Appendix B - Description of the Analysis Process

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Introduction

The major goal of analysis is to provide enough information to help decision makers and the public understand trade-offs between alternative management scenarios. Information also helps determine which combination of goods, services, and land allocations will maximize net public benefits. The regulations at 36 CFR 219 (1982 regulations) developed under the National Forest Management Act (NFMA) provide the analytical framework within which these decisions are made.

For the Shoshone National Forest plan revision a geographic information system (GIS) was used to develop the forest plan revision database. The database stores information about features located on the landscape, ranging from natural features such as rivers and vegetation types to constructed features such as roads and campgrounds. Legal or administrative boundaries such as the Forest boundary, research natural areas (RNA), and wilderness boundaries are also part of the GIS database. The database was used to analyze suitable timber lands, rangelands, describe the existing resource conditions, and perform other analyses for the revision.

1986 Forest Plan Management Area Adjustments

Management areas developed in 1986 for the current forest plan were mapped manually. Once the Shoshone acquired GIS in the early to mid-1990s the hard copy management area map was digitized and added to the GIS database. As part of the plan revision, that layer has been updated to correct spatial errors or to reflect changes to the forest plan since 1986. The following changes were made to the data.

Clarks Fork Wild River Corridor

The Clarks Fork Wild River management area (10D) was changed to match the official boundary as designated by legislation. Adjacent management areas were adjusted to match the official boundary.

High Lakes Wilderness Study Area

The High Lakes Wilderness Study Area management area (10E) was changed to match the legislatively defined boundary. Adjacent management areas were adjusted to match the official boundary.

Dunoir Special Management Unit

The Dunoir Special Management Unit management areas (10F) were digitized using 1:24,000 topographic maps to make the lines more accurate.

Line Creek Plateau Research Natural Area

Line Creek Plateau Research Natural Area (RNA) management area was added to the forest plan management area map. The RNA was established in 2000 in a forest plan amendment. The portion of the RNA that falls outside of the High Lakes Wilderness Study Area was digitized and assigned a new management area number (10ALC).

Swamp Lake Botanical Area

Swamp Lake is the only existing special interest area (SIA) on the Shoshone. It was officially designated in a forest plan amendment in 1987 and was not included on the 1986 Forest Plan management area map. The SIA boundary was digitized and added to the management area maps and given the management area number (10G) assigned to it in the plan amendment. Adjacent management areas were adjusted to match the boundary.

Kirwin Historical Area

In 1992, the Shoshone acquired Kirwin, an old mining town from the late 19th to early 20th century, when the Richard King Mellon Foundation and the Conservation Fund purchased it from the American Metals Climax Mining Company and donated it to the Forest. A forest plan amendment in 1995 established a management area (10H) for the Kirwin property. The boundary was digitized and added to the management area map. Adjacent management areas were adjusted to match the boundary.

Forest Boundary Changes

In 2011, the Shoshone received a land donation on the Wind River Ranger District which was incorporated into the surrounding management areas. This added to the National Forest System (NFS) lands northwest of Dubois, Wyoming.

Timber Inventory data

Three sources of inventory data were used in the timber analysis. Inventory data are the source for the utilization standards and volume equations used in the analysis. Inventory information for estimating stand characteristics and volumes was obtained from the Forest Inventory and Analysis data and from the Shoshone's common stand exam data. Forest Inventory and Analysis provides a statistically based sample of forest resources across all ownerships that can be used for planning and analyses at local, state, regional, and national levels. Summary documentation of the Forest Inventory and Analysis data for the Shoshone is provided in Forest Resources of the Shoshone National Forest (USDA Forest Service 2008). An additional source of information from the Shoshone's common stand exam was used to supplement the Forest Inventory and Analysis inventory data. These data are available electronically within the Forest's FSVeg database.

Vegetation mapping for the Shoshone was derived from the R2Veg database.[1.] R2Veg is the Rocky Mountain Region's corporate vegetation database. It consists of existing vegetation data in a spatial layer and a series of tables containing vegetation attributes. The spatial and tabular components are housed together in an ArcGIS geodatabase. R2Veg data were captured as part of the Integrated Resource Inventory effort using a combination of photo interpretation and field verification. Information was recorded at the basic level of life form or ground cover (tree, shrub, grass, forb, barren, or water), species, size, and density (USDA Forest Service 2005, USDA Forest Service 2008a).

Update to R2Veg Vegetation Database for Plan Revision

The Forest GIS vegetation database (R2Veg) was fundamental to several analyses performed for the Plan revision effort. Although it is updated every few years to reflect changed conditions, there were inaccuracies that had to be updated immediately to more realistically represent conditions on the ground. No changes were made to the vegetation database between draft and final. No vegetation inventory was conducted and no significant wildfires occurred. The current database is representative of forest conditions and is adequate for making the needed alternative comparisons. Changes made (see table 1) address the following situations.

Wildfires

Cover type and structural stage were updated to reflect changes to stands resulting from recent wildfires (Gunbarrel, Hole in the Wall, Warm Springs, Norton Point and Castle).

[1] In 2011, R2Veg data were moved to a new database called FSVeg Spatial. For the revision process, the data are being used in the R2Veg format before being transferred.

Regeneration Cover Types

Forested stands that were burned or where insects killed the overstory were erroneously classified as grasslands or shrublands, based on the fact that the majority of the vegetation was grass or shrubs at the time of inventory. Information in the database indicated that the stands previously contained trees. The majority of these stands will transition back to forested vegetation over time, so they should be classified as forested cover types with a current structural stage of grass/forb or shrub for modeling purposes. The vegetation database was adjusted to reflect this.

Alpine versus Grasslands

There was a need to split out alpine habitat from grasslands. This was accomplished using the alpine soils GIS layer to identify grasslands characterized by alpine vegetation. A small amount of willow habitat was also placed in the alpine group. Alpine grassland has a structural stage of grass/forb and alpine willow habitat has one of seedling/sapling. Not all alpine habitat was split out because a majority of the high-elevation sites are classified as rock and/or ice.

Table 1. Acres changes resulting from database update of vegetation data

Cover Types	Acres Prior to Update	Acres after Update	Change
Alpine		300,647	300,647
Aspen	27,669	27,792	123
Douglas fir	314,520	355,789	41,269
Grasslands	977,974	518,783	-158,545[2]
Limber pine	38,251	39,167	916
Lodgepole pine	269,033	389,133	120,101
Non-vegetated	332,368	328,170	-4,198
Other tree	4,760	4,786	26
Sagebrush	52,149	49,955	-2,193
Spruce/fir	331,682	315,986	-15,696
Water	16,363	16,363	0
Whitebark pine	174,033	192,682	18,649
Willow	15,825	15,374	-451
Totals	**2,554,626**	**2,554,626**	

Forest health (insect and disease)

Information on forest health used in Plan revision was summarized from aerial and ground observations by Region 2 Forest health protection staff and Region 2 state partners. Aerial surveys are conducted annually, primarily over western conifer and aspen forest. Aerial surveys can detect faded foliage caused by bark beetle attack, needle or leaf loss or discoloration caused by defoliating insects, wind thrown trees, and in some cases, fungi or abiotic factors. Ground surveys constitute a broad range of observations in rural and urban forest environments throughout the region. Data used in plan revision include aerial surveys conducted through 2011.

[2] The acres of alpine and grassland habitats were combined to estimate the change in grassland cover type.

Due to the nature of aerial surveys, data will only provide rough estimates of location, intensity, and the resulting trend information for agents detectable from the air. Data presented should only be used as a partial indicator of insect and disease activity.

Aerial surveys were conducted in 2012 for the forest. That latest information was not incorporated into the analysis between draft and final. It was determined that the existing vegetation dataset was adequate to analyze differences among alternatives and inform the decision maker. Any changes to the database would have required many of the vegetation-related analyses done for the EIS to be redone. The benefit of redoing the analysis versus the time and cost of redoing that work was not deemed favorable. More accurate information may be necessary for a site-specific analysis, but for an analysis at the forest scale the differences are not significant. The additional acres identified in the 2012 aerial survey amount to approximately 14,000 acres across the whole forest.

Insect epidemic information used in spectrum analysis

One of the land stratification identifiers used in the spectrum model was whether the land had been impacted by the insect epidemic. This was used to determine whether to assign a yield table that had been modified for bug impacts. Because of the nature and accuracy of the aerial survey data as compared to the vegetation database, there is not good correlation in the accuracy of mapping and polygon boundary locations. In general, the aerial survey mapping is less spatially accurate than the vegetation data. This is not a limitation when the aerial survey data is for the primary purpose of identifying trends from year to year. It is a limitation when there is an attempt to combine the aerial survey information with more accurate stand data.

This issue was addressed by using the stand data as a controlling layer in combining the two data sets. Basically the bark beetle information was extracted from the aerial data and was overlaid with the conifer stands from the vegetation layer. Any aerial data that fell outside of a conifer stand was dropped. There was also no attempt made to match up the cover type classification from the aerial data with the vegetation data. The aerial data were strictly used to identify whether there was an impact from the epidemic, regardless of tree species.

The resulting information has a lower estimate for total acres impacted from the epidemic on the forest, but still indicates a significant impact to the timber base (more than half the base impacted by insects), and the interdisciplinary team felt the data were appropriate for comparing effects across alternatives. The acres are not intended to provide an estimate of total impacts and should not be used for that purpose.

Range Capability and Suitability Evaluation

The requirement to perform analysis of rangeland suitability is found in the NFMA at 36 CFR 219.20. The process followed on the Shoshone National Forest is based on Region 2 direction. This analysis focused on those environmental components that had the greatest effect on range suitability and were most important for comparison among alternatives. Items that did not vary by alternative and had a similar effect in all alternatives were not included. For example, range capability was not reduced by calculating the acreage that occurs on road surfaces. That number is relatively constant across the alternatives and does not provide information that is important for the decision-making process. Those types of site-specific components are addressed during project-level allotment management planning.

Rangeland Capability

The definition of rangeland capability found in 36 CFR 219.3 (1982 regulations) 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 upon current resource 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.

Process for Determination of Rangeland Capability

The Forest GIS and the most current available data were used for the following analysis.

1. Begin with all NFS lands.
2. Areas that are dominated by a large percentage of rock, barren ground, and generally non-vegetated ground were subtracted. Water in the form of lakes and ponds was also subtracted at this step.
3. Slopes greater than 60 percent were subtracted. These areas are identified as not suitable for cattle and sheep grazing. In the DEIS analysis, the 40 to 60 percent slope range, which is generally suitable for sheep grazing was identified as not being capable. Most of the Shoshone is not available for sheep grazing and the interdisciplinary team felt the information on capability for sheep was not needed by the decision maker. Sheep are only grazed on two allotments on the south end of the Forest and the terrain is generally less than 40 percent slopes in those areas. Comments received on the DEIS objected to this approach. They felt it did not follow standard protocols and provided in incorrect display of grazing capability. Based on the comments, we reconsidered our approach and adjusted it to include the 40 to 60 percent slope range as capable acres. Now they are not removed until the suitability screen where suitability for cattle grazing is determined.
4. The remaining acres are generally capable for grazing.

Rangeland Suitability

The definition of suitability found at 36 CFR 219.3 (1982 regulations) follows:

> Suitability – The appropriateness of applying certain resource management practices to a particular area of lands, 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.

Rangeland suitability varies by alternative or grouping of alternatives.

Process for Determination of Rangeland Suitability

1. Unusable areas identified in the capability analysis were subtracted.
2. Acres with slopes 40 to 60 percent slope were subtracted as not being suitable for cattle grazing.
3. Acres that have an over story or tree canopy cover were subtracted. Transitory range is normally only considered for a short time when conditions favor the production of sufficient understory vegetation. To simplify the analysis, cover types for lodgepole pine, Douglas-fir, and spruce/fir were subtracted at this stage, based on the assumption that the desired condition on those areas was a fully stocked timber stand that would limit understory vegetation. Other cover types (aspen, whitebark pine, limber pine) were not subtracted because they generally occur in less dense stands or provide conditions that support understory vegetation that provide forage.
4. Acres that occurred outside of existing allotments were subtracted from all alternatives except for alternative F. These are areas where management area prescriptions do not support livestock grazing. They include areas like wilderness that have never been grazed and other areas where grazing has not occurred because of limited forage. Management activities have not supported grazing in these areas.

All of the areas outside of wilderness that had some forage potential were included in alternative F to provide an opportunity for evaluation.

5. In alternative F, some of the acres in new allotments occurred in old sheep allotments that were not restocked with cattle because of their general unsuitability for cattle grazing. To better represent that situation in the analysis, acres classified as alpine within old sheep allotments were subtracted from alternative F.
6. One of the design criteria in alternative C was for no cattle grazing on bighorn sheep and elk crucial winter range. Those acres are subtracted in alternative C.
7. The remaining area is generally suitable for grazing.

Forest Plan Suitability Determination

For forest planning purposes, the combined "capability" and "suitability" analysis constitutes a suitability determination. The capability and suitability analysis, and resultant suitability determination is not a decision to graze livestock on any specific area of land, nor is it a decision about or estimate of livestock grazing capacity. The capability/suitability analysis and suitability determination may or may not provide supporting information for a decision to graze livestock on a specific area.

Any landscape area will contain areas that are capable and/or suitable as well as areas that are modeled as being other than capable and/or suitable. Since the forest plan-level suitability determination is based on a modeling process, and is dealing with a variety of complex landscapes, it is inevitable that this intermingling will occur on a land base of any significant size. Therefore, these suitability determinations are not intended to imply that livestock will be precluded from being found on lands that may be modeled as other than capable or suitable.

At the forest plan level, the suitability determination provides basic information regarding the potential of the land to produce resources and supply goods and services in a sustainable manner, as well as the appropriateness of using that land in a given manner. This information assists the interdisciplinary team and the line officer in evaluating alternatives and arriving at forest plan-level decisions. It also helps with an analysis of alternative uses foregone.

Lands Suitable for Timber Production

The timber suitability classification for the Shoshone was accomplished by applying planning regulation criteria (36 CFR 219.14 1982 regulations) in a step-wise process. Forest-wide geographic information system data were used to analyze and map the classification. Ranger district timber personnel reviewed the results and adjusted criteria to reflect on-the-ground experience. The process and rationale are described below.

Identification of Lands Generally Not Suitable for Timber Harvest

Criteria for determining lands generally not suitable for timber harvest are outlined in 36 CFR 219.14 (1982 regulations). Lands generally not suitable for timber harvest are those where:

1. Statute, executive order, or regulation prohibits timber harvest on the land, or the Secretary of Agriculture or the Chief of the Forest Service has withdrawn the land from timber harvest.
2. At the broad forest scale, the responsible official estimates that soil, slope, or other watershed conditions will be irreversibly damaged by timber harvest.

3. At the broad forest scale, the responsible official estimates there is no assurance that such lands can be adequately restocked within 5 years after harvest.
4. Trees are unable to grow due to environmental conditions (such as insufficient rainfall, low temperature, or other growing conditions preventing the establishment of tree cover).

Under criterion 1, areas were identified as not suitable for timber harvest. These included designated wilderness, the Dunoir Special Management Unit, and High Lakes Wilderness Study Area. The Glacier Addition to the Fitzpatrick Wilderness is not included with this group. The wilderness designation for that area allows timber harvest for bighorn sheep management.

Criteria 2, 3, and 4 are considered together because there is overlap between data used to screen for the criteria. Table 2 displays lands excluded from timber harvest and the criteria under which they fall.

Table 2. Areas where irreversible damage, adequate restocking, and other environmental conditions make the area not suitable for timber harvest

Land conditions	Criteria rationale
High elevations above 11,000 feet	Adequate restocking and environmental conditions
Low elevations and southwest aspects[3]	Adequate restocking and environmental conditions
Slopes greater than 40 percent	Irreversible damage
Areas of water, rock, or barren	Environmental conditions

Identification of Lands Generally Suitable for Timber Harvest

All lands that do not meet the criteria described above were identified as lands generally suitable for timber harvest.

These lands include:

1. Lands where timber production achieves or is compatible with the achievement of desired conditions and objectives established by the plan.
2. Other lands where harvest for multiple-use objectives other than timber production, including salvage sales, may take place.

Timber Production Achieves or is Compatible with Desired Conditions and Resource Objectives

This category includes lands where:

1. Timber production would either (a) achieve, (b) be compatible with, or (c) could contribute to, the achievement of desired conditions and resource management objectives , and
2. A flow of forest products can be planned and scheduled on a reasonably predictable basis over time.

[3] Elevations were adjusted by ranger district from north to south to reflect on-the-ground experience (Clarks Fork Ranger District below 7,200 feet, Greybull and Wapiti Ranger Districts below 7,600 feet, Wind River Ranger District below 8,000 feet, and Washakie Ranger District below 8,400 feet). These numbers are still being fine-tuned.

On these lands, timber production may be a primary multiple-use resource objective. In many cases, timber production may be secondary to other multiple-use resource objectives. If meeting desired conditions and resource objectives would achieve or be compatible with producing commercial timber products over time, and those products can be planned and scheduled on a reasonably predictable basis, the land should be identified as generally suitable for timber production. An important factor in determining whether desired conditions and objectives are compatible with timber production is whether regeneration of the stand as an element in maintaining the desired conditions of forest vegetation is planned at any time in the future. If regeneration is not planned at any time in the future, those lands are not included in this category. The identification of lands generally suitable for timber production as one of the management objectives is not a final decision approving projects or activities.

For the Shoshone, lands within Management Area (MA) Category 5 were included in this category, excluding those lands that meet the criteria described in the next section.

Other Lands where Timber Production is not Compatible with Desired Conditions or Resource Objectives

Special areas and proposed special areas were identified where the desired conditions are not compatible with timber production. These include the designated Clarks Fork Wild and Scenic River segment, Line Creek Plateau Research Natural Area, and proposed research natural areas and special interest areas.

On some lands, timber production is not compatible with the resource objectives. Those lands are described in table 3.

Table 3. Lands where resource objectives are not compatible with timber production

Lands description	Rationale
Cover types of aspen, cottonwood, pinyon	Resource objectives are to maintain these cover types. These are not commercial timber species.
Cover types of whitebark pine or limber pine	Pure stands of these species are not compatible with timber production. They do not generally produce marketable products in pure stands. This does not apply when they occur in mixed stands with other conifer species.
Cover types of grasslands and shrublands	Resource objectives are to maintain these cover types.
Moraine soil type (in the Washakie geographic area)	Highly rocky soils are not compatible with timber production.

On some lands, the desired conditions for management areas proposed in Plan revision are not compatible with timber production. These include all management areas in categories other than 5, including management areas MA 4.2 Scenic byways, scenic areas, vistas, and travel corridors and MA 4.3 Back country access corridors. In addition, any lands in inventoried roadless areas in alternatives B, C, D, and G are not compatible with timber production. Harvest in those alternatives is restricted due to the reasons identified in the 2001 Roadless Area Conservation Rule.

Suitable timber acres for alternative A

The timber suitability determination is a forest plan decision and is only changed by a plan revision or amendment. The current suitable timber for the existing plan is 86,300 acres. This acreage has not changed since the 1986 Forest Plan was first signed, though the 1994 amendment that lowered the allowable sale quantity (ASQ) did attempt to map the location of the acres. The accuracy of that map was limited by the technology and information available at that time. In this DEIS, suitable acres are reported

as 86,300 for alternative A, but it was felt that using this number for analysis of effects would skew the relative comparison with the other alternatives.

To address this information, the suitable acres for alternative A were remapped using the same process used for the action alternatives described above. The existing forest plan management area allocations were used in that process. This remapping resulted in 107,000 acres of suitable timber land. These acres were used in the analysis process. It is felt that this gives a more appropriate comparison across the alternatives and does not change alternative A's relative ranking on number of suitable timber acres across the alternatives. If alternative A is chosen as the preferred alternative in the final decision, this mapping of the suitable acres will be established as the suitable acres.

Timber Yield Table Development

Timber yield tables used in the analysis were developed using the Forest Vegetation Simulator (FVS). The FVS is a forest growth and yield model designed to forecast forest stand development from stand inventory data. The FVS grows individual forest stands into the future with regard to current stand conditions, regionally embedded growth and mortality relationships, and user-defined management options. Post processing of multiple stand simulations to describe the average stand condition for a group of similar stands is completed to create stratum-based yield tables. Yield tables were then produced for multiple strata under multiple management options for use in the timber model to allocate treatments on the landscape in order to obtain desired conditions. Documentation of the development of the timber yield tables is found in Summary of Yield Table Development for Forest Plan Revision (USDA Forest Service 2006).

Due to the advent of bark beetle outbreaks throughout the Shoshone, it was necessary to generate new yield tables to represent the current state and projected yields of lands affected by bark beetles. Lands determined to be affected by insects were represented by new simulation runs. Those lands determined to be not affected were represented by simulations done in 2006. Representation of bark beetle outbreaks was accomplished using FVS forest pest extensions. Those extensions were: Lodgepole Mountain Pine Beetle Model and Western Root Disease Model. Root disease impacts were not a component in any strata, but the Western Root Disease Model has bark beetle impact capabilities that were used to represent Douglas-fir beetle in the Douglas-fir forest cover type and spruce beetle in the Engelmann spruce/subalpine fir forest cover type. Dwarf mistletoe impacts were also included in the projections using the Dwarf Mistletoe Model where indicated by tree damage and severity codes in the inventory data.

All original inventory data used in the 2006 projections were used in the 2012 projections and no new data were introduced. Also unaltered were the strata classes to which the individual stands were assigned, as well as the calibration and regeneration parameters developed for the original FVS projections (USDA Forest Service 2012).

Spectrum Model

Spectrum, a forest planning model, was used to estimate the ASQ and long-term sustained-yield capacity for the Shoshone National Forest plan revision. Spectrum is a linear program-based model used to optimize the allocation of land and the scheduling of activities and outputs on a forest over a planning horizon (USDA Forest Service 2008b). Spectrum is available from the Forest Service's Inventory and Monitoring Institute in Fort Collins, Colorado. The latest version, Spectrum 3.0 was used in this analysis. A commercial linear program solver called C-Whiz (version 4.2) was used to solve the matrix generated by Spectrum. C-Whiz can be purchased from Ketron Management Science.

Spectrum utilizes data components that include land units, management actions, activities and outputs, costs and revenues, management objectives, and a planning time frame or horizon (USDA Forest Service 2008b).

Spectrum Land Units and Strata

Land units in Spectrum are defined by up to six layers of descriptive qualifiers or identifiers. For the Shoshone model, the planning area was stratified into land units based on six identifiers: timber objective, vegetation cover type (dominant species), habitat structural stage (stand density and size class), inventoried roadless area/roading classification, insect epidemic mortality, and ranger district.

Vegetation management prescriptions and yields are assigned based on a subset of the land units in Spectrum defined by cover type and habitat structural stage (see table 4). The yield tables developed for Plan revision were assigned based on this subset of land units.

To simplify model runs and since the model was only being used to model timber harvest, lands where timber harvest was not allowed were not included in the final Spectrum analysis. The spectrum analysis for altenative B was used for alternative G in the FEIS. All the land allocations in alternative G, including those for timber objectives and inventoried roadless, are the same as alternative B. As a result, the other changes in alternative G, don't result in a change to the timber harvest analysis.

Table 4. Spectrum strata

Spectrum Level Identifiers	Code and Definition	Notes
Timber objectives	TMPROD - Timber production TMHARV - Timber harvest allowed TMNOHV - Timber harvest not allowed	Identify suitable timber lands (timber production) and where other timber harvest was allowed or not allowed
Cover type	LP - Lodgepole SF - Spruce/Fir DF - Douglas fir LM - Limber pine AS - Aspen WB - Whitebark pine GRA - Grass and forbs NFL - Non-forested lands SHR - Shrublands WAT - Water OTH - Other tree species ALP - Alpine	Used to identify predominate cover type and to assign yield tables and prescriptions. Cover type was one of two attributes used to stratify yield tables.
Habitat structural stage	2T- Seedling/sapling 3A - Pole low density 3B - Pole medium density 3C - Pole high density 4A - Mature low density 4B - Mature medium density 4C - Mature high density 3T - Pole any density 4T - Mature any density 1M - Grass forb 2S - Shrubs TT - Any stage NA - Not applicable	Used to identify habitat structural stage and to assign yield tables and prescriptions. Habitat structural stage was one of two attributes used to stratify yield tables.

Table 4. Spectrum strata

Spectrum Level Identifiers	Code and Definition	Notes
Inventoried roadless area and roaded lands	IRARDD - Inventoried roadless area that is roaded IRAXXX - Inventoried roadless area without roads XXXRDD - Other forest areas that are roaded XXXXXX - Other forest areas without roads	Used to identify if lands were inventoried roadless areas and/or if lands were within one mile of a system road. Roading identifier was used to determine if new system road construction was needed to harvest timber.
Insect	INSECT - Impacted by insect epidemic XXX - Not impacted by insect epidemic	Used to identify conifer stands impacted by insect epidemic. Used to determine whether to assign yield tables simulated for insect epidemics.
Ranger district	CLRKFK – Clarks Fork Ranger District WAPITI - Wapiti Ranger District GRYBLL - Greybull Ranger District WNDRVR - Wind River Ranger District WSHKIE - Washakie Ranger District	Used to identify ranger district

Spectrum Miscellaneous Model Parameters

The Shoshone model uses a 200-year planning horizon, beginning in 2010. This time span consists of 20 periods or decades; each period is 10 years. A discount rate of 4 percent was used for economics.

Spectrum Timber Cost and Revenues Coefficients

Revenues

Revenues are based on sell data from 40 timber sales sold between 2004 and 2011. Only sales over 10 acres in size were used in the calculations for sawlogs. Sales smaller than 10 acres were not included in the calculations. These smaller sales tended to be unique, such as pile sales, and are not representative of what is being modeled in Spectrum. The 40 timber sales included represented over 97 percent of the timber sale volume and value sold between 2004 and 2011. A rate was calculated for green, dead, and mixed green/dead sawlogs. The rates for dead and mixed dead/green were within 20 percent of each other, so they were averaged together and one rate is being used for them. The green rate is approximately 50 percent higher, so it is being kept separate. Revenues developed are for all species. (See table 5.)

The fuelwood or products other than sawtimber (POL) value used is based on the free use rate of $7.50. An average of all fuelwood/POL sales from 2004 to 2011 yielded an average of $7.20. Based on the closeness of this number to the established rate of $7.50, we decided to use the established rate.

Table 5. Timber revenues

Product	Revenue (dollars per Ccf*)
Fuelwood/POL	7.50
Green sawtimber	31.90
Mixed Dead/green sawtimber	17.00

*Ccf = Hundred cubic feet

Timber sale-related costs

- Timber sale preparation, administration, and planning costs are based on costs experienced between 2006 and 2011.
- Stand exam costs are based on current contract costs. The cost is higher for surveys done within lynx habitat because additional data are gathered to analyze effects. The higher cost is used for the four northern ranger districts because the majority of the suitable timber lands on those districts fall within lynx analysis units (LAU). The lower cost is used on the Washakie Ranger District, which does not have any LAUs.
- Precommercial thinning costs are based on costs experienced on adjacent Forest Service units. Shoshone National Forest costs were not used because there have not been any recent contracts. In the last few years, funding has been allocated to fuels projects instead of precommercial thinning contracts.
- Planting costs are based on costs recently experienced on the Shoshone. There are three different rates: (1) a full rate for planting after wildfire; (2) an interplant rate that makes up the majority of our acres planted (this rate is lower because there is usually some amount of existing regeneration within planted stands); and (3) a rate for whitebark pine planting, which is more expensive overall both because it costs more to raise seedlings and to plant, given that planting sites tend to be more remote.
- Costs for road construction and reconstruction are based on costs experienced on the Shoshone. The difference between these costs is much less than is traditionally seen. This is related to the fact that much of our terrain and soils lead to higher costs, even for reconstruction.
- Costs for road maintenance and temporary roads are based on costs experienced on the 40 timber sales used in calculating the revenue numbers. (See table 6.)

Table 6. Activity costs

Activity	Cost
Sale preparation (dollars per Mcf*)	146.00
Sale administration (dollars per Mcf)	252.00
Sale planning (dollars per Mcf)	56.00
Stand exam (Clarks Fork, Wapiti, Greybull, Wind River Ranger Districts) (dollars per acre)	9.20
Stand exam (Washakie Ranger District) (dollars per acre)	8.20
Precommercial thinning (dollars per acre)	280.00
Planting – full planting (dollars per acre)	391.00
Planting – Interplanting (dollars per acre)	295.00
Planting – whitebark pine (dollars per acre)	$480.00
Road construction (dollars per mile)	23,000.00
Road reconstruction (dollars per mile)	21,150.00
Temporary roads (dollars per mile)	15,895.00
Extended skidding (dollars per Mcf)	204.10
Road maintenance (dollars per Mcf)	18.60

*Mcf = Thousand cubic feet

Output coefficients

The acre and volume coefficients for timber harvest are generated for the FVS yield tables used within the Spectrum model (see table 7). (See Timber Yield Table Development for discussion.)

Other coefficients

- Road reconstruction miles are based on the rates experienced in the 40 timber sales used in the revenue calculations. This coefficient applies to all timber sales on lands with existing roads and on the second entry on lands without existing roads.
- Two numbers were calculated for road construction miles. The number for lands with existing roads is based on rates experienced in the 40 timber sales used in the revenue calculations. There is always the potential for some new road construction, even in currently roaded areas. The number for lands without existing roads is based on the estimated miles needed to access a square mile of land considering skidding distances and the construction of some temporary roads.
- Temporary road miles are based on the rates experienced in the 40 timber sales used in the revenue calculations. This coefficient applies to all timber sales on lands with existing roads and on the second entry on lands without existing roads.
- The extended skidding cost is applied to lands where we cannot build a road system (inventoried roadless areas or IRA) or temporary roads. Those lands are managed with extended skidding distances up to one mile.
- Acres of planting are based on costs experienced on current timber sales.

Table 7. Output coefficients

Output	Coefficients
Road reconstruction	0.0043 mile per acre harvested
Road construction (lands with existing roads)	0.0003 mile per acre harvested
Road construction (lands without existing roads)	0.0031 mile per acre harvested
Temporary roads	0.0031 mile per acre harvested
Planting-full planting	0.75 acre planted per clearcut or fire salvage acres harvested
Planting-interplanting	0.20 acre planted per acre of final harvest other than clearcut
Planting-whitebark	0.75 acre planted per acre of restoration treatment (I don't think we will be modeling this in Spectrum, but still need to discuss)

Application of road coefficients

A description of how road coefficients were assigned to the strata in the different alternatives follows (see table 8). This description is not to be interpreted as forest plan direction, but rather as a way to model that direction within the spectrum model. Spectrum is only used to model the portion of timber harvest that will be sold as commercial timber. Under plan direction, trees can be cut for other purposes that do not require a road system to remove timber from the forest. Direction on where road construction is suitable is found in the forest plan.

For lands outside of IRAs, the assignment is straightforward and the same in all alternatives. In suitable timber lands, the only difference is based on roading and miles of new construction. For lands available for timber harvest, no new road construction is permitted.[4] However, temporary roads are allowed, and therefore, extended skidding costs are not needed. Road reconstruction costs are included regardless of whether the lands are roaded or not. When the area is not roaded, it is assumed that the reconstruction costs are being applied to roads outside of the area.

For lands within IRAs the assignment differs according to whether the alternative is consistent with the 2001 Roadless Conservation Rule. For alternatives A, E, and F the assignment is the same as for lands outside of IRA. For alternatives B, C, D, and G, there are no lands assigned as suitable timber lands within IRAs so there are no coefficients to apply. For timber harvest lands, no new system roads or temporary roads can be built, so those coefficients are not applied. Harvest on timber harvest lands can only occur if the harvest area is within one mile of an existing road and with the application of extended skidding. Road reconstruction costs are still applied under the assumption that the roads being reconstructed are outside of the area. Inventoried roadless area acres that are not within one mile of an existing road will not be harvested under the assumption that they are not accessible without the building of roads.

[4] There is one management area that is assigned to timber harvest lands that does allow new road construction. That is MA 4.2, travel corridors. Although new road construction is allowed, it would rarely be done for harvest because the corridor is a 0.5-mile buffer on existing roads, and all lands could be reached with skidding and temporary roads. So for the purpose of spectrum modeling these timber harvest lands can be lumped with other lands that don't allow new road construction.

Table 8. Application of road coefficients and costs by level identifiers

Road Status Attribute	Alternative	Land Suitability attribute	
		Timber production lands	Timber harvest, but not production
Lands that are not within inventoried roadless area and are within 1 mile of a system road.	All Alts	Road construction 0.0003 mile/acre harvested Road Reconstruction 0.0043 mile/ acre harvested Temporary roads 0.0031 mile/ acre harvested No extended skidding cost	No road construction Road Reconstruction 0.0043 mile/acre harvested Temporary roads 0.0031 mile/acre harvested No extended skidding cost
Lands that are not within inventoried roadless area and are not within 1 mile of a system road.	All Alts	Road construction 0.0031 mile/ acre harvested Road Reconstruction 0.0043 mile/ acre harvested Temporary roads 0.0031 mile/ acre harvested No extended skidding cost	No road construction Road Reconstruction 0.0043 mile/acre harvested Temporary roads 0.0031 mile/acre harvested No extended skidding cost
Lands that are within inventoried roadless area and are within 1 mile of a system road	Alts B, C, D, G	No acres of this type in these alts	No road construction Road Reconstruction 0.0043 mile/ acre harvested No temporary roads Use extended skidding cost
	Alts A, E, F	Same as lands not within inventoried roadless area	Same as lands not within inventoried roadless area
Lands that are within inventoried roadless area and are not within 1 mile of a system road	Alts B, C, D. G	No acres of this type in these alts	None of these acres will be harvested for timber in these alternatives
	Alts A, E, F	Same as lands not within inventoried roadless area	Same as lands not within inventoried roadless area

Timber Economic Suitability Analysis

Economic suitability is a financial analysis required during forest planning to determine the costs and benefits of a range of management intensities for timber production (36 CFR 219.14(b) 1982 regulations). It helps answer the question of whether lands suitable for timber harvest or production can produce timber cost effectively. The analysis is required for those lands that have not already been determined to be unsuitable for timber harvest. For each unique land class represented in the Spectrum model, the present net value (PNV) of each management prescription that might be applied to that land class is calculated. The PNV is the sum of discounted costs and revenues associated with the management prescription for the entire planning horizon. Costs and revenues in this analysis are expressed in 2010 dollars. Costs are explained in detail in the section *Spectrum Timber Costs, Revenues and Coefficients*. They include costs associated with planning and conducting a timber sale. Revenues are expected gross receipts to the government based on expected stumpage prices. Future costs and benefits are discounted to present values using a 4 percent interest rate.

Several factors about this analysis should be understood. First, no decisions about the management of the land are made at the conclusion of the analysis. Rather, the results are used for comparison between management regimes and are but one of many pieces of information used in the formulation of alternatives. Second, the analysis doesn't represent a single point in time. The management prescription is assumed to continue through time (regular harvest cycles for uneven-aged management and multiple rotations for even-aged management) and all costs and returns are considered over the entire 200-year planning horizon and discounted to the base year.

Results

The average PNVs for the Shoshone are negative to varying degrees, depending on the management prescription. For most management prescriptions, there was a wide range of PNV per acre values across the land types where the prescription may be applied. Most of the variation within a management prescription is explained by the age of the stand at the beginning of the planning horizon. Table 9 displays the average PNV values for each management prescription, and averages for young and mature stands within that management prescription.

Low or negative PNV occurs for various reasons. For most harvest treatments on the Shoshone, costs exceed revenues. Because of discounting, a prescription that has treatments in early decades will have a more negative PNV than the same prescription with treatments in later decades. This explains why for each management prescription, the younger stands have a less negative PNV than the older stands.

Table 9. Present net value by prescription by habitat structural stage (Mature = 4A, 4B, 4C, 4T; Young = all others)

Management Prescription	Age Class	Average PNV $/acre
Clearcut		**-163.15**
	Mature	-224.22
	Young	-31.72
Convert DF to Aspen		**-188.05**
	Mature	-214.48
	Young	-33.99
Convert SF to Aspen		**-116.11**
	Mature	-203.38
	Young	-14.80
Group Selection, opt. 1		**-150.57**
	Mature	-202.60
	Young	-18.04
Group Selection, opt. 2		**-20.89**
	Mature	-75.55
	Young	-6.58
Individual tree selection, opt. 1		**-110.36**
	Mature	-194.14
	Young	-12.54
Individual Tree Selection, opt. 2		**-92.91**
	Mature	-161.12
	Young	-5.83
Overstory Removal (opt.1)then Shelterwood		**-308.39**
	Mature	-308.39
Overstory Removal (opt.2) then Shelterwood		**-208.33**
	Mature	-208.33

Table 9. Present net value by prescription by habitat structural stage (Mature = 4A, 4B, 4C, 4T; Young = all others)

Management Prescription	Age Class	Average PNV $/acre
Overstory Removal (opt.3) then Shelterwood		**-140.74**
	Mature	-140.74
Seed Tree Cut w/ thin in exist and regen		**-78.31**
	Young	-78.31
Seed Tree Cut w/ thin in regen		**-143.00**
	Mature	-232.97
	Young	-53.24
Three Step shelterwood		**-68.32**
	Mature	-122.25
	Young	-9.14
Three Step Shelterwood pct		**-9.74**
	Young	-9.74
Two Step shelterwood		**-111.16**
	Mature	-144.10
	Young	-14.44

Fire and fuels analysis

Shoshone National Forest Wildland Fire Hazard Rating

Wildland fire hazard on the Forest was determined using FlamMap, a fire mapping and analysis PC-based program that describes potential fire behavior across a landscape under constant environmental conditions (weather and fuel moisture). Fire behavior was calculated for each 30x30 meter pixel of the forest using vegetation and topological characteristics combined with wind and live and dead fuel moistures. Fireline intensity or flame length was used as the indicator to determine a hazard rating across the forest landscape. Fireline intensity or flame length is related to the heat felt by a person standing next to the flames. See table 10.

Table 10. Hazard rating interpretation

Hazard Rating	Fireline Intensity (BTU/ft./s)	Flame Length (Feet)	Interpretation
Low	0 to 100	0 to 4	Fires can generally be attacked at the head or flanks by persons with handtools.
Moderate	100 to 500	4 to 8	Fires too intense for direct attack by persons with handtools; equipment such as dozers, engines or aircraft can be effective.
High	500+	8+	Torching, crowning, spotting may cause serious control problems, control at the head of the fire is ineffective.

Data used for the analysis were obtained from LANDFIRE, version LF 2010, May 2013. LANDFIRE data used for the analysis included:

- 40 Scott and Burgan Fire Behavior Fuel Models
- Forest Canopy Bulk Density
- Forest Canopy Base Height
- Forest Canopy Cover
- Forest Canopy Height
- Slope
- Aspect
- Elevation

Version LF 2010 reflected vegetation change and disturbance 1999 to 2010 for fire, vegetation management, and succession. Vegetation changes from fire, management, or succession after 2010 were not reflected in the data. Wildfires that have occurred since 2010 on the Shoshone include Norton Point (24,237 acres), Hole in the Wall (2,541 acres on the Shoshone), and Index Creek (214 acres). Management activities on the forest were not incorporated in the latest data version. Vegetation characteristics (fuel model change, increase in crown base height, decrease in canopy bulk density and decrease in canopy cover) were modified manually using Spatial Analyst in ArcMap for the wildfire areas to reflect a change in vegetation before running the FlamMap analysis.

FLAMAP Analysis

FlamMap calculates fire behavior characteristics based on fuels, topography, and weather (Finney 1998).

Inputs:

Potential fire behavior was modeled at the 90th percentile weather and fuel moisture conditions, equivalent to high to very high fire danger rating.

The 90th percentile conditions were calculated for the four National Fire Danger Rating System (NFDRS) Remote Automated Weather Stations (RAWS) used on the forest identified in the Cody Interagency Dispatch Zone Fire Danger Rating Operation Plan (CIDZFDOP), April 2013, version 1.0.

Crandall RAWS and Eagle RAWS were identified as the weather stations that best correlated weather conditions and fire business on the northern portion of the forest and Elkhorn RAWS and Anderson Ridge RAWS on the southern portion.

FireFamily Plus was used to determine percentile fuel moistures using Energy Release Component (ERC) and westerly winds (NW, W, and SW) for each station and then averaged for one live and dead fuel moisture value used in the FlamMap analysis. All four stations had similar fuel moisture values. See Table 11.

Table 11. 90th percentile fuel moistures

1-hr Fuel Moisture	10-hr Fuel Moisture	100-hr Fuel Moisture	Herbaceous Fuel Moisture	Woody Fuel Moisture
3%	4%	6%	50%	70%

Live fuel moistures were estimated rather than calculated using FireFamily Plus. The calculated values are generally inaccurate and commonly estimated based on time of year and average curing rates.

Weather is entered as a single event without any temporal variation and is represented by wind. West wind direction was used as it reflects between 65 to 81 percent of the wind direction at the four RAWS. A 20-foot wind speed of 20 mph was estimated to represent 90th percentile conditions. Wind Ninja wind vectors within the FlamMap model were used to reflect wind direction and speed based on topological influences.

Outputs:

The FlamMap output used for the analysis was flame length. The raster data from the output was downloaded into ArcMap for display purposes and acres were calculated from the data.

A significant part of the portion contains non-burnable fuels as reflected in the flame length outputs of zero feet. Not all of the areas with zero feet flame length were considered non-burnable as flame lengths less than 0.5 feet are rounded down to zero. Areas with low flame lengths include some of the more recent wildfires where fuels have not regrown or accumulated enough to reflect a flame length. The 40 Scott and Burgan Fire Behavior Fuel Models layer was used to determine the areas that were non-burnable as shown in table 12. The acres of non-burnable were subtracted from the total acres that FlamMap estimated to have a zero flame length.

The acres calculated from the data were 154 acres less than the 2,438,150 acres currently assigned to the Shoshone. To match the acres, each rating area was manually assigned an additional 51.3 acres to balance the forest acres.

Table 12. Unburnable areas

Description	Acres
91-NB1 Urban Development	1,682
92-NB2 Snow/Ice	14,742
93-NB3 Agriculture	44
98-NB8 Open Water	13,618
99-NB9 Bare Ground	539,935
Total	570,021

Table 13. Forest hazard rating

Hazard Rating	Description	Acres
None	Unburnable Fuels	570,021
Low	Flame Length 0-4 ft.	696,189
Moderate	Flame Length 4-8 ft.	345,500
High	Flame Length 8+ ft.	826,440
Total		2,438,150

Wildfire costs calculations

Seven large fires that ranged in size from 214 to 68,148 acres during the period of 2008 to 2012 were used to the derive costs estimates for the alternatives. These fires were managed for protection and/or resource benefits objectives and management responses ranged from monitoring, partial suppression, point protection and full suppression. The season of 2008 was selected as the starting year since it is the

same year that the 1986 Forest Plan was amended to allow the management of wildfires outside of wilderness as well as providing managers with the full range of response options for managing wildfire. The revised Forest Plan would continue with the same management direction as what is currently in the amended plan. Based on the similarity in management direction, it was determined that the costs associated with managing large fires on the Forest would be representative of future cost for the next 10 to 15 years. All wildfire costs were adjusted to 2013 dollars. (See table 14, table 15, and table 16.)

Table 14. Shoshone National Forest wildfire suppression costs (2008 to 2012)

Fire Name	Zone	Year	Acres Burned	Cost	Rehab Cost	WFM Cost/acre	Rehab Cost/acre
Gunbarrel	NZ	2008	68,148	$11,200,000	$368,500	$164	$5
Castle	NZ	2009	326	$100,000	$0	$307	$0
North Fork	SZ	2010	333	$900,000	$0	$2,703	$0
Norton Point	SZ	2011	24,237	$1,900,000	$79,500	$78	$3
Hole in the Wall	NZ	2011	6,343	$4,250,000	$0	$670	$0
Warm Springs	SZ	2011	807	$370,000	$0	$458	$0
Index	NZ	2012	214	$825,000	$0	$3,855	$0
Total			**100,408**	**$19,545,000**	**$448,000**	**$195**	**$4**

Data from FIRESTAT (fire report) for fire cost and acres burned

Table 15. 2008-2012 wildfire cost adjusted to 2013 dollars

Fire Name	Zone	Year	Acres Burned	2013 Wildfire Cost	2013 Rehab Cost	2013 WFM Cost/ac	2013 Rehab Cost/ac
Gunbarrel	NZ	2008	68,148	$12,096,200	$397,500	$177	$6
Castle	NZ	2009	326	$108,387	$0	$332	$0
North Fork	SZ	2010	333	$959,744	$0	$2,882	$0
Norton Point	SZ	2011	24,237	$1,964,128	$82,183	$81	$3
Hole in the Wall	NZ	2011	6,343	$4,393,443	$0	$693	$0
Warm Springs	SZ	2011	807	$382,488	$0	$474	$0
Index	NZ	2012	214	$835,554	$0	$3,904	$0
Total			**100,408**	**$20,739,944**	**$479,683**	**$207**	**$5**

CPI inflation calculator used - *http://data.bls.gov/cgi-bin/cpicalc.pl*

Table 16. Wildfire cost by alternative (2013 dollars)

Alternative	Acres Burned	Wildfire Cost	Rehab	Total Cost
A	185,200	$38,254,299	$884,763	$39,139,062
B	182,900	$37,779,218	$873,775	$38,652,994
C	184,100	$38,027,086	$879,508	$38,906,594
D	184,000	$38,006,431	$879,030	$38,885,461
E	175,000	$36,147,421	$836,034	$36,983,455
F	161,400	$33,338,250	$771,062	$34,109,312
G	182,900	$37,779,218	$873,775	$38,652,994

References

Finney, M.A. 1998. FARSITE: Fire Area Simulator – Model development and Evaluation. Res. Pap. RMRS-RP-4. Ogden UT: USDA Forest Service Rocky Mountain Research Station. 47 p. [0360]

LANDFIRE 1.2.0 Existing Vegetation Type layer.U.S. Department of the Interior, Geological Survey. [Online]. Available:http://landfire.cr.usgs.gov/viewer/ [2013, May 3].

Wildlife Grizzly Bear Denning Analysis

The following section summarizes how the information from Podruzny et al. 2002 and grizzly bear amendment (2006) was used to address snow machine use on grizzly bear denning habitat. In the rest of this discussion those references will be referred to as the denning analysis. The assumptions used in the denning analysis to identify what areas were closed to snowmobiling are different than what we use in this EIS. For the Shoshone, the areas identified as closed in the denning analysis include areas with closure orders, generally inaccessible terrain that was seldom used, and winter range areas that would have a closure order applied if there was ever more than incidental use. In this EIS, we identify areas as being open to use if plan direction allows it, even if there is little chance of anything besides incidental use occurring. As a result, in this EIS analysis alternative A shows more area open to winter motorized use than what is actually occurring or than what is shown in the denning analysis. The action alternatives displayed in this EIS definitively identify areas that will be open or closed to snowmobile use, so they are comparable to the analysis assumptions used in the denning analysis. Of the action alternatives, alternative B is designed to be most like alternative A, and as such, would be most comparable to the no-action alternative used in the denning analysis. The percentage of the forest closed to snowmobile use in alternative B is 80 percent and is very close to the 78 percent of closed denning habitat shown in the denning analysis. For the purposes of this EIS analysis, we will use the percentage of closed area we have calculated for the action alternatives. Though the absolute amounts may not be correct, we feel they are close and that they provide good metrics for comparing the alternatives. To account for the approximation represented by this approach, the percentages were rounded to the nearest 10 percent.

Scenery Management

Introduction

The Forest Service, in cooperation with other agencies, academic institutions, organizations, and private practitioners, developed the Scenery Management System (SMS) in 1994 to provide managers with a

systematic approach for determining the relative value and importance of scenery in a national forest. The SMS evolved from and replaced the Visual Management System (VMS), which was used in the existing forest plan. The SMS takes the VMS process one step further by rating the importance of the landscape and by developing scenic classes that measure the value of a landscape being viewed. It allows managers to compare the scenic value of a landscape with the value of other resources during the planning process.

National Direction

Forest Service Manual (FSM) 2380.3 requires the agency to "inventory, evaluate, manage, and, where necessary, restore scenery as a fully integrated part of the ecosystems of National Forest System lands through the land and resource management and planning process." FSM 2380.31 specifies the use of the basic concepts, elements, principles, and variables defined in *Landscape Aesthetics, A Handbook for Scenery Management* (USDA Forest Service 1995). The handbook outlines the vocabulary and systematic approach that is SMS and was used in this plan revision process to identify scenic classes across the Shoshone National Forest.

Scenery Analysis

Scenery management analysis involved identifying scenic components as they relate to people viewing them, mapping these components using GIS and existing data, and assigning a value for aesthetics. This value, or scenic class, provided information for the revision process.

Data in the Forest GIS database were used for the analysis. Scenic attractiveness, distance zones, and concern levels were combined to establish scenic classes. Scenic classes were then combined with scenic integrity to develop landscape character goals and scenic integrity objectives. The following describes the analysis process applied.

Scenic Attractiveness

Scenic attractiveness classes are developed to determine the relative scenic value of lands within a landscape. The first step in defining scenic attractiveness was the development of landscape character Descriptions for land units across the Shoshone. Landscape character descriptions provided the frame of reference for defining the scenic attractiveness classes. The land units used are subsections, a level of the national ecological hierarchy for the Shoshone. Subsections are land units with common vegetation, landform, soils, and geology. A description of these physical and biological features was combined with the scenic attributes of the landscape to create scenic attractiveness classes.

Three scenic attractiveness classes were used in the analysis as prescribed by the SMS. They are:

- **Class A** - Distinctive
- **Class B** - Common or typical
- **Class C** - Indistinctive

Landscape elements of vegetation, cultural features, water features, relief, and vegetation characteristics are all considerations in developing the scenic attractiveness map. Using GIS, subsections (Land Type Associations Layer) across the Forest were categorized into the three scenic attractiveness classes as follows.

Scenic Attractiveness Class A

1. High dissection, high percentage of rock, steep slope
    a. Land type described as highly dissected
    b. Land type with elevations ranging above 8,000 feet and slopes ranging above 70 percent

c. Land type description of greater than 75 percent rock outcrops.

2. High elevation
    a. Land type with elevations above 10,000 feet
    b. Land type with predominately alpine vegetation

3. High occurrence of lakes and stream bottoms.
    a. Land types that have a high number of lakes as determined by visual inspection,
    b. Land types associated with stream bottoms.

In addition, selected lakes greater than 25 acres in size and 40 selected streams (see table 17) were buffered by 0.25 mile and identified as scenic attractiveness class A.

Table 17. Streams assigned to scenic attractiveness class A

Beartooth Creek	Greybull River	Roaring Fork Creek
Cabin Creek	Grinnell Creek	Shoshone River
Clarks Fork Yellowstone River	Index Creek	South Fork Shoshone River
Clearwater Creek	Ishawooa Creek	South Fork Warm Spring Creek
Crandall Creek	Lake Creek	South Fork Wood River
Crazy Creek	Little Popo Agie River	Sunlight Creek
Dead Indian Creek	Middle Fork Wood River	Sweetwater Creek
Deer Creek	Middle Popo Agie River	Venus Creek
Dinwoody Creek	North Fork Crandall Creek	Warm Spring Creek
Dunoir Creek	North Fork Shoshone River	West Dunoir Creek
Eagle Creek	North Popo Agie River	Wind River
East Dunoir Creek	Pass Creek	Wood River
Fishhawk Creek	Pilot Creek	
Gannett Creek	Rampart Creek	

Scenic Attractiveness Class B

All lands not classified as A or C were classified as scenic attractiveness B.

Scenic Attractiveness Class C

All land types that had a primary vegetation component of grass or sage brush were classified as scenic attractiveness C, if they were not already in the A category.

Landscape Visibility

Concern levels and distance zones help define landscape visibility.

Concern Levels

Concern levels are a measure of the degree of importance the public places on landscapes viewed from travelways and use areas. Normally, areas are assigned a concern level value from 1 to 3 to reflect the relative high-to-low importance of a scene. Concern level is a function of both the number of visitors as well as their intent, so, for example, an interstate highway and a wilderness trail can both be mapped as

concern level 1. Concern level 3 was initially considered in the process, but the majority of the Shoshone falls within concern levels 1 and 2, so concern level 3 was dropped from the analysis. Areas on the Forest were assigned the following concern levels using the Forest GIS database.

- **Level 1** was assigned to primary travelways, areas of concentration such as recreation facilities, special designations such as scenic byways or national recreation/historic trails and cultural sites. Users have a high level of concern for scenery in these areas.
- **Level 2** was assigned to areas of local importance such as state highways, county roads, secondary trails, scenic overlooks, summer home tracts, etc. The remainder of the Shoshone was assigned this concern level.

Distance Zones

Distance zones are measured from the viewpoint of the concern level areas (1 or 2) to determine the relative sensitivity of scenes, based on their distance from an observer. Distance zones are an important part of scenery analysis, because as the distance increases, the level of visible detail decreases. And, as distance increases, so does the opportunity to mitigate the impacts to scenery. Distance zones are divided into three categories:

- **Foreground** - 0 to 0.5 mile from the viewer
- **Middleground** - up to 4 miles from the foreground, or 0.5 to 4 miles
- **Background** - greater than 4 miles from the viewer to the horizon

Using GIS software, points were placed every 0.5 mile on system roads and every mile on system trails. Roads and trails had previously been classified as concern levels 1 or 2. The result was a point data set of "seen areas." A viewshed model was then applied to the seen data to determine what is visible. On forests like the Shoshone with a lot of topographic relief, visibility is also affected by steep terrain, ridges, road cuts, etc. A 30-meter Digital Elevation Model was used to determine potentially visible areas. The result was an estimate of what can be seen from points across the Forest and the relative importance of the view.

Scenic Classes

The results of the scenic attractiveness and landscape visibility analyses are combined to produce scenic classes (not to be confused with scenic attractiveness class). Scenic classes are numerical ratings from 1 to 7 that rank the relative scenic value of landscape areas, with 1 being the most important or valuable. The ratings are determined using a matrix of the scenic attractiveness and landscape visibility indicators. Table 18 shows the scenic class matrix.

Table 18. Scenic class values derived from scenic attractiveness and landscape visibility analyses

	Distance Zone/Concern Level[5]						
Scenic Attractiveness		FG1	MG1	BG1	FG2	MG2	BG2
	A	1	1	1	2	2	2
	B	1	2	2	2	3	4
	C	1	2	3	2	4	5

Scenic Integrity Objectives

Scenic integrity objectives (SIO) are the product of the scenery analysis process and are derived by considering the scenic classes, existing scenic integrity levels, and the integration of other resource objectives. Scenic integrity refers to the degree of direct human-caused deviation in the landscape from activities such as road construction, timber harvesting, mining, etc. Before SIOs were developed, existing scenic integrity was determined and mapped. This is basically an inventory of the current status of the landscape and the scenery analysis just described in the previous sections. It tells resource specialists and decision makers how much visible disruption there is for a given landscape.

There are six levels of scenic integrity ranging from very high to unacceptably low. Very high represents areas that are unaltered or have only minor alterations. Landscapes classified as unacceptably low are characterized by evident deviations from the natural landscape.

For the forest plan revision effort, lands were classified into four of the six possible scenic integrity objective levels; very high, high, moderate and low. For alternative A, the existing visual quality objectives developed under the VMS system were converted as shown in table 19.

Table 19. Scenic integrity objective crosswalk from visual quality objectives

Scenic Integrity Objective (SMS)	Visual Quality Objective (VMS)
Very High - unaltered	Preservation
High – appears altered	Retention
Moderate – slightly altered	Partial Retention
Low – moderately altered	Modification

The scenic integrity objectives guide the type of management activity as well as the amount, degree, intensity, and distribution of those activities needed to achieve goals. They may be expressed as forest plan goals and objectives, and in other cases as standards and guidelines.

Management area direction was combined with scenic classes to map the scenic integrity objectives on the Forest. Table 20 shows the outcome.

[5] Distance Zone codes are FG = Foreground, MG = Middleground, BG = Background. The number after the Distance Zone code is the Concern Level.

Table 20. Scenic integrity objectives by management area and scenic class

Management Area	Scenic Class	Scenic Integrity Objective
1.1	1,2,3,4,5	Very High
1.1A	1,2,4	Very High
1.2	1,2,3,4	Very High
1.2A	1,2	Very High
1.2B	1,2,3	Very High
1.3	1,2	High
1.3	3,4	Moderate
1.5A	1,2	Very High
1.6A	1,2	Very High
1.6B	1,2,3	Very High
2.2A	1,2	Very High
2.3	1,2	Very High
3.1A	1,2	High
3.1B	1,2	High
3.1B	3	Moderate
3.1C	1,2	High
3.3A	1,2	High
3.3A	3,4	Moderate
3.3B	1,2	High
3.3B	3,4	Moderate
3.3C	1,2	High
3.3C	3,4	Moderate
3.5	1,2,3,4	Moderate
3.5A	1,2,3,4	Moderate
3.5B	1,2,3,4	Moderate
3.5C	1,2,3,4	Moderate
3.5D	1,2,3,4	Moderate
4.2	1,2,3	High
4.2	4	Moderate
4.3	1,2,3,4	Moderate
4.5A	1	Moderate
5.1	3,4	Low
5.1	1,2	Moderate
5.2	1,2	Moderate
5.2	3,4	Low
5.4	1,2	Moderate
5.4	3,4	Low
8.2	1,2	High

Recreation Opportunity Settings

Since the early 1980s, the recreation opportunity spectrum (ROS) has been used as a framework for identifying, classifying, planning, and managing a range of recreation settings. Six distinct settings: urban, rural, roaded natural, semi-primitive motorized, semi-primitive non-motorized, and primitive are defined using specific physical, managerial, and social criteria. For detailed information on ROS categories and criteria, refer to the ROS User Guide, 1982 USDA Handbook.

Existing ROS was remapped for the Shoshone using the latest GIS data and direction in the ROS User Guide. It is understood that ROS mapping is not an exact science and some flexibility is necessary at the ground level to deal with specific conditions and anomalies that are not exact matches with specific ROS class criteria and definitions.

Mapping Process – existing ROS setting

The following section outlines the steps to map existing ROS classes. The first steps describe the process and data layers necessary in producing initial ROS maps using GIS. Remaining steps are the adjustment of initial GIS maps using local expertise about the landscapes and use patterns.

Mapping criteria derived from the ROS User Guide were used in defining the physical, social and managerial setting of each landscape:

Identify division between motorized and non-motorized ROS settings. Motorized ROS settings are areas within 0.5 mile of motorized travel routes. Motorized travel routes include roads and motorized trails where motorized use is allowed.

A further refinement of motorized areas requires a roads designation of “better than primitive” or “primitive.” For this analysis, better than primitive roads are defined as roads designed for use by highway vehicles. We defined this as maintenance level 3, 4, and 5 roads. All other roads and motorized trails were defined as primitive.

All motorized routes were buffered by 0.5 and 3 miles. Areas that fell within 0.5 mile of a motorized route were classified as “motorized.” All areas outside were classified as “non-motorized.”

Classify non-motorized lands as either primitive or semi-primitive non-motorized. Areas 3 miles or greater away from motorized routes were initially classified as primitive. Areas less than 3 miles and more than 0.5 mile from all roads and motorized trails were initially classified as semi-primitive non-motorized.

Classify initial semi-primitive motorized and roaded natural ROS settings. Using the resulting work, further delineate motorized ROS settings as either semi-primitive motorized or roaded natural. Polygons within the 0.5-mile buffers of routes designated as primitive were classified as semi-primitive motorized (SPM). Areas within 0.5-mile buffers of “Better than Primitive” roads were classified as roaded natural (RN).

Apply size criteria to primitive and semi-primitive polygons. This step identifies areas meeting the various size criteria as well as identifying areas that don’t meet the size criteria. The areas not meeting the size criteria were analyzed to ensure other criteria are fully considered before eliminating the area due strictly to remoteness and size. Areas greater than or equal to 5,000 acres meet all criteria for primitive (P). Those that don’t meet the 5,000 acres were evaluated further as described below.

Areas identified as semi-primitive non-motorized (SPNM) with a size greater than or equal to 2,500 acres were selected. These areas meet all criteria for SPNM. Areas not meeting the size criteria were further evaluated as described below.

Areas identified as "SPM" polygons greater than or equal to 2,500 acres were selected. These areas meet all criteria for SPNM. Remaining "SPM" polygons smaller than the 2,500 acres were further evaluated as described below.

Conduct adjacency assessment to refine P, SPNM, and SPM settings that do not meet size criteria. For those areas initially mapped as primitive, but that were smaller than 5,000 acres, adjacent ROS settings were examined. It is possible for them to be contiguous to semi-primitive non-motorized areas, yet still provide a primitive experience. In our process, this situation did not exist and these areas were classified as one of the semi-primitive settings.

For SPNM areas that did not meet the 2,500-acre size criteria, adjacent ROS designations were considered. When adjacent lands were primitive, the area could still provide an SPNM experience, and it was mapped as such. In addition, if the area was isolated due to topography or other permanent landscape features, the area, even though not 2,500 acres, could still provide SPNM. These determinations were made by interdisciplinary team members.

There may also be instances where a small SPNM setting is engulfed by an SPM setting. In this case, the SPNM setting would become part of the SPM polygon. Although motorized use is not allowed in this portion of the setting, it contributes to the semi-primitive character.

Small SPM settings that were not adjacent to other semi-primitive areas were coded as roaded natural.

Distinguish between roaded natural and rural. No size criteria apply to roaded natural or rural ROS classes. Remaining buffered areas within 0.5 mile of "better than primitive roads" were classified as "RN." The only area classified as rural was the ski area along the North Fork of the Shoshone. The classification was assigned based upon the highly developed nature of the site and is consistent with the classification made in the existing forest plan.

Wilderness Settings

Wilderness settings are related to recreation opportunity spectrum (ROS) settings insofar as ROS is a starting point. The existing forest plan identified wilderness settings as different management areas (management areas 8A, 8B, and 8C). A forest team of recreation specialists from the Shoshone National Forest Supervisor's Office and the ranger districts modified the current forest plan settings for plan revision, based on current management direction and conditions on the ground. That process generally followed the following criteria. In the new revised plan, wilderness settings are not split into separate management areas. They are treated like ROS and are an inventory that is used in making management decisions.

Semi-primitive – areas adjacent to heavily used trails where there are higher encounters with other people.

Primitive – areas not classified as semi-primitive or pristine

Pristine – areas that are more than 1 mile away from system trails.

For alternative analysis, wilderness settings were applied to the recommended wilderness areas using the following criteria shown in table 21.

Table 21. Wilderness setting criteria for recommended wilderness areas in alternatives C and D

Existing ROS setting	Distance from system trail	Assigned wilderness setting
Roaded natural	Any distance	Semi-primitive
Semi-primitive motorized	Any distance	Semi-primitive
Semi-primitive non-motorized	0 to ¼ mile	Semi-primitive
	Greater than ¼ mile	Primitive
Primitive	0 to ¼ mile	Semi-primitive
	¼ to 1 mile	Primitive
	Greater than 1 mile	Pristine

ROS management area objectives

The mapping discussed above describes the existing ROS setting based on conditions on the ground. The interdisciplinary team identified ROS objectives for each management area, based on the desired conditions for the management area and the existing ROS setting. Table 22 shows how those assignments were made.

Table 22. ROS objectives assignments for management areas

Management Area	Existing ROS classification	ROS objective
1.1, 1.1A, 1.2, 1.2A, 1.2B	Any	Primitive
1.3	Any	Semi-primitive non-motorized
1.5A	Roaded natural or semi-primitive motorized	Semi-primitive motorized
	Semi-primitive non-motorized	Semi-primitive non-motorized
1.6A, 1.6B, 2.2A, 2.3	Any	Semi-primitive non-motorized
3.1A, 4.5A	Any	Roaded natural
3.1B	Roaded natural or Semi-primitive motorized	Semi-primitive motorized
	Semi-primitive non-motorized	Semi-primitive non-motorized
3.1C	Semi-primitive motorized or Semi-primitive non-motorized	Semi-primitive non-motorized
3.3A, 3.3C, 3.5, 3.5A, 3.5B, 3.5C, 3.5D[6]	Any	Semi-primitive motorized
3.3B	Any	Semi-primitive non-motorized
4.2, 4.3	Any	Roaded natural
5.1 or 5.2 or 5.4	Roaded natural	Roaded natural
	Semi-primitive motorized or Semi-primitive non-motorized or primitive	Semi-primitive motorized
8.2	Any	Rural

[6] 3.5B and 3.5D are both assigned to semi-primitive motorized, because of the overall objective to conduct vegetation management where some motorized activity could be expected. Objective does not change the overriding direction for what type of recreation experience is to be provided for.

Social and Economic Analysis

Social and economic impacts and economic efficiency were analyzed for each alternative. Social and economic impacts were measured in terms of changes to jobs and income. Economic efficiency was measured based on changes in present net value.

Economic Impacts

Introduction

Economic effects to local counties were estimated with input-output analysis using the IMPLAN (IMpact analysis for PLANning) modeling system (MIG 2010) and FEAST (Forest Economic Analysis Spreadsheet Tool). The IMPLAN modeling system allows the user to build regional economic models of one or more counties for a particular year. The model for this analysis used the 2009 IMPLAN data. FEAST is a spreadsheet modeling tool that serves as an interface between user inputs and imported data from an existing IMPLAN model.

Input-output analysis is a means of examining relationships within an economy, both between businesses and between businesses and final consumers. It captures all monetary market transactions for consumption in a given time period. Economic impact analysis is defined as “the net change in economic activity associated with an industry, event, or policy in an existing regional economy” (Watson et al. 2007). By using Forest Service expenditure data, resource output data, and other economic information, IMPLAN can describe, among other things, the jobs and income that are supported by NFS management activities. The direct employment and labor income benefit employees and their families and therefore directly affect the local economy. Additional indirect and induced, multiplier effects (ripple effects) are generated by the direct activities. Together the direct and multiplier effects comprise the total economic impact to the local economy. The data used to estimate the direct effects from timber harvest is information provided by University of Montana’s Bureau of Business and Economic Research. The data used for estimate the direct effects from livestock grazing includes price information from the U.S. Department of Agriculture’s Economic Research Service and expenditure information from University of Idaho livestock budgets. The data used to estimate the direct effects from recreation is information from the Forest Service’s latest National Visitor Use Monitoring (NVUM) report for the Shoshone National Forest and Shoshone National Forest recreation permits records. The economic effects tied to other Forest Service programs and the multiplier effects were estimated using IMPLAN. Resource specific data (recreation visits, animal unit months of grazing, timber volume harvested, etc.) were collected. For current management levels, a 3-year average using 2008 to 2010 data were calculated for resources to eliminate the year to year variability inherent in the data.

Procedures

To estimate the economic impacts to the Shoshone National Forest area economy, one IMPLAN model covering three counties was developed. The counties included Fremont, Hot Springs, and Park counties in Wyoming. This area defines the functional social and economic planning area. Labor flows between towns and counties are generally contained within these three counties. Flows of labor, goods, and services between this area and other counties are not captured in the model, but considered as exports or imports.

Impact analysis describes what happens when a change in final sales (e.g., to non-residents—or exports—and governments) occurs for goods and services in the model region. Changes in final sales are the result of multiplying production data (e.g., cubic feet of timber or recreation visits by non-locals) times sales. Economic impacts were estimated using the best available production and sales data.

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. The income measure used was labor income expressed in 2009 dollars. Labor income includes both employee compensation (pay plus benefits) and proprietor income (e.g., self-employed).

The planning area model was 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. Methods for developing response coefficients and levels of dollar activity are explained below.

Data and Assumptions

Timber Production

Current levels were developed from historic harvest levels on the forest. Products were broken out by sawtimber, products other than logs, and salvage. For the alternatives, timber production levels were derived using the Spectrum model. It was assumed that the predicted timber sold in the model would be harvested in the same timeframe. Because the vast majority of timber volume was sawtimber and because there are no longer any large-scale sawmills in the study area, the analysis only considered the economic impact of logging for the timber harvest with lumber processing assumed to occur outside the study area.

The data used to estimate the direct effects from timber harvest were developed by University of Montana's Bureau of Business and Economic Research for the Central and Southern Rocky Mountain Region, which includes Wyoming. The indirect and induced effects were generated by the IMPLAN model.

General and Commercial Recreation

General recreation visitor days were calculated using the most recent National Visitor Use Monitoring (NVUM) data for the Shoshone National Forest. The current level was based on the most recent data collection, which occurred in fiscal year 2009. Recreation figures were held constant for all alternatives.

In addition to the general recreation use of the Shoshone National Forest, a number of commercial recreation businesses also operate on the Forest. Much of this recreation activity is probably not captured in the NVUM data. Shoshone National Forest data on the recreation permit fees associated with this commercial recreation activity were used to estimate the direct impacts of the commercial recreation use on the forest. The estimates of secondary impacts for both general and commercial recreation were generated by the IMPLAN model.

Grazing

Due to variability in livestock prices, a 10-year average price (2000 to 2009) is used in the analysis. In order to make the analysis more reflective of the livestock industry in the study area the “analysis-by-parts” procedure, based on a 2010 University of Idaho livestock budget for a 500 head cow-calf ranch, was used to input the expenditure data into the IMPLAN model for the study area. Three firm-level perspectives were considered in the economic assessment including: (1) evaluating Forest Service animal unit months (AUMs) only, (2) evaluating Forest Service AUMs in terms of their impact on ranch productivity, and (3) evaluating Forest Service AUMs in terms of their impact on ranch viability. These perspectives were based on a previously developed multi-period linear program model for Federal lands-dependent ranches in Wyoming. For the economic analysis, impacts were considered under the third level, or evaluating Forest Service AUMs in terms of their impact on ranch viability.

The direct, indirect, and induced effects from changes in grazing levels were generated by the IMPLAN model. The levels of livestock grazing were varied by alternative, based on estimates from the Shoshone.

Minerals

Because the Shoshone has had little or no mineral activity for the last 25 years, projections are for a low probability of any development during the planning period, and projections that any development that did occur would be the same in all alternatives, no economic analysis of minerals was conducted.

Federal Expenditures and Employment

Total employment and salaries paid by the Forest Service were based on a 3-year average for 2008 to 2010. Total Forest expenditures were also based on a three-year average (2008 to 2010). The direct, indirect, and induced effects from changes in forest expenditures and employment were generated by the IMPLAN model. The levels of forest expenditure varied by alternative based on estimates from the Shoshone National Forest.

Output Levels

Table 23 displays the output levels that were used to perform the economic impact analysis.

Table 23. Resource outputs by alternative used for economic impact analysis

Activity	Units	Alt A	Alt B	Alt C	Alt D	Alt E	Alt F	Alt G
Saw Timber	Mcf/decade	14,634	14,211	12,543	13,574	18,782	25,848	14,211
POL	Mcf/decade	804	764	715	735	1,030	1,400	764
Salvage	Mcf/decade	1,564	1,578	1,631	1,576	2,328	3,264	1,578
Livestock Grazing	AUMs/year	55,881	55,881	31,401	55,881	58,329	61,497	55,881
Non-local Day Trips	Trips/year	96,909	96,909	96,909	96,909	96,909	96,909	96,909
Non-local Overnight on Forest	Trips/year	32,303	32,303	32,303	32,303	32,303	32,303	32,303
Non-local Overnight off Forest	Trips/year	96,909	96,909	96,909	96,909	96,909	96,909	96,909
Local Day Trips	Trips/year	284,266	284,266	284,266	284,266	284,266	284,266	284,266
Local Overnight on Forest	Trips/year	25,842	25,842	25,842	25,842	25,842	25,842	25,842
Local Overnight off Forest	Trips/year	19,382	19,382	19,382	19,382	19,382	19,382	19,382
Non Primary Trips	Trips/year	90,448	90,448	90,448	90,448	90,448	90,448	90,448

Economic Efficiency

Economic efficiency is defined as how well the dollars invested in each alternative produce benefits to society. Present net value was used as an indicator of economic efficiency.

To calculate present net value, a spreadsheet was used which tracks revenues, costs, and benefits for a 50-year period. Built into the spreadsheet were predicted increases and decreases to output levels over time. A 4 percent discount rate was used.

Table 24 displays the economic values that were used for each resource. All values were input as 2012 dollars. The values were derived from different sources. Timber revenues were those reported by the Spectrum model. Range values were based on the rate for private grazing fees for 2008 in the State of

Wyoming. Recreation, fish, and wildlife values were based on an analysis of the National Visitor Use Monitoring data (Bowker et al. 2009) and a draft report on Resource Planning Act (RPA) non-market values (Retzlaff 2010). Costs were a 3-year average of actual expenditures by program area for fiscal years 2008 to 2010.

Table 24. Values used for present net value analysis

Activity	2012 Dollar Value	Source
Sawtimber (M$)	$31.90	From spectrum model by alternative
Mixed dead/green sawtimber	$17.00	From spectrum model by alternative
Fuelwood/POL	$ 7.50	From spectrum model by alternative
Livestock grazing (AUMs)	$19.12	
Recreation ($/Visit)		
Camping	$31.53	Retzlaff 2010 RPA updates
Motorized Recreation	$51.46	Retzlaff 2010 RPA updates
General Recreation	$24.22	Retzlaff 2010 RPA updates
Hiking	$97.62	Retzlaff 2010 RPA updates
Nature-based Recreation	$40.35	Retzlaff 2010 RPA updates
OHV Use	$66.12	Retzlaff 2010 RPA updates
Primitive Camping	$32.51	Retzlaff 2010 RPA updates
Picnicking	$50.98	Retzlaff 2010 RPA updates
Skiing, Alpine	$199.80	Retzlaff 2010 RPA updates
Snowmobiling	$182.56	Retzlaff 2010 RPA updates
Fish & Wildlife ($ / Visit)		
Hunting	$47.19	Retzlaff 2010 RPA updates
Fishing	$70.17	Retzlaff 2010 RPA updates
Viewing wildlife and nature	$40.08	Retzlaff 2010 RPA updates

References

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Alternative Objective Development

The revised forest plan contains a number of objectives that identify desired results to be achieved within the planning period to help meet plan goals. Most of these objectives remain constant across the action alternatives. However, in seven of these objectives, the results vary in the action alternatives. Table 25 contains a short discussion of those objectives and how they were varied across the alternatives for the analysis.

Table 25. Objectives to help meet plan goals and how they compare among the alternatives

Objective	Alternative variation	Rationale
Increase aspen cover type on #### acres using mechanical treatments.	B, D, E, F = 2,500 ac. C = 2,000 ac. G = 3,500 ac.	The 2,500-acre number for alternative B was the initial objective for the proposed action and was established by the interdisciplinary team based on the desired condition, current capability, and input from the public, including Wyoming Game and Fish, asking for an aggressive objective. Consideration for varying the number across the alternatives included suitable acres and generally accessible acres. The number is reduced in alternative C because of the addition of wilderness and a reduction in managed lands. In alternatives E and F, acres don't go up even though suitable acres are up. The reason is that there is more suitable land where commercial timber is a goal and there will be more pressure to favor conifer over aspen because aspen is not a commercial species. Alternative A does not have an objective. The objective was raised in alternative G. The objective was raised in response to public comment to further emphasize aspen and the climate change analysis, which indicates the area suitable for aspen expansion is likely to expand.
Restore ### acres of whitebark pine	A, B, D, E = 750 ac. C = 500 ac. F = 1,250 ac. G = 1,400 ac.	The 750 acres for alternative B was the initial objective for the proposed action. There is a desire for a higher objective, but until more rust-resistant planting stock is available, the interdisciplinary team felt a more measured approach is best. The variation across the alternatives is based on differences in suitable acres and generally accessible acres. The objective was raised in alternative G. The objective was raised in response to public comment to further emphasize whitebark pine and latest assessment from the interdisciplinary team that a higher objective is feasible.
Use treatments to reduce invasive plant species on #### acres	A, B, D, E, G = 2,000 ac. C = 1,500 ac. F = 3,000 ac.	The 2,000 acres for alternative B was the initial objective for the proposed action and is based on the level of treatment that is currently occurring. The variation across the alternatives was based on suitable acres and generally accessible acres. Mid-range alternatives are relatively close for these numbers, so only the more extreme alternatives were varied.
In management area categories 4, 5, and 8 hazardous fuels ratings are reduced on ##### to ##### acres.	A, B, C, D, G = 30,000 – 40,000 E = 35,000 – 45,000 F = 45,000 – 55,000	These numbers are based on accomplishments in the last 10 years. Budgets have generally been adequate for accomplishing this work in the last 10 years and it is felt that capacity (internally and externally) for accomplishing the work was the major limiting factor. Though there was a desire to consider increasing the level, given budget projections for the planning period, the interdisciplinary team does not project that it will be possible to increase capacity and it is very likely that available dollars will decrease. Alternative variation is based on a proration of acres tied to management area allocations, suitable acres, and generally accessible acres.

Table 25. Objectives to help meet plan goals and how they compare among the alternatives

Objective	Alternative variation	Rationale
Permitted animal unit months will range between plus or minus 10 percent of ##### animal units months.	A, B, D, G = 60,000 C = 35,000 E = 77,500 F = 81,500	60,000 AUMs for alternative B were the initial objective for the proposed action based on the permitted stocking levels for the last 10 years. Variations on the alternatives are based on changes in suitable acres, considering current stocking rates.
Annual timber sold averages ##### Ccf	A = 17,000 B, G = 16,500 C = 14,900 D = 15,900 E = 22,100 F = 30,500	These numbers are based on the spectrum analysis for the plan revision and are a function of suitable timber acres, management area allocations, and timber budget projections (see Spectrum analysis and budget projection sections).
At least # new, wheeled motorized trail loop opportunities are developed	B, G = 3 loops D = 1 loop E = 4 loops F = 8 loops	The 3 new loops for alternative B were the initial objective for the proposed action based on interdisciplinary team input considering budget levels. The remaining numbers were calculated by prorating based on management area acres open to motorized trail construction, alternative B having 3 new loops, and alternative C having 0 new loops.

Alternative Budget Level Projections

Alternative output projections take into consideration projected future budgets. The starting point for budgets was based on the forest average of the last 6 years (2006 to 2011). This cutoff was used because budgets prior to 2006 used different accounting to allocate administrative costs and numbers across the different resource program areas are not comparable. Though it is unknown what will happen with future budgets, it is likely, given the current state of the national budget, that the trend will be downward during at least the first part of the planning period. What happens in the latter half of the planning period is unknown. Other than the specific items mentioned below, the interdisciplinary team felt that a flat budget projection was the best way to do a comparative analysis of the alternatives. This flat budget is in line with alternative A – the no-action alternative. Most of the projected outputs in the alternatives are relatively close and could be produced under the flat budget scenario.

The interdisciplinary team did vary projected budget levels for three program areas in some alternatives, based on the assumption that the variation in the alternative would result in some redistribution of budget allocation.

The first of these is for the trails program. In alternative F, the large increase in acres allocated to back country motorized recreation is large enough that there would likely be a change in emphasis to building motorized trails that could not be accommodated within the current budget scenario. In alternative F, the projected budget for trails is doubled.

The other two items that are varied across the alternatives are the forest products program and planting costs with the vegetation and watershed management program. These budget items are usually varied based on opportunity for forest products program costs and need for planting costs under current budget processes. The forest products program was varied proportionally based on suitable timber acres in the alternatives. The planting program was varied based on harvest levels and associated planting needs in the alternatives. The current levels for these programs were indexed to alternatives A and B as the starting point.

Table 26 displays the projected budget scenarios for the alternatives.

Table 26. Project program budget levels for the alternatives (thousands of dollars)

Program area	2006-2001 average program budget	Alt A	Alt B	Alt C	Alt D	Alt E	Alt F	Alt G
Facilities Maintenance	$220	$220	$220	$220	$220	$220	$220	$220
Roads Capital Improvement	$720	$720	$720	$720	$720	$720	$720	$720
Trails Capital Improvement	$420	$420	$420	$420	$420	$420	$840	$420
Facilities Assessment	$180	$180	$180	$180	$180	$180	$180	$180
Inventory and Monitoring	$530	$530	$530	$530	$530	$530	$530	$530
Lands Ownership Management	$140	$140	$140	$140	$140	$140	$140	$140
Minerals and Geology	$50	$50	$50	$50	$50	$50	$50	$50
Land Management Planning	$350	$350	$350	$350	$350	$350	$350	$350
Grazing Management	$270	$270	$270	$270	$270	$270	$270	$270
Recreation, Heritage, Wilderness	$1,240	$1,240	$1,240	$1,240	$1,240	$1,240	$1,240	$1,240
Forest Products	$750	$750	$750	$680	$720	$1,000	$1,400	$750
Vegetation and Watershed Management	$700	$700	$700	$625	$700	$750	$840	$700
Wildlife and fish Management	$640	$640	$640	$640	$640	$640	$640	$640
Hazardous Fuels Reduction	$1,140	$1,140	$1,140	$1,140	$1,140	$1,140	$1,140	$1,140
Wildfire Preparedness	$1,230	$1,230	$1,230	$1,230	$1,230	$1,230	$1,230	$1,230
Administrative Management	$1,920	$1,920	$1,920	$1,920	$1,920	$1,920	$1,920	$1,920
TOTAL	$10,500	$10,500	$10,500	$10,355	$10,470	$10,800	$11,710	$10,500

Benchmark Analysis (new section)

A benchmark analysis was included in the Analysis of the Management Situation (AMS) to help guide the formulation of alternatives to the proposed action in the DEIS. A benchmark analysis provides baseline data to support the formulation of alternatives, and aids in defining the range within which alternatives can be constructed. Benchmarks estimate the Shoshone's physical, biological, and technical capabilities to produce goods and services. Benchmarks are focused on the revision topics and need for change.

In response to public comment, the Benchmark analysis was revisited between draft and final. There was a request for further discussion on monetary benchmarks and there was an overall desire to ensure the sufficiency of the benchmark analysis. During development of the alternatives in cooperation with the public and local governments some of the alternatives ended up outside of the range established by the

benchmarks. This was the result of some of the original constraints and assumptions used in the benchmark analysis being relaxed in the development of the alternatives. To remedy this situation the benchmark analysis was reviewed and reworked to make the assumptions consistent within the context of the suite of alternatives. In addition, acre allocations were recalculated using the latest GIS data used for the FEIS analysis.

Additional information is included here that was not available during the development of the alternatives. The new information is still consistent with the information presented in the DEIS that was used in crafting a range of alternatives. The information provides some additional numbers for comparison and ensures that the numbers are comparable between the benchmarks and the alternatives. In some cases numbers have been developed to supplement the descriptions used in the DEIS. There is no new information that changes the potential range of resource options considered in the DEIS.

For each benchmark, a scale is presented that shows where the alternatives fall within the decision space defined by each particular benchmark.

This presentation replaces the benchmark analysis in the AMS and was used to inform the decision maker's final decision.

Maximum timber

This benchmark represents the maximum potential area of the Shoshone that can be classified as suitable for timber production. Forest land not considered as suitable for timber production in this benchmark analysis includes land unavailable through statute or administrative action (such as wilderness), and lands defined as physically unsuitable for timber production such as non-forest lands, steep slopes, and high and low elevations sites. This benchmark represents the highest possible timber harvest volume consistent with the principles of non-declining flow and harvests that do not exceed the long-term sustained yield.

Table 27. Acre allocation for maximum timber benchmark

	Max Timber
Lands generally not suited for timber harvest	
Wilderness, Dunoir, High Lakes, wild river, RNA, SIA	1,418,000
Rock, steep slopes, Restocking not assured	346,300
Total lands generally not suited for timber harvest	1,764,300
Lands generally not suited for timber production	
Grass, shrub, noncommercial species, soil type	323,800
Total lands generally not suited for timber production	323,800
Lands generally suitable for timber production	
Suitable acres	349,900
Total lands generally suitable for timber production	349,900
Total Forest Acres	2,438,000

This acre allocation would result in an annual harvest that would average 64,875 Ccf during the next decade. The harvest for this benchmark is interpreted based upon the acre versus volume relationship represented in alternative F. The following scale displays how the alternatives fall relative to the maximum suitable acres represented by the timber benchmark.

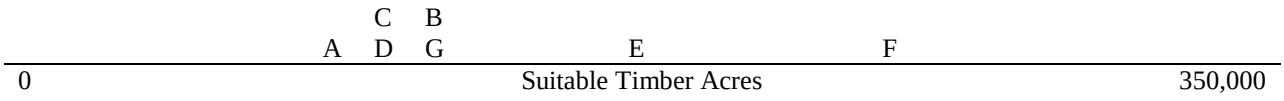

Figure 1. Relationship of suitable timber acres for each alternative to the maximum timber benchmark suitable acres

Maximum commercial livestock grazing

This benchmark represents the maximum potential area of the Shoshone that can be classified as suitable for commercial livestock grazing. National Forest System land not considered suitable for commercial livestock grazing in this benchmark analysis includes land removed through statute or administrative action (such as wilderness). Grazing that occurred when a wilderness was designated is included, but there is no expansion into wilderness that was not grazed at the time of designation. Allotments that preexisted wilderness and that are not currently being grazed are also included. In addition, lands defined as physically unsuitable for grazing such as steep slopes and rock are not included.

Table 28. Acres capable and suitable for livestock grazing in the maximum grazing benchmark

	Max Grazing
Capable acres	993,600
Suitable acres	416,200

This acre allocation would provide 61,670 AUMs of commercial grazing annually. The AUMs for this benchmark are interpreted based upon the acre versus AUM relationship represented in alternative F. The following scale displays how the alternatives fall relative to the AUMs represented by the grazing benchmark.

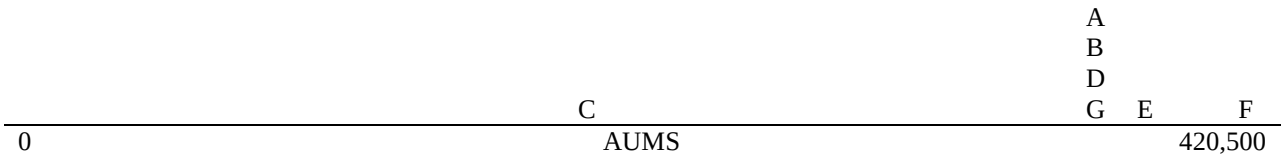

Figure 2. Relationship of AUMs for each alternative to the maximum grazing benchmark AUMs

Maximum oil and gas

This benchmark represents the maximum potential area of the Shoshone that would allow surface occupancy for oil and gas development. National Forest System land not considered as suitable for oil and gas development in this benchmark analysis includes land removed through statute. Those lands include designated wilderness, High Lake Wilderness Study Area, Dunoir Special Management Unit, and Clarks Fork Wild River which includes 1,416,200 acres in aggregate. The remaining 1,021,800 acres are suitable for surface occupancy under this benchmark.

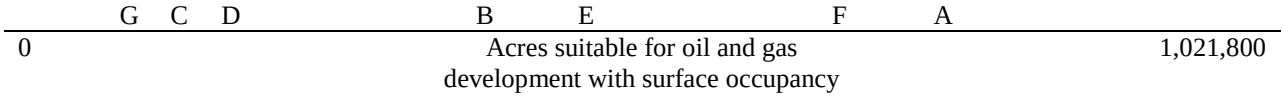

Figure 3. Relationship of acres suitable for surface occupancy for oil and gas development for each alternative to the maximum oil and gas benchmark

All of the alternatives have the same likelihood of oil and gas development given the low potential for development on the Shoshone. See the FEIS discussion for further information.

Maximum motorized summer recreation

This benchmark represents the maximum potential area of the Shoshone that can be classified as suitable for summer motorized recreation. National Forest System land not considered as suitable for summer motorized recreation in this benchmark includes land removed through statute or administrative action. Those lands include designated wilderness, High Lake Wilderness Study Area, Dunoir Special Management Unit, Line Creek RNA, and Swamp Lake SIA which includes 1,411,100 acres in aggregate. In addition, physically unsuitable lands (slopes greater than 40 percent), representing 322,300 acres are excluded. The remaining, 704,300 acres are identified as suitable for summer motorized recreation in this benchmark.

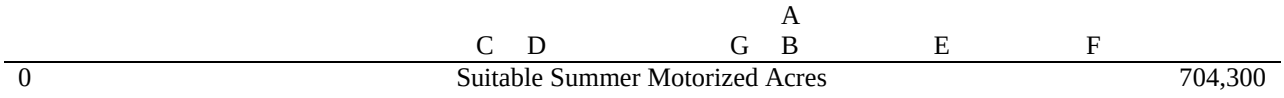

Figure 4. Relationship of acres suitable for summer motorized recreation for each alternative to the maximum summer recreation benchmark.

Maximum motorized winter recreation

This benchmark represents the maximum potential area of the Shoshone that can be classified as suitable for winter motorized recreation. National Forest System land not considered as suitable for winter motorized recreation in this benchmark includes land removed through statute or administrative action (such as wilderness). This also includes the portion of Line Creek Plateau Research Natural Area, which is not open to snowmobiling, designated wilderness, and the Dunoir Special Management Unit. This benchmark is also consistent with direction for the High Lakes Wilderness Study Area, which allows snowmobile use. Total acres suitable for winter motorized use in the benchmark is 1,042,800 acres.

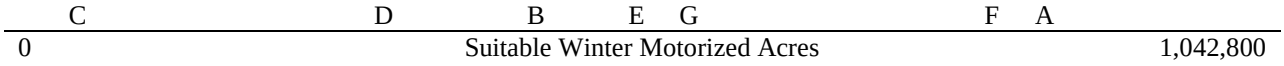

Figure 5. Relationship of acres suitable for winter motorized recreation for each alternative to the maximum winter recreation benchmark

Maximum non-motorized recreation

This benchmark represents the maximum potential area of the Shoshone that can be managed for summer non-motorized recreation. National Forest System land not considered as available for non-motorized recreation in this benchmark includes land already accessed by forest roads designed for passenger cars that are open to the public. The ROS inventory was used as the basis to make this calculation and to compare alternatives. The roaded natural category represents those lands that are within 0.5 mile of a road designed for passenger car use. For this benchmark, that represents 156,700 acres. The remaining acres amounting to 2,281,400 would be managed for non-motorized recreation in this benchmark.

Figure 6. Relationship of acres of non-motorized recreation for each alternative to the maximum non-recreation motorized recreation benchmark

The asterisk (*) on the above scale represents that point at which designated wilderness acres fall on the scale.

Maximum recommended wilderness

This benchmark represents the maximum recommended wilderness areas for the Shoshone. All areas identified in the evaluation of potential wilderness are included, which amounts to 745,600 acres. Acres of existing wilderness are not included in the total, since they have already been designated.

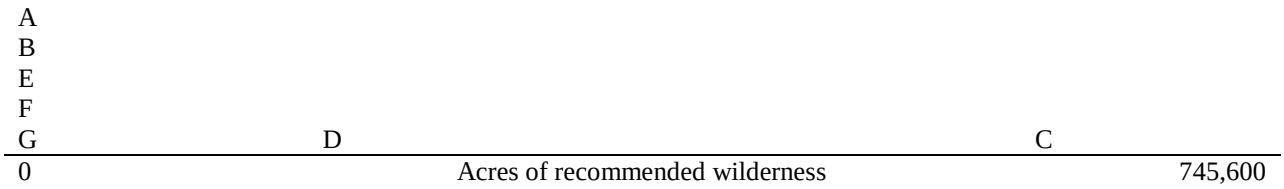

Figure 7. Relationship of acres of recommended wilderness for each alternative to the maximum recommended wilderness benchmark.

Maximum grazing and timber labor income

This benchmark represents the maximum labor income that would result from maximizing the use of the forest for grazing livestock and producing timber. It provides a surrogate for comparing the alternatives and their contributions to the markets for livestock and timber. The benchmark includes the acres allocations for the maximum grazing and maximum timber benchmarks. Labor income for the benchmark was interpreted based upon the labor income for alternative F in comparison to suitable acres allocations. For this benchmark the average annual labor income for the next decade associated with grazing and timber production would be $13,519,000.

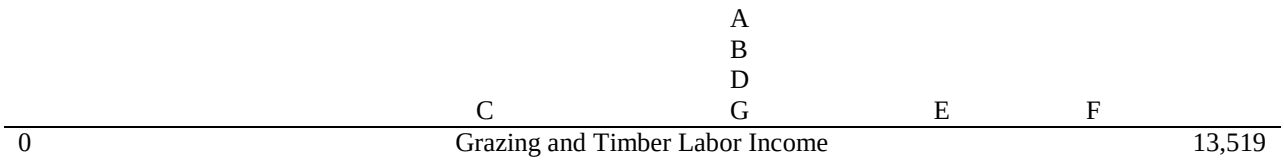

Figure 8. Relationship of grazing and timber income for each alternative to the maximum grazing and timber labor income benchmark.

Benchmark not analyzed

No monetary benchmarks were completed for the AMS. Some public comment on the DEIS noted this and requested that a maximum present net value benchmark be completed. They commenter cited both a desire to have the information to examine the range of alternatives and a concern that the lack of the benchmark would make the plan revision effort deficient.

In general, Region 2 policy used by other Forests in the region does not require monetary benchmarks to be completed for plan revision. The regional position is that they have limited utility. Theoretically, the information generated by such benchmarks would provide a solid focal point from which a decision

maker could evaluate economic opportunity costs and resource trade-offs. This is not the case. The allocation and scheduling models used in estimating these benchmarks are very sensitive to changes in the values used. Since the "assigned values" we use are often untenable based on the assumptions used, the results of these benchmark analyses do not provide a solid footing for making plan revision decisions.

The requirement to analyze these benchmarks assumes that an allocation/scheduling model can be built which adequately represents all resources having "an established market value or an assigned value." This is not the case. Our knowledge of the joint production functions within national forest ecosystems is not sufficient to adequately quantify all inputs and outputs as required in the deterministic models currently being used for forest planning analysis. This provides another reason for not relying on these benchmarks to provide meaningful information to the decision maker.

For these reasons, the decision maker has chosen to not produce a PNV benchmark. In order to address some of the public comment, a benchmark is included that represents the maximum labor income for grazing and timber. The interdisciplinary team feels that the information available to produce this benchmark is adequate to provide a meaningful comparison across the alternatives. This does not totally address the public comment since it does not include recreation outputs. As discussed elsewhere in the FEIS, the information to develop production functions for recreation outputs does not exist in a form that would allow for meaningful comparison of alternatives. In discussions with the public commenter, they were also unable to identify any information that could be used to conduct an analysis for recreation.

Another benchmark that was not completed was the minimum level benchmark which represents the least amount of management needed to maintain and protect the Shoshone as part of the National Forest System. The minimum level benchmark represents only those costs and outputs associated with protecting and managing activities and investments where there is little or no management discretion. Although incidental outputs are permissible, there will be no management action-related timber or recreation outputs. Forest vegetation will evolve through natural succession. The decision maker does not feel this benchmark is necessary to inform their decision.