have been less affected by humans will provide for an overall improvement in ecological function.

LTAs, the primary unit for this analysis, are mid-scale units that have similar characteristics, such as general soil type, slope, aspect, elevation, and potential natural vegetation (LTAs represent the landscape level in the National Hierarchy of Ecological Units). The LTAs found on the forest were lumped into five groups:

- Spruce-fir forest and associated meadows in mountain landform LTA types
- Mixed coniferous and hardwood forests in mountain landform LTA types
- Spruce-fir forest and associated meadows in tableland/mesa landform LTA types
- Mixed coniferous and hardwood forests in tableland/mesa landform LTA types
- Aspen-fir forests and mixed grass/shrublands in tableland/mesa landform LTA types.

Data sources for existing vegetation were the Rocky Mountain Resource Information System database (RMRIS) and the Common Vegetation Unit database (CVU). A GIS theme was built, named WR_VEG, which combined information from CVU (non-wilderness) and RMRIS (wilderness).

General areas of past human activities including timber sales, mining, and grazing were determined using the activity theme in the forest GIS. Areas of concentrated timber harvest within this activity theme were used to delineate the managed areas used in this analysis (cutting units make up approximately 15 percent of the acreage within the timber sale activity areas shown in the activity theme). The LTAs for each of the timber harvest areas were noted, and efforts were made to pick matching reference LTA blocks for comparison within the same general vicinity of the forest. In cases where no similar reference area could be found, the managed area was dropped from the managed area/reference area analysis. In other cases, areas were dropped because landscape pattern changes resulting from timber harvest were insignificant. A total of 13 managed areas were chosen, ranging in size from 2,000 to 27,000 acres. The total acreage of the managed areas was 122,900 acres (about 5 percent of the forest). Approximately 40 percent of the timber harvest that has occurred on the Forest over the past 50 years is represented within these managed areas.

A total of 16 reference areas were delineated to compare to the managed polygons. These reference areas range in size from 4,500 acres to 71,000 acres (about 10 percent of the forest).

Each managed area and reference area was evaluated for:

- General patch characteristics,
- Characteristics of late-successional forest types,
- Patterns of structural classes, and
- Comparison of mature structural classes to younger structural classes.

General patch character

Polygons representing existing vegetation cover types were grouped into structural classes for analysis. Structural classes were determined based on size class and canopy coverage, as shown in **TableB-44.**

Initial analysis of the data indicated that the Structural Class 5 for spruce-fir made up nearly a third of the entire forest. This cover type and structural class were analyzed for average patch size, average core patch size, nearest neighbor, and the expected verses observed number of patches. The most significant interpretations are as follows:

- Approximately 1,900 acres of spruce-fir within the managed polygons (4 percent of the total spruce-fir acreage) have been managed through even-aged silvicultural systems and have shifted stands from Structural Class 5 to a different class. An additional 8,700 acres (18 percent) have been managed through silvicultural treatments that maintain multi-storied stands, including shelterwood prep cut or sanitation salvage. These treatments normally do not change the structural class of the stand. The wide variability in the patch class data may mask impacts of past management activities.
- The current state of the spruce-fir patches indicates that the past 50 years of management may have created more small patches in the size classes of 0-30 and 31-70 acres, while reducing the number of stands larger than 1,000 acres (no species on the forest have been identified that are dependent on late-successional spruce-fir patches greater than 1,000 acres in size).
- The average core patch size appears to be less in the managed areas than in the reference areas. This could affect species that are dependent upon large areas of interior forest. The average core patch is still large enough in the managed areas to meet the basic needs of all species identified on the Forest. Further reductions in the average patch size in managed areas may begin to negatively affect species needing large interior patches.
- Species that are dependent on late-successional spruce-fir stands have to travel slightly less distance between suitable stands in the managed polygons than in the reference areas. This change in average distance may be a function of the wide variability in the measured areas, or may be a function of the beginning stages of fragmentation.

Table B-41
Structural class descriptions

Structure class	Habitat structural stage	Description
1	1, 2	Grass/forb/shrub/seedling: Site dominated by grasses, forbs, shrubs, and/or tree seedlings up to 1 inch diameter at breast height (DBH).
2	3a	Sapling-pole: Site dominated by trees in the majority of the 1-8.9 inch DBH size for spruce-fir, Douglas-fir, or lodgepole pine, and/or 2-8.9 inch DBH for aspen, with a canopy closure of less than or equal to 40 percent.
3	3b, 3c	Sapling-pole: Same as Structure Class 2, except canopy closure is 41-100 percent.
4	4a	Mature: Site dominated by trees in the majority of the 9 inches or larger DBH size and tree age under 200 years for spruce-fir or Douglas-fir, under 150 years for lodgepole pine, and under 100 years for aspen. Canopy closure is 40 percent or less.
5	4b, 4c, 5	Late-successional forest: 1) Site dominated by trees in the majority of the 9 inches or larger DBH size and tree age under 200 years for spruce-fir or Douglas-fir, under 150 years for lodgepole pine, and under 100 years for aspen. Canopy closure is greater than 40 percent. 2) Site dominated by trees in the 5 inches or greater DBH size with a tree age greater than 200 years for spruce-fir or Douglas-fir, 150 years for lodgepole pine, and 100 years for aspen. Canopy closure is over 70 percent.

Late-successional forest types

Many species of animals and plants are dependent on late-successional forests, and so an analysis was done to compare the amount of Structural Class 5 to the total of Structural Classes 1 through 4, for each cover type. Average patch size, amount of edge, and average core patch size were compared between the managed and reference areas. The most significant interpretations are as follows:

- It was not expected that late-successional Douglas-fir or spruce-fir would exhibit marked changes between managed and reference stands as a consequence of past timber harvest activities. Silvicultural practices that maintain multi-storied stands with small interspersed even-aged groups are the most commonly used treatments in the spruce-fir categories. However, the average patch size in spruce-fir managed areas was 55 acres, which is approximately 44 percent smaller than in reference areas. The average patch size in Douglas-fir managed areas was 18 acres, which is 70 percent smaller than in reference areas.
- Within the managed areas, approximately four percent of the late-successional spruce-fir has been treated with shelterwood prep cuts or individual tree selections. An additional 15 percent of the treatments have had sanitation salvage treatments focusing on dead spruce. Shelterwood prep cut, individual tree selection, and sanitation salvage treatments normally do not change a Structural Class 5 stand to another category. Approximately 1,900 acres (4 percent) of the late-successional spruce-fir has been treated using silvicultural treatments that normally would change a Structural Class 5 stand to a different category. Only 5 acres of Douglas-fir have been managed with even-aged silvicultural treatments that would change late-successional stands to other categories.
- The small scale of these activities within the larger analysis areas does not readily explain the smaller patch sizes for these cover types. The smaller patch size average in managed areas may be a result of the management that has

occurred, a function of the wide existing variability of the stands, or a combination of both. No species has been identified on the forest for which the average patch size would be a factor limiting viability.

- A reduction was expected in late-successional classes in aspen and lodgepole pine in managed areas due to past clearcutting. However, for both these categories, the average managed patch size was larger than the reference patch size. Edge densities and average core patches both showed similar conflicting results to the average patch size assessment. The wide variability in patch size in both managed and reference stands coupled with the relatively low level of active management likely mask any major impacts from timber management activities. The current average patch size in late-successional aspen and lodgepole pine stands has not been identified to be a viability-limiting factor for any species on the forest.
- Edge density results were similar in all classes except late-successional aspen and both classes of lodgepole pine, where managed areas had a higher amount of edge than reference areas. The increase in the amount of edge in late-successional lodgepole pine may negatively affect the use of this class by edge-sensitive species.
- The average core patch size results followed the general results of the average patch size assessment. It is difficult to develop management implications based on the conflicting results concerning cover types and past silvicultural treatments.

Structural classes

Some wildlife species are dependent upon structural components of their habitats and do not necessarily rely on the specific tree species. This analysis compared structural classes regardless of the cover types and tree species involved. Results can be summarized as follows:

- In all cases, the average patch size and corresponding average core size were larger in the reference areas than in the managed areas. In Structural Class 5, the average patch size in managed areas was 98 acres, compared to 110 acres in reference areas. The significance of this difference is unknown, especially when it is remembered that the variability in all landscapes was very wide.
- Contrary to expectations, the difference between average patch size in managed and reference areas was the least in Structural Classes 1 and 5. Anticipated management-induced changes (the creation of more small patches) were expected to show up the most in these two classes. Variability was very high in all classes. Again, it appears that the wide variability of patch size coupled with low past activity levels are masking any major changes that may exist as a result of management activities.
- The results of past management activities were expected to show higher edge densities in Structural Classes 1 and 5 in the managed polygons due to the creation of sharp edges and smaller patches associated with clearcuts. There were slightly higher densities in Structural Classes 3 and 5 in the managed polygons, while Structural Classes 1 and 4 had slightly lower edge densities in the managed areas.
- No clear conclusions concerning the impacts of past management to structural stage conditions could be reached through this analysis.

Young versus old

This assessment was designed to look at potential impacts to habitats for species that are specific to either young or mature age classes. In this assessment, grouped Structural Classes 1 through 3 were compared to grouped Structural Classes 4 and 5 classes. The difference between this assessment and the late-successional assessment was the grouping of Structural Class 4 with Structural Class 5, instead of with Structural Classes 1 through 3. Results and management implications of this assessment were very similar to the results from the late-successional assessment. Managed mature aspen and lodgepole pine classes exhibited larger average patch sizes than reference areas, contrary to what was expected. Edge densities and core patch sizes followed the late-successional assessment. Variability in patch size and edge densities was also high in this assessment.

References. Baker, W. L. In Press. Measuring and Analyzing Forest Fragmentation in the Rocky Mountains and Western United States. In Knight, R.L., F.W. Smith, S.W. Buskirk, W.H. Romme and W. L. Baker. ed. Forest Fragmentation in the Southern Rocky Mountains.

Erhard, D., R. Metzger, and R. Tribble. 1997. Managing for Habitat Connectivity in Spruce-fir Landscapes on the Rio Grande National Forest. Unpublished Report. USDA Forest Service, Monte Vista, CO 11p.

Forman, R.T.T. and M. Godron. 1986. Landscape Ecology. John Wiley and Sons, New York. 620p.

Harris, L.D. 1984. The Fragmented Forest: Island biogeography theory and the preservation of biotic diversity. University of Chicago Press, Chicago. 211p.

McGarigal, Kevin and Barbara J. Marks. 1995. FRAGSTATS: Spatial Pattern Analysis Program for Quantifying Landscape Structure. Gen. Tech. Rep. PNW-GTR-351. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 122p.

Urban, D.D., R.V. O'Neill, and H.H. Shugart, Jr. Landscape Ecology. Bioscience 37: 119-129.

Old growth inventory

Old growth forests are an important component of biological diversity. A stand that has reached an old growth condition has developed a diversity of functions and interactions that did not exist in earlier stages. The later stages of development differ from earlier stages by features such as tree size, standing dead trees, down dead trees, number of canopy levels, distribution of ages, and composition of understory species.

Old growth occurs in both older forests dominated by fire dependant species and forests dominated by shade tolerant species. The age at which old growth develops and the structural attributes that characterize old growth vary by cover type, climate, site conditions, and past disturbances. A stand may contain some trees that meet criteria for old growth but as a whole lacks the functions and interactions of an old growth ecosystem.

A stand that has several of the following characteristics may be a candidate for classification as old growth:

- Large trees considering the species and/or the site
- Variation in tree sizes and spacing
- Dead trees, both standing and down
- Decadence in the form of broken tops, deformed tops, bole decay, or root decay
- Multiple canopy layers
- Gaps in the tree canopy and understory patchiness.

Sporadic, low to moderate severity disturbances are an integral part of the internal dynamics of many old growth ecosystems. Canopy openings resulting from the death of overstory often give rise to patches of small trees, shrubs, and forbs in the understory. Old growth is not necessarily virgin or primeval, but may develop following human disturbances, or as a result of man's influence on the landscape, such as exclusion of fire.

A description of old growth in the intermountain west was presented by Mel S. Mehl in *Old Growth Descriptions for the Major Forest Cover Types in the Rocky Mountain Region*. This description, plus enhancements developed for the Arapaho-Roosevelt forest plan revision effort (1990), were used to define old growth for the three primary conifer cover types found on the forest: Engelmann spruce/subalpine fir, Douglas-fir/ponderosa pine, and lodgepole pine.

On sites dominated by spruce or fir, old growth character is defined as:

- Presence of large trees (14"+ DBH), including 15 or more trees per acre 12"+ DBH
- Presence of large snags (14"+ DBH), including 2 or more snags per acre 12"+ DBH
- Presence of large fallen trees (14"+ DBH), including 3 or more trees per acre 12"+ DBH
- Presence of multi-storied canopy
- Overhead canopy closure greater than 20 percent
- Presence of large, old, declining, live trees.

On sites dominated by Douglas-fir or ponderosa pine, old growth character is defined as:

- Presence of large live trees (18"+ DBH), including 15 or more trees per acre 12"+ DBH
- Presence of large fallen trees (14"+ DBH), including 3 or more per acre 12"+ DBH
- Presence of large fallen trees (14"+ DBH), including 3 or more trees per acre 12"+ DBH
- Presence of multi-storied canopy
- Overhead canopy closure greater than 20 percent.
- Presence of large, old, declining, live trees

On sites dominated by lodgepole pine, old growth character is defined as:

- Presence of 15 or more large live trees per acre (10"+ DBH)
- Presence of two or more large snags per acre (10"+ DBH)
- Presence of three or more large fallen trees per acre (10"+ DBH)
- Presence of multi-storied canopy
- Overhead canopy closure greater than 20 percent
- Presence of large, old, declining, live trees.

The following elements contribute to quality of old growth:

- Presence of more than one tree species
- Presence of small openings with grasses, forbs, or shrubs
- Presence of seedlings, saplings, or poles
- Little or no evidence of logging
- Little or no evidence of fire, insect infestation, or wind disturbance.

An old growth inventory was completed for conifer cover types, for both existing stands and recruitment stands (stands that are expected to become old growth within eighty years). The final product of the inventory was a forest-wide GIS theme of conifer stands meeting regional definitions of old growth, as described by Mehl 1992. This forest-wide level inventory can be used in broader scale analyses or as a starting point in more site-specific analyses.

Due to the ecology and life history of aspen as a tree species, the term *old growth* is seldom used in regard to aspen cover types. Although this old growth inventory did not include aspen cover types, the amount of *late-successional* aspen was estimated: the RMRIS database was queried for aspen-dominated forests consisting of trees with 9 inches DBH or greater, tree sizes large and very large, and trees having mature or old growth structural stages (4B, 4C and 5).

The conifer old growth inventory was accomplished by:

- Identifying sites that might be classified as old growth using existing data (CVU database and RMRIS database),
- Collecting information on potential old growth sites via interpretation of aerial images, and
- Conducting a field survey of potential old growth sites.

A list of potential old growth sites was compiled by querying the CVU and RMRIS databases to get a list of stands dominated by Douglas-fir, Engelmann spruce, subalpine fir, and lodgepole pine, with trees at least 9 inches DBH (tree size large and very large), and having mature or old growth structural stage (4B, 4C, or 5). The Stage II field survey data for these stands were examined. Stands lacking key old growth characteristics and stands less than 5 acres in size were eliminated from the list.

Aerial images for each site were examined to obtain as much information as possible relative to the criteria for old growth. Sites in the vicinity that had been field surveyed and rated as old growth were used to assist the process of interpreting sites that had not been visited in the field.

A field review of each potential old growth site was conducted. Inventory sheets were used to record average conditions within a stand based on walk-through observations. These inventory sheets were modeled after scoresheets created by Dennis Lowry. Surveyors recorded the presence or absence (yes, no) of various factors used in old growth evaluation. A majority of positive answers (yes) signifies that the stand is old growth. In addition, notes were made on wildlife use; threatened, endangered, or sensitive species observed; and unique features of the stand or landscape was recorded.

Entire sites were called old growth, recruitment, or not old growth, though areas of each may have been present within individual sites. If a spruce-fir or lodgepole pine stand was estimated to be old growth in at least half of the area, it was rated as old growth. In Douglas-fir sites, where old growth conditions were clumpy and fragmented, less than half of the area could be old growth and still rate as an old growth site. During field survey, notes were taken on evidence of past logging, fire, or other disturbances.

When judging whether sites were old growth or not, primary consideration was given to the presence or absence of key old growth characteristics. All of the characteristics needed to be present to be classified as old growth. Sites classified as old growth were rated as excellent, good, fair, or marginal quality. Primary consideration was given to the quantity and quality of the key characteristics in addition to the common characteristics in the quality rating determination.

In the lodgepole, Douglas-fir, and ponderosa pine cover types that were determined to be old growth, the length of time expected to remain old growth was estimated. Different average life spans of the species were considered in making these estimates.

Each site classified as old growth was rated as to whether old growth quality was expected to improve with the passage of time. In the areas that were not determined to be old growth, the time that it would take to become old growth, if at all, was estimated.

WILDLIFE AND PLANT SPECIES VIABILITY ANALYSIS

As part of revising the forest plan revision process, staff addressed wildlife and plant species for which there are viability concerns with the intent of ensuring that adequate direction was incorporated into the 2002 Forest Plan to meet National Forest MA diversity and conservation requirements for maintaining viability for all native and desired non-native species.

The Forest Viability Team members and their area of responsibility include:

- Keith Giezentanner, Forest Ecologist, Project Leader
- Christine Hirsch, Forest Fisheries Biologist, aquatic faunal species
- Mark Crites, Forest Planning Biologist, terrestrial faunal species
- Barry Johnston, GMUG Botanist, plant species.

The forest enlisted additional personnel to work on screening groups of species.

The viability analysis process was adapted from a process used on the Chugach National Forest and modified by the Black Hills National Forest. A brief description of the process is (see details in the forest Viability White Paper in the administrative record):

The viability team applied a criteria-based screening process to a list of species developed for analysis on the forest.

Species were ranked within each criterion to document species security or the existence of a concern for that criterion for that species. The forest's screening process resulted in three determinations:

- Species for which there is a viability concern on the White River National Forest. For those species where criteria rankings indicate a clear concern for present or foreseeable future viability, the forest viability team documented the risk factors associated with the species and placed them on the forest list of species with viability concerns. If the available information indicates that there may be a risk to future or current viability for the species, that species was placed on the Forest list of species with viability concerns.
- Species needing more baseline inventory and evaluation to determine status. Species for which the screening criteria did not identify a present or near-future viability concern on the White River National Forest, but for which we lack sufficient information related to taxonomy or distribution to confidently place the species in Category 3.
- Species for which there is currently is no concern for species viability on the forest. Justifications for these determinations were documented, including the references used to make the determination.

The team reviewed the rankings of the screened list and assessed which species were considered to have viability concerns.

For each species identified as having a viability concern, a team member prepared a report and recommended direction to be incorporated, as appropriate, into the 2002 Forest Plan. These reports included information on habitat relationships, causal factors resulting in the viability concern, management actions necessary to ensure future viability, and additional inventory or evaluation needs.

Incorporate recommended management actions from viability reports into forest plan direction.

FEIS alternatives were evaluated by means of an outcome-based assessment to determine how well they met the viability needs of the species identified as having a viability concern.

An additional viability analysis process for the entire Rocky Mountain Region is planned for completion within the next five years. This regional process is broader in scope and detail. It involves the development of detailed, peer-reviewed documentation for a large number of species across the Rocky Mountain Region. Additionally, a greater amount of detail concerning the reference habitat conditions upon which those species are dependent will be incorporated using reference models of sustainability. Upon completion of the regional process, the forest will review and incorporate all applicable, new direction into the 2002 Forest Plan.

COLORADO RIVER CUTTHROAT TROUT ANALYSIS

The Colorado River cutthroat trout analysis focused on risk associated with potential disturbance of various management prescriptions to cutthroat trout and on the potential for recovery of cutthroat trout populations within various management prescriptions.

Management Activity Level Assessment

Existing cutthroat trout populations on the Forest are currently at very low levels due to the small stretches of habitat they are limited to by barriers and displacement by exotic trout species. Disturbance associated with management activities can reduce the habitat quality of occupied cutthroat habitat by increasing sediment delivery to streams and by direct physical alternation of stream habitat.

L = Low Management Activity Level = Populations with no concentrated recreation or development which are not in a management unit contributing to the Allowable Sale Quantity (ASQ).

M = Moderate Management Activity Level = Populations which are predominately in areas of Low Management Activity Level (see above) but also lie near or within Management Areas which allow or encourage concentrated recreation, development, or contribute to the ASQ.

H = High Management Activity Level = Populations which are predominately in management areas which allow or encourage concentrated recreation, development, or contribute to the ASQ.

Table B-42
Colorado River cutthroat trout populations per Management Activity Level by Subbasin

Subbasin (number of populations)	Alt. B			Alt. C			Alt. D			Alt. E			Alt. F			Alt. I			Alt. K		
	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H
Upper White (9)	2	0	7	5	1	3	3	1	5	8	0	1	2	1	6	8	0	1	3	2	4
Colorado Plateau (6)	1	1	4	2	1	3	1	1	4	5	0	1	1	0	5	4	1	1	1	2	3
Colorado Headwaters (6)	4	0	2	3	1	2	3	1	2	4	0	2	3	0	3	6	0	0	2	1	3
Roaring Fork River (17)	11	0	6	13	2	2	10	2	5	15	2	0	9	0	8	12	3	2	9	2	6
Eagle River (13)	8	2	3	7	2	4	7	2	4	9	3	1	7	1	5	9	3	1	8	3	2
Blue River (11)	3	4	4	4	3	4	4	3	4	5	3	3	3	2	6	6	3	2	4	5	2
Total (62)	**29**	**7**	**26**	**34**	**10**	**18**	**28**	**10**	**24**	**46**	**8**	**8**	**25**	**4**	**33**	**45**	**10**	**7**	**27**	**15**	**20**

Potential Viable Cutthroat Populations

This analysis focused on the subwatersheds with the physical characteristics necessary to support a viable population of cutthroat trout (30 km of connected stream channel, good habitat condition) and the management prescription in which they were situated. All potential subwatersheds currently contain exotic trout species that would need to be removed to allow for cutthroat trout recovery. Management areas considered likely to promote viable populations were those that included a focus for native species recovery. These management areas included: 1.11 through 2.2, 3.32, 5.4, 5.43, and 5.5.

Some of these management areas contribute to the Allowable Sale Quantity (ASQ) and were treated as having a relatively high activity level when they were analyzed for effects to existing cutthroat populations and other aquatic species (due to the disturbance). This apparent inconsistency (likely to promote viable cutthroat populations versus greater risk to existing populations from management related disturbance) is appropriate because the focus is different:

- For the existing cutthroat population analysis (see above), the focus was on potential for disturbance to each population. These areas will not necessarily be reclaimed for cutthroat and the risk of disturbance associated with timber harvest and related road building remains.

The viable population analysis focuses on the ability to aggressively manage streams within the selected watersheds to restore or reintroduce cutthroat. This includes potentially physically disturbing activities such as barrier construction and physical or chemical removal of exotic trout species.

RESEARCH NATURAL AREAS ANALYSIS

In 1996, the forest began its analysis of potential sites for establishment as research natural areas (RNAs). Tom Andrews, Region 2 RNA Ecologist, and Keith Giezentanner, White River National Forest ecologist, began the process by delineating potential areas on quadrangle maps. Several filtering screens were used during this delineation: areas had to be roadless, could not be currently grazed by domestic livestock, could not have had past timber harvest activities or other land disturbing activities, and recreation use had to be at a low enough level to be within the objectives of an RNA. A total of nearly 60 areas were mapped through this process. These maps were discussed with District representatives to make sure that current and expected future management activities on the areas would be compatible with RNA delineation. Several areas were dropped from future consideration at this point due to incompatible management.

With the knowledge that the forest had only two field seasons to review and document the potential RNA areas, efforts were made to reduce the number of sites to a more manageable number. Evaluation of the sites revealed that many were essentially duplicates of other sites. A qualitative assessment was made of which sites would best represent the values of the RNA program and the total number was reduced to 27 (later raised to 28 with the addition of Deadhorse Creek, an area that had been missed during the initial mapping). These 27 areas were reviewed during the summers of 1996 and 1997 under a Challenge Cost Share agreement between the forest and the Colorado Natural Heritage Program. Ecological evaluations were completed for each of the areas and are on file in the Supervisor's Office.

After the field review and ecological evaluations were completed for all areas, it was determined that several of the potential areas did not meet the requirements of the RNA program for a variety of reasons, such as an abundance of noxious weeds or incompatible recreation use. These areas were dropped from further consideration at that time. A total of 15 potential RNAs were brought forward from this process. These areas were mapped into the alternatives at various levels based on the themes of the alternatives.

WATERSHED ANALYSIS

The analysis process for watershed assessment is discussed in Appendix J.

WATER YIELD ANALYSIS

The method used to estimate water yield over five decades was based on Chapter 3 of *An Approach to Water Resources Evaluation of Non-Point Source Silvicultural Sources: A Procedural Handbook,* known as *WRENSS* (EPA 1980). The specific procedures used are the same as those used by the Arapaho-Roosevelt National Forests and Pawnee National Grassland for their Revised Land and Resource Management Plan. Full documentation of this methodology is provided in their document's FEIS Appendices, Appendix B. A copy of documentation and spreadsheets for the Forest's analysis is available in the planning record.

RANGE ANALYSIS

The Code of Federal Regulations (CFR) contains several provisions dealing with rangeland capability and suitability. Specifically, 36 CFR 219.3 provides definitions as follows:

- *Capability:* The potential of an area of land to produce resources, supply goods and services, and allow resource uses under an assumed set of management practices and at a given level of management intensity. Capability depends on current conditions and site conditions such as climate, slope, landform, soils, and geology, as well as the application of management practices, such as silviculture, or protection from fire, insects and disease.
- *Suitability:* The appropriateness of applying certain resource management practices to a particular area of land, as determined by an analysis of the economic and environmental consequences and the alternative uses foregone. A unit of land may be suitable for a variety of individual or combined management practices.

The 36 CFR 219.20 contains the following direction about grazing resources in Forest Planning:

- In forest planning, suitability and potential capability of National Forest System lands for producing forage for grazing animals and for providing habitat for indicator species shall be determined as provided in paragraphs (a) and (b) of this section. Lands so identified shall be managed in accordance with direction established in forest plans.

    a. Lands suitable for grazing and browsing shall be identified and their condition and trend shall be determined. The present and potential supply of forage for livestock, wild and free roaming horses and burros, and the capability of these lands to produce suitable food and cover for selected wildlife species shall be estimated. The use of forage by grazing and browsing animals will be estimated. Lands in less than satisfactory condition shall be identified and appropriate action planned for their restoration.

    b. Alternative range management prescriptions shall consider grazing systems and the facilities necessary to implement them; land treatment and vegetation manipulation practices; evaluation of past problems; possible conflict or beneficial interactions among livestock, wild free-roaming horses and burros and wild animal populations, and methods of regulating these; direction for rehabilitation of ranges in unsatisfactory condition; and comparative cost efficiency of the prescriptions.

Rangeland capability

Capable rangelands are those lands that are accessible to livestock, produce forage, or have inherent forage producing capability, and can be grazed on a sustained basis. Rangeland capability was determined by eliminating lands as follows:

- Non-National Forest System lands.
- Areas not producing forage, such as barren areas, streams, lakes, reservoirs, and roads.
- Low forage-producing vegetation types such as dense canopy conifer areas.
- Slopes greater than 40 percent for cattle and slopes greater than 70 percent for sheep.
- Areas of unstable and unproductive soil types.

The remaining area is capable rangeland as shown in **Table B-43**.

Rangeland suitability

After an area is determined to be capable of supporting livestock grazing, a suitability analysis is conducted to consider economics and multiple resource management objectives.

Table B-43
Livestock use capability analysis

	Acres by classification	Running total after deductions	Cattle	Sheep
Total White River National Forest	2,481,949	2,481,949		
Private land	199,712	2,282,237		
Non-vegetated				
Barren	232,662	2,049,575		
Water	11,922	2,037,653		
Roads	4,031	2,033,622		
Streams	651	2,032,971		
Low forage potential				
Dense conifer canopy	813,366	1,219,605		
Inaccessible areas				
More than 40% slope for cattle	341,026		878,579	
More than 70% slope for sheep	51,192			1,168,413
Unstable/unproductive soils				
Less than 40% slope for cattle	6,808		871,771	
Less than 70% slope for sheep	14,090			1,154,323
Acres capable of supporting cattle			871,771	
Acres capable of supporting sheep				1,154,323

Economics

The economic analysis was completed from two perspectives:

- Financial efficiency is an approach that includes only revenues received from grazing fees and agency expense in managing for livestock production.
- Cost efficiency is an approach that considers not only the revenues and costs shown in the financial efficiency analysis, but also other benefits to society (full market value of grazing received by the permittee) and other costs (permittee expenses).

For both financial efficiency and cost efficiency, the PNV for 50 years is calculated at a four percent discount rate. The 1998-99 grazing fee rate established by Congressional formula of $1.35 per head month for cattle and $0.27 per head month for sheep was used for the financial efficiency calculation. The RPA market clearing value of $10.64 per animal unit month for cattle and sheep was used for the cost efficiency calculation. The results of the economic suitability analysis are shown in **Table B-44**.

Table B-44
Economic analysis for livestock grazing suitability

	Management Scenario		
Average annual values over 50 years	**Current Mgmt**	**Reduced Mgmt**	**No Grazing**
Head months – sheep	126,907	95,180	0
Head months – cows	77,591	58,463	0
Head months – total	204,498	153,643	0
Acres capable	1,154,323	1,154,323	1,154,323
Head months per acre	0.18	0.13	0
Acres per head month	5.65	7.51	NA
Revenue/head month – sheep	$0.27	$0.27	$0.27
Revenue/head month – cows	$1.35	$1.35	$1.35
Weighted average revenue/head month	$0.68	$.68	NA
Revenues/acre	$0.12	$.09	$0
Animal unit months (AUMs) – sheep	38,074	28,554	0
AUMs – cattle	95,668	71,909	0
AUMs – total	133,742	100,463	0
Benefits/animal unit month – sheep	$10.64	$10.64	$10.64
Benefits/animal unit month – cattle	$10.64	$10.64	$10.64
Weighted average benefits/AUM	$10.64	$10.64	$10.64
Benefits/acre	$1.23	$0.93	$0
Permit administration costs	$292,071	$248,260	$0
Range improvement costs	$125,986	$91,113	$66,241
Total cost	$418,057	$339,373	$66,241
Costs per acre	$0.36	$0.29	$0.06
Net revenues per acre	-$0.24	-$0.20	-$0.06
Net benefits per acre	$0.87	$0.64	-$0.06
Financial efficiency per acre			
Present value revenues	$2.58	$1.93	$0
Present value costs	$7.73	$6.23	$1.29
PNV	-$5.15	-$4.30	-$1.29
Cost efficiency per acre			
Present value benefits	$26.42	$19.98	$0
Present value costs	$7.73	$6.23	$1.29
PNV	$18.69	$13.75	-$1.29

The suitability analysis is presented in three parts: current suitability, vacant allotment analysis, and suitability by forest plan alternative.

- The process used to determine current suitability was:
- Start with the capable acres generated from the above steps.
- Subtract capable acres in areas that are closed to grazing or not in an allotment.
- Subtract capable acres within administrative sites, fenced highway right of ways, exclosures, developed recreation sites, existing RNAs, and threatened and endangered species critical habitat.

The acreage of these lands are shown in **Table B-45**.

Table B-45
Acres suitable for livestock grazing

		Running total after deduction	
	Acres by classification	**Cattle**	**Sheep**
Acres capable of supporting livestock		871,771	1,154,323
Deductions for unsuitable areas			
Capable acres within closed allotments			
Acres capable of supporting cattle	149,742	722,029	
Acres capable of supporting sheep	321,276		833,047
Administrative sites	304	721,725	832,743
Fenced highway right of ways	764	720,961	831,979
Exclosures	3	720,958	831,976
Developed recreation sites	1,180	719,778	830,796
Existing RNAs	328	719,778	830,796
TES critical habitat	0	719,778	830,796
Total suitable acres		**719,778**	**830,796**

Vacant allotments

There are approximately 248,000 acres capable of supporting livestock within 51 vacant allotments on the forest. Information on these allotments was collected, including:

- Acres capable of supporting livestock
- Kind of livestock the allotment is suited for
- Accessibility
- Past stocking levels and last year of recorded use
- Adjacency to existing active allotments
- Value to aid in future management flexibility
- Demand for grazing in that area.
- Present level of recreational use
- Potential conflicts with adjacent landowners
- Presence of threatened and endangered species
- Presence of bighorn sheep
- If the allotment is in existing wilderness
- If the allotment is in areas recommended for wilderness, RNAs, wild and scenic rivers, or special interest areas.

Based on analysis of the information collected for each vacant allotment, results of public scoping, and the emphasis of each forest plan alternative under consideration, recommendations were developed by alternative as to which allotments should be retained as vacant until a site-specific can be completed, which allotments should be partially retained, and which allotments should be permanently closed to domestic livestock grazing. Once closed, these areas would be removed from the suitable land base. The recommendations are presented in **Table B-46**, and summarized in **Table B-47**.

Table B-46
Vacant allotment recommendations

	Alternative					
Allotment name	**B**	**C**	**D**	**E**	**F**	**I**
Aspen Ranger District						
Brush/E. Snowmass	Retain	Close	Close	Close	Retain	Close
Grizzly/Tabor	Retain	Close	Close	Close	Retain	Close
Hunter/Midway	Retain	Retain	Retain	Close	Retain	Close
Independence	Retain	Close	Close	Close	Close	Close
No Name	Retain	Close part	Close part	Retain	Close part	Close
Richmond/Difficult	Retain	Close	Close	Close	Retain	Close
Conundrum	Retain	Close	Close	Close	Close	Close
Red Mountain	Retain	Retain	Retain	Retain	Retain	Close
Woody Creek	Retain	Retain	Retain	Retain	Retain	Retain
Blanco Ranger District						
Park Creek	Retain	Close	Close	Close	Close part	Close
Dillon Ranger District						
Argentine	Retain	Close	Close part	Close	Close part	Close
Baldy	Retain	Close	Close	Close	Close	Close
Buffalo Creek	Retain	Close	Close	Close	Close	Close
Copper Mountain	Retain	Close	Close	Close	Retain	Close
Corral	Retain	Close part	Close part	Close	Retain	Close
Officer's Gulch	Retain	Close	Close	Close	Close	Close
Ptarmigan	Retain	Close	Close	Close	Close	Close
Searl	Retain	Close part	Close part	Close	Retain	Close
Acorn	Retain	Close part	Retain	Close	Retain	Retain
Black Creek	Retain	Close	Close part	Close	Close part	Close part
Boulder Creek	Retain	Close	Close	Close	Close	Close part
Maryland Creek	Retain	Close	Close	Close	Close	Retain
MC	Retain	Close	Close	Close	Close	Retain
Pioneer	Retain	Close	Close	Close	Retain	Close part
Soda Creek	Retain	Close	Close	Close	Close	Close
Tenderfoot	Retain	Close	Close	Close	Close	Close
Willow Creek	Retain	Close	Close	Close	Close	Close
Eagle Ranger District						
East Lake Creek	Retain	Close	Close	Close	Close	Close part
North W Mountain	Retain	Close	Close	Close	Retain	Close
South W Mountain	Retain	Close	Close	Close	Retain	Close
Squaw Creek	Retain	Close	Close	Close	Close	Retain
Sweetwater	Retain	Close	Close part	Close	Retain	Retain
Holy Cross Ranger District						
Homestake	Retain	Close	Close	Close	Retain	Close
Spring Creek	Retain	Close part	Retain	Close	Retain	Retain
Tennessee Pass	Retain	Close	Close part	Close	Close part	Close
Beaver Creek	Retain	Close	Close	Close	Close	Close
Berry Creek	Retain	Close part	Retain	Close	Retain	Retain
Lake Creek	Retain	Close	Close	Close	Retain	Retain
Northside	Retain	Retain	Retain	Retain	Retain	Retain
Rifle Ranger District						
Blue Lake	Retain	Retain	Retain	Retain	Retain	Retain
Dolan	Retain	Retain	Retain	Retain	Retain	Retain
Transfer	Retain	Retain	Close part	Retain	Retain	Retain
Grizzly Creek	Retain	Close part	Close part	Close	Close part	Retain
Horsethief	Retain	Close	Close	Close	Close	Close
No Name	Retain	Retain	Close part	Retain	Retain	Retain

Table B-46 continued

	Alternative					
Allotment name	**B**	**C**	**D**	**E**	**F**	**I**
Sopris Ranger District						
Ivanhoe	Retain	Retain	Close part	Close	Retain	Close
Last Chance	Retain	Retain	Retain	Close	Retain	Close
Upper Crystal	Retain	Retain	Close part	Close	Retain	Close
Gal.Ras.Uhl	Retain	Retain	Retain	Close	Retain	Close
Fryingpan	Retain	Retain	Retain	Close	Retain	Retain
Wheatley	Retain	Close	Close	Close	Close	Retain

Table B-47
Summary of vacant allotment recommendations.

	ALTERNATIVE					
Number of allotments	B	C	D	E	F	I
Retain	51	13	12	8	28	17
Partial closure	0	7	12	0	6	4
Close	0	31	27	43	34	30

Suitability by forest plan alternative

Livestock grazing has been identified as an appropriate activity in all management areas with the exception of RNAs, bighorn sheep habitat, and, to a minimal extent, special interest areas. Grazing is not appropriate in these management areas as it conflicts with the purpose for which the areas were established. Acres suitable for grazing vary by alternative, based on the allocation of proposed RNAs.

In Management Area 5.42, Bighorn Sheep Habitat, domestic sheep grazing is prohibited unless adequate temporal or spatial separation can be demonstrated. If temporal or spatial separation can occur, domestic sheep grazing is allowed. The analysis of temporal or spatial separation is conducted on a case-by-case basis at the site-specific level.

The process used to determine suitability by alternative was as follows:

- Start with the current suitable acres.
- Subtract capable acres within vacant allotments recommended for closure or partial closure.
- Subtract capable acres that have management area designations that do not allow livestock grazing (subtract only capable acres within management areas that have standards or guidelines that do not allow livestock grazing and that are not in areas presently closed to grazing or being recommended for closure).

Table B-48 summarizes the acreages.

Table B-48
Acres suitable for livestock grazing

	ALTERNATIVE					
	B	***C***	***D***	***E***	***F***	***I***
Present suitable acres	830,796	830,796	830,796	830,796	830,796	830,796
Vacant allotment closure recommendations	0	160,000	136,000	197,000	81,000	173,000
Capable acres within recommended RNAs*						
Capable acres within Coal Basin SIA (2.1) Bighorn sheep habitat						7,760
Suitable acres by alternative	830,796	670,796	694,796	633,796	749,796	650,036

Notes:

**RNA acres by alternative listed in FEIS Volume 1, Chapter 3, Topic 5, Part 2, Research Natural Areas*