Appendix B
Description of the Analysis Process

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Introduction

The preparation of the Forest Plan, including a Final Environmental Impact Statement, is required by the Forest and Rangeland Renewable Resources Planning Act (RPA) of 1974 as amended by the National Forest Management Act (NFMA) of 1976. The planning regulations promulgating these acts are found within the Code of Federal Regulations, Title 36, Part 219 (36 CFR 219). The Chequamegon-Nicolet National Forests (CNNF) are accomplishing revision of their 1986 Plans under the 1982 version of 36 CFR 219, which is required at least every 15 years.

The purpose of Forest Planning is to identify and select for implementation a Forest Plan alternative that provides "… for multiple use and sustained yield of goods and services from the National Forest System in a way that maximizes long-term net public benefits in an environmentally sound manner" (36 CFR 219). Net public benefit is defined to be "…the overall long-term value to the nation of all outputs and positive effects (benefits) less all associated inputs and negative effects (costs) whether they can be quantitatively valued or not. Net public benefits are measured by both quantitative and qualitative criteria and there is no single measure or index. The maximization of net public benefits to be derived from management of the National Forest System is consistent with the principles of multiple use and sustained yield" (36 CFR 219).

Congress required that each Forest Plan must provide for the following three items:

- Maintenance of long-term productivity of the land. The land must be maintained in a condition that will not impair its capability to produce future outputs of goods and services.
- Coordination and integration of planning activities for multiple use management. Each resource must be considered equally in the planning process. At a minimum, no resource is emphasized to the exclusion or violation of the minimum or threshold management requirements of other resources. Minimum management requirements guide the development, analysis, approval, implementation, monitoring, and evaluation of the forest plan.
- Cost efficient management prescriptions. Management alternatives shall be the most cost efficient combination of management prescriptions examined that meet the objectives of each alternative management plan.

The following five items are required to be analyzed/determined as part of the development of Forest Plan alternatives:

- The maximum physical and biological potentials of significant goods and services together with associated costs and benefits;
- The potential to resolve public issues and management concerns;
- The allowable sale quantity (ASQ) of timber;

- Use of a systematic interdisciplinary approach to ensure coordination and integration of planning activities for multiple use management; and
- Establishment of quantitative and qualitative Standards and Guidelines.

The Final Environmental Impact Statement (FEIS) for the revised Forest Plan evaluates nine management alternatives (the current Plans, and eight others), and displays the rationale for choosing the Selected Alternative as the alternative that best maximizes long-term net public benefits in an environmentally sound manner.

This Appendix describes thirteen steps in the Forest Plan revision process (see ***Planning Process Framework***) and, in the discussion of these steps, references are made to data collection, inventory, and analysis processes important to the Forest Plan revision. These additional processes are described in further detail in the ***Inventory Data and Information Collection***, ***Effects of Alternatives*** and ***Social and Economic Analysis*** sections of this Appendix.

Planning Process Framework

The above-listed requirements demonstrate the complexity of resolving natural resource management planning issues. Numerous resource specialists, analytical tools, and quantitative methods were used to separate complex problems into manageable parts—enabling forest management to identify quantitative and qualitative trade-offs among the alternatives. The process used to develop and analyze alternative management scenarios is based on planning steps specified in NFMA regulations.

Step 1: Identify the Purpose and Need

The issues, concerns, and opportunities (identified early in the Forest Plan revision process) were used to develop the Goals and Objectives that give purpose to the Land and Resource Management Plan (LRMP). A series of public meetings were organized after the Forest Supervisor determined that a revision was needed. The public was encouraged to comment on the preliminary issues and the four major revision topics identified in a "Notice of Intent" to prepare an environmental impact statement for revising the existing forest plans (June 20, 1996). The four major revision topics within the Notice of Intent are:

1. Access and recreation opportunities
2. Biological diversity
3. Special land allocations
4. Timber production

These four topics became the focus of the Forest Plan revision effort. Appendix A contains details about problem statements and major issues, concerns, and opportunities. Chapter 1 of the FEIS, Purpose and Need, provides a brief narrative description of the problems and findings associated with each.

Step 2: Develop Planning Criteria

A part of the planning process is development of planning criteria whose purpose is "…to guide the planning process. Criteria apply to collection and use of inventory data and information, analysis of the management situation, and the design, formulation, and evaluation of alternatives. Criteria designed to achieve the objective of maximizing net public benefits shall be included" (36 CFR 219.12 (c)). Various laws, executive orders,

regulations, and agency policies provided the basis for planning criteria. Public issues and management concerns and the plans and programs of other government agencies also contributed to their development.

Planning criteria for the Chequamegon-Nicolet Nation Forests' plan revision were developed in two sub-categories for the Chequamegon-Nicolet National Forests' revision effort:

1. *Principles to guide the overall forest planning process* -- These principles addressed the Forests' management philosophy, public involvement efforts, the preparation of documents, scale of analysis, collaboration, and consultation with tribal governments and other agencies, and the use of information, classification systems, and science.
2. *Factors (expressed in terms of decision criteria) to provide a basis for alternative development, and selection of a preferred alternative* -- These factors/decision criteria are specific criteria designed to aid in the development of alternatives, the analysis and evaluation of the alternatives, and the selection of the alternative which provides maximum net public benefits—given current issues, concerns, and opportunities. These criteria primarily address responses to issues and concerns, areas of public interest, cost efficiency, and environmental consequences, and can be subdivided into those that address each of the four major revision topics. The decision criteria (DC) used to develop the alternatives within the Draft Environmental Impact Statement (DEIS) and to select one of these as the basis for developing the Proposed Plan are summarized below, by major revision topic, including a listing of the indicators considered for each criterion.

Access and Recreation Opportunities

DC: Providing quality opportunities for ATV/ORV recreation within acceptable standards of environmental quality. This criterion will also include a policy that is more balanced between the two Forests.

DC: Providing the maximum transportation system for recreation and natural resource management, while focusing limited maintenance funds on fewer corridors. In addition, road terminology and inventory accuracy are consistent between forests.

Indicators (for both decision criteria listed above):

- Maximum ATV connector, route and trail miles potentially available by Forest
- Months of ATV access per year
- Commonality of ATV policies between the Forests
- Estimated miles of ATV trail to be closed due to non-motorized area allocations
- Miles of ORV (4WD) designated trail
- Projected decrease in roads available to the driving public due to Open Road Density designations
- Projected decrease in total corridors due to Total Road Density upper limit zones

DC: Opportunities for non-motorized recreation, which give the sense of remoteness and solitude, in areas that contain high quality recreation characteristics, such as excellent scenery, and/or plentiful fish and game.

Indicators:

- Acres recommended as Wilderness Study Areas
- Relative qualities of recommended Wilderness Study Areas
- Acres proposed as Semi-Primitive Non-Motorized 6A Management Areas
- Acres proposed as Semi-Primitive Non-Motorized 6B Management Areas
- Relative qualities of proposed 6A and 6B areas
- Spatial arrangement of Wilderness, Wilderness Study Areas, and SPNM areas

Biological Diversity

DC: Maintenance or restoration of ecosystems that provide for species viability, movement toward sustaining systems that are underrepresented in the regional landscape, and progress toward approximating the range of natural variability.

Indicators:

- Total acres of open-land management and number of blocks (>1,000 acres) of openland management
- Acres of Interior Northern hardwood (landscape scale), Red/White Pine, and oak/pine Management Area emphases
- Estimated acres of Interior Northern Hardwood and total interior forest projected at 100 years
- Number and total area of patches greater than 40,000 acres that emphasize northern hardwood management (Northern Hardwoods Core Areas)
- Projected percent of National Forest composed of the Aspen forest type, currently, in 10 years, and in 100 years.
- Percent of the Forests' landbase allocated in Management Areas described as Alternative Management Areas (MA 2B, 3B, 4B and 4C).

Special Land Allocation (Research Natural Areas and Special Management Areas)

DC: Due to the value of the candidate and currently designated Research Natural Areas (RNAs) and Special Management Areas (SMAs) to maintaining and/or enhancing biological diversity on the Forests, the areas (and acreage) allocated to these designations are constant across all alternatives (except the current Plans) and have been included as part of the Minimum Level Benchmark.

From an ecological standpoint, all candidate and designated RNAs and SMAs are considered to be ecological reference areas that provide the following benefits:

- Act as refugia for rare species: approximately 50 to 60 percent of rare species locations on the Forests occur within these Ecological Reference Areas.
- Act as recovery areas for rare species. The ecological characteristics provided by the areas are the same as those that many rare species require.
- Act as controls for research and monitoring. Ecosystem restoration activities are prescribed in several Management Areas within the Plan revision. Ecological Reference Areas that are remnants of natural vegetative communities allow comparison for restoration effectiveness monitoring. They also act as controls when assessing whether

monitoring results are due to management activities or to climatic changes or other factors over which the Forest Service has no control.

Timber Production

DC: An improved estimation of available timber harvest that contributes to local economic vitality, and provides for a long-term sustainable harvest.

Step 3: Collect Inventory Data and Information

Data and information needed to support the plan revision effort, some of which will be useful in implementation and monitoring the plan, were identified and gathered during the Analysis of the Management Situation (AMS) phase of plan revision and by special task teams continuing on after the (AMS). Existing inventories were assessed along with the need for new inventories. The type of data and information needed for the revision process was based primarily on the four revision topics. Task teams were assigned to identify and make available the information needed to design alternative responses to issues and information needed to analyze effects of each alternative. The following items are listed as examples of data and information collected for the revision of the Forest Plans: (1) The delineation of management areas and the criteria used to identify them; (2) Results of monitoring the previous Land and Resource Management Plans; (3) Timber inventory and yield projection information (see *Timber Resource Land Suitability Acres*); and (4) Analytical tool information, e.g., SPECTRUM model details (see *Models*; *SPECTRUM*). In addition, a forestwide roads analysis, a semi-primitive non-motorized area inventory, an ATV suitability inventory and analysis, and a landscape analysis and design inventory were conducted. All of these inventories are discussed in this Appendix.

Step 4: Analyze the Management Situation

Public comments received during the implementation of the 1986 Plans, changed conditions recognized through forest plan implementation monitoring and evaluation efforts, the availability of new information and scientific understanding, and the information gathered as a result of completing 18 resource assessments all served as indicators for the needs to change the Forests' management direction and established building blocks for Analyzing the Management Situation (AMS).

The AMS helped the Forests assess their potential to resolve resource management issues and concerns, establish a broad range of alternatives, determine its capability to supply goods and services in response to societal demands, and helped the Forest clarify the needed changes in management direction. The management problems gave an indication of the outputs, values, and benefits needed to address issues, concerns, and opportunities. The primary tasks involved in analyzing the management situation were:

1. Assessing the Forest's potential to resolve identified problems;
2. Projecting demand for recreation, timber, and wildlife outputs; and
3. Developing and analyzing benchmarks to help define economic and biological resource production opportunities, identify conflicts between market and non-market objectives, and define the range within which integrated alternatives were formulated.

The AMS reports reflect relatively recent agency direction on ecosystem management. The AMS focuses on the Forest's ability to promote healthy, sustainable ecosystems and provide high quality customer services that meet a wide variety of public needs. The

AMS documents also assess planning issue interrelationships, potentials among resource capabilities, and the question of what mix of resource outcomes, ecological conditions, and customer services should be provided.

The following AMS reports were compiled: (1) All Terrain and Off-Road Vehicles; (2) Aquatic, Riparian, and Wetland Ecosystems; (3) Ecosystem Restoration; (4) Landscape Patterns; (5) Old Growth; (6) Special Land Allocations; (7) Special Forest Products; (8) Timber Resources; (9) Wilderness and Semi-Primitive Non-Motorized Areas; and (10) Wildlife.

Step 5: Formulate Alternatives

The 1996 Notice of Intent to prepare an environmental impact statement for revising the Chequamegon and Nicolet National Forest Plans, the 18 resource assessments, the 10 Analysis of the Management Situation reports (and summarizing Problem Statements), and the planning criteria all contributed toward the formulation of alternatives. The AMS reports addressed ranges of possible alternative formulation to address each problem area. An in-depth review of the existing Forest Plans' Goals, Objectives, Standards, and Guidelines was also conducted to identify needed changes. The alternatives were formulated to respond to the planning problems, to explore a broad range of opportunity costs and tradeoffs, and to facilitate evaluating the benefits and costs of achieving various outputs and values. The planning process provided a basis for identifying the alternative that most closely maximizes net public benefits (consistent with the minimum management requirements). Management Area maps for each alternative were developed with input from district employees' with on-the-ground experience. Forest employees, local government officials, and the general public helped refine the alternatives after they were introduced through a series of local and regional public meetings.

Step 6: Analyze the Effects of the Alternatives

The physical, biological, social, and economic effects of implementing each of the eight alternatives were analyzed and compared in accordance with NEPA procedures. A more detailed discussion of this analysis can be found under *Estimating the Effects of Alternatives* and *Social and Economic Analysis* in this Appendix. Within those sections the Landscape Analysis and Design report, resource projection models, species viability evaluations and other effects analyses are described.

Step 7: Comparison of Alternatives

The Planning Team worked with other Forest staff, the Forest Supervisor, and the District Rangers to evaluate and compare the alternatives, based on planning criteria. The comparison focused strongly on the degree to which each alternative responded to the individual management problems, taking into consideration tradeoffs associated with public values that have been shared with the Forest.

Step 8: Recommend the Preferred Alternative

The outcome of the alternative comparison described above was the selection of Alternative 5 as the alternative best maximizing net public benefits. This Alternative was presented to the Regional Forester for concurrence, and then it was used as the basis for preparation of the Proposed Land and Resource Management Plan 2003 and associated DEIS.

Step 9: Publish Proposed Plan and Draft Environmental Impact Statement

Following concurrence by the Regional Forester, the Proposed Plan and Draft EIS were entered into the public record and were made available to the public in hardcopy and electronic (CD-ROM) format.

Step 10: Solicit Public Comments

Following the publication of the Proposed Plan and Draft EIS, public comments were solicited and the public was directed to focus their comments on the proposed Forest Plan as implemented under the agency Preferred Alternative (Alt.5). Public comment were received through written letters, e-mails, facsimile, and in oral statements at public hearings organized by Forest Service staff for the sole purpose of soliciting comments. A Content Analysis Team contracted by the Forest Service compiled the public comments and categorized them into public concern statements to be addressed by the Planning Team (described in Appendix A).

Step 11: Consider Public Comments and Develop a New Alternative

Based on public concerns, changes to the proposed Forest Plan and Alternative 5 (agency Preferred Alternative in the Draft EIS) were necessary to better reflect public interests, to incorporate new information, and to correct errors in the draft documents.

Step 12: Recommend the Selected Alternative

The Selected Alternative was developed from modifications to Alternative 5 and was recommended to the Regional Forester to be the basis of the *2004 Land and Resource Management Plan* of the Chequamegon-Nicolet National Forests.

Step 13: Publish the Record of Decision, *2004 Forest Plan* and FEIS

Following concurrence by the Regional Forester, the Record of Decision (ROD), the *2004 Land and Resource Management Plan* and associated FEIS were entered into the public record and were made available to the public in hardcopy and electronic (CD-ROM) format.

Inventory Data and Information Collection

Introduction

Collecting and organizing data for analysis involved the use of many different sources of information. Data were used by the Planning Team to address issues, concerns, and opportunities; determine resource potentials and limitations; quantify outputs; predict and analyze the effects of alternatives; and analyze the management situation. As an example, timber resources were identified by species, size, and condition to determine their volume and value. Specific resource information such as roadless area boundaries, wildlife game species habitat, travel systems, recreation opportunity spectrum classes, administrative boundaries, and wilderness areas were identified. Much of this data was collected and processed from existing resource inventories. Most of the collected resource information was assembled on maps and entered into the Geographic Information System (GIS).

Geographic Information Systems

Geographic Information System (GIS) was used to develop the Forest Plan Revision spatial database. The resulting database was used to analyze suitable timberlands, build SPECTRUM analysis areas, and perform a variety of analyses needed for alternative design, alternative comparison, and effects analysis. Spatial coverage used in Forest Plan Revision include:

- Management area polygons were derived from integration of land type association coverage, forest type information (from the CDS database described below), and social considerations such as proposed wilderness study areas, semi-primitive non-motorized areas, and wild, scenic, and recreational river corridors. The spatial boundaries of planning polygons remained constant through all of the alternatives. Which management area prescription was applied to each polygon varied among alternatives as a primary way of creating different reasonable approaches to resolving revision issues.
- Vegetation polygons were derived from Chequamegon-Nicolet National Forests' stand coverage. The tabular data was taken from the Combined Data System Database and "frozen" in the year 2000 for use in plan revision analyses.
- Candidate Research Natural Areas (CRNAs), Special Management Areas, and Old Growth and Natural Feature Complexes were identified in GIS using stand boundaries. Selected stands for each category were identified from the Landscape Analysis and Design Process. This process is described in more detail later in this document. The RNAs, CRNAs and SMAs remained constant throughout the alternatives but old growth selected varied by alternative.
- Other coverages are derived in whole or in part from the Chequamegon-Nicolet NF Corporate Database. These coverages include roads, trails, Recreation Opportunity Spectrum areas, land ownership, and hydrologic features (lakes, rivers, streams, and other water bodies).

Timber Inventories

Forest Vegetation Simulator (FVS), a single-tree growth model that predicts diameter and height growth as well as mortality probabilities for individual trees, was used to predict growth. Lakes States tree data in the TWIGS model was used as its basis. The FVS model aggregates individual tree information to provide stand-level estimates.

Stands having forest-type/age-class combinations needed for SPECTRUM yield analysis were identified from the Forest CDS (Combined Data Systems) databases, and plots were randomly selected from each grouping. This tree data was analyzed by the FVS model, and yield projections were made for several decades. Therefore, there is not a single growth rate used in the calculation, but a multitude of rates, calculated by the model based on Lakes States forest data, and applied to Forest-inventoried tree data for various tree species and sizes.

Age-based yield tables were then developed for forest types found on the Chequamegon-Nicolet National Forests using projections from the FVS model, yields per acre from harvests on the Forest during the period between 1987 and 1996, and volume estimates based on Forest Inventory and Analysis data.

The yield tables were used to inform the SPECTRUM model. SPECTRUM projects future outputs, long-term sustained yield, and other numbers related to forest vegetation for Alternatives. Based on projected outputs from the SPECTRUM model, the calculated

average annual net growth in cords per acre for the Selected Alternative is 0.43. More detail can be found in the planning record.

Timber Resource Land Suitability Acres

The first step in identifying land suitable for timber management is to identify the forest and non-forest lands as per 36 CFR 219.3. The following categories of lands are then subtracted from the forest lands, to determine those lands considered tentatively suitable for timber production: (1) forested lands withdrawn from timber production by Congress, the Secretary of Agriculture, or the Chief of the Forest Service, e.g., designated wilderness area; (2) forested lands not capable of producing industrial wood; (3) forest lands not that cannot be regenerated with new trees within 5 years; (4) forest lands where technology is not available to ensure timber production without irreversible resource damage to soils productivity or watershed conditions; and (5) forest lands for which there is insufficient information to make a determination.

Forest land suitable for timber production is then determined by subtracting the following lands from the tentatively suitable lands: (1) land proposed for resource uses within an alternative that preclude timber production such as proposed wilderness, and Research Natural Areas; (2) land on which minimum management requirements cannot be met in conjunction with timber management; and (3) forest lands where timber management is not cost efficient for reaching an alternative's management objectives.

Most of the variation in acres of suitable forestland among alternatives in this revision is due to the variable amounts of potential wilderness and semi-primitive non-motorized areas (with no vegetation management) assigned to each alternative. Management Areas 1-4 were classified as suitable for timber harvesting. Table B-1 displays suitable acres by alternative.

Table B-1. Timberland Suitability for the Chequamegon-Nicolet National Forests

	Land Classification	Calculations for Land Classifications 1-7 are common to all Alternatives								
		Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 9	Sel. Alt.
1	Non-Forest (includes water, roads and permanent openings)	0	203,622	203,622	203,622	203,622	203,622	203,622	203,622	203,622
2	Forest land	1,318,863	1,318,863	1,318,863	1,318,863	1,318,863	1,318,863	1,318,863	1,318,863	1,318,863
3	Lands withdrawn from timber production as designated by Congress, the Secretary of Agriculture, or the Chief of the Forest Service. Includes wilderness, Argonne Experimental Forest, Oconto River Seed Orchard, and designated Research Natural Areas (suited lands only).									
	a) Wilderness (MA 5)	44,624	44,624	44,624	44,624	44,624	44,624	44,624	44,624	44,624
	b) Argonne Exp Forest (MA 8A)	5,427	5,427	5,427	5,427	5,427	5,427	5,427	5,427	5,427
	c) ORSO (MA 8B)	649	649	649	649	649	649	649	649	649
	d) RNAs (MA 8E-only those that have been designated)	2,537	2,537	2,537	2,537	2,537	2,537	2,537	2,537	2,537
4	Forest lands not capable of producing crops of industrial wood	0	0	0	0	0	0	0	0	0
5	Forest lands physically unsuited:									
	a) Irreversible damage likely to occur (LSC 720)	3,234	3,234	3,234	3,234	3,234	3,234	3,234	3,234	3,234
	b) Not restockable within 5 years (LSC 710)	22,816	22,816	22,816	22,816	22,816	22,816	22,816	22,816	22,816
6	Forest lands-inadequate information	16,579	16,579	16,579	16,579	16,579	16,579	16,579	16,579	16,579
7	Tentatively suited forest lands	1,222,997	1,222,997	1,222,997	1,222,997	1,222,997	1,222,997	1,222,997	1,222,997	1,222,997
8	Forest lands not appropriate for timber management									
	a) T, E & S Species Habitat (LSC 801 + estimate)	26,948	26,948	26,948	26,948	26,948	26,948	26,948	26,948	26,948
	b) Project-level NEPA (LSC 809)	4,931	4,931	4,931	4,931	4,931	4,931	4,931	4,931	4,931
	c) Recreation areas (LSC 810)	2,798	2,798	2,798	2,798	2,798	2,798	2,798	2,798	2,798
	d) Not Cost Efficient (LSC 820)	47,722	47,722	47,722	47,722	47,722	47,722	47,722	47,722	47,722
	e) Excessive road costs (LSC 830)	1,367	1,367	1,367	1,367	1,367	1,367	1,367	1,367	1,367
	f) Potential wilderness (MA 5B)	0	5,803	6,991	32,737	10,734	22,619	14,002	10,418	10,483
	g) SPNM (MA 6A)	0	1,786	40,281	65,585	9,121	9,204	21,171	4,528	8,154
	h) Openland Management (MA 8C)	6,880	9,516	9,516	9,276	9,516	9,516	9,516	9,516	9,516
	i) Wild and Scenic River corridors (MA 8D)	30,427	30,427	30,427	30,427	30,427	30,427	30,427	30,427	30,427
	j) Recommended RNAs (MA 8E)	440	12,090	12,090	12,090	12,090	12,090	12,090	12,090	12,090
	k) Special Management Areas (MA 8F)	11,400	39,706	39,706	39,706	39,706	39,706	39,706	39,706	39,706
	l) Old Growth (MA 8G)	15,932	41,367	45,757	47,324	41,367	45,757	47,324	47,324	41,367
	m) Low Site Index (LSC 840)	71,397	71,397	71,397	71,397	71,397	71,397	71,397	71,397	71,397
	n) Hemlock & remaining forested lowland	68,408	53,049	53,012	49,485	51,997	51,164	52,618	52,697	51,997
9	Unsuited forest lands (items 3-6 + 8a-8n)	384,516	444,773	488,809	537,659	455,987	471,512	477,883	457,735	454,769
10	Total suitable forest land (Item 2 – 9)	934,347	874,090	830,054	781,204	862,876	847,351	840,980	861,128	864,094
11	Total National Forest Land (items 1 + 2)	1,522,485	1,522,485	1,522,485	1,522,485	1,522,485	1,522,485	1,522,485	1,522,485	1,522,485

In Alternative 1:

St.Peter's Dome Area is included in the MA 8F total.

Only 15,932 acres were designated as old growth. Allocation allowed for 67,600 acres but many acres were deferred from treatment, not designated.

In all Alternatives:

Only the acreage of MA 6A is included in item 8g. Timber management is planned in MA 6B areas. Mary Griggs Area was aded to MA 8F.

Roadless Area Inventory and Wilderness Evaluation

See Appendix C for a history and description of the Forests' roadless area inventory and evaluation for the purposes of determining areas suitable of consideration as potential Wilderness Study Areas.

Semi-Primitive Non-Motorized (SPNM) Area Inventory

Potential SPNM areas were inventoried on the Forests according to Recreation Opportunity Spectrum (ROS) descriptions developed for use in mountainous areas of the western U.S. The ROS descriptions were modified to fit Chequamegon-Nicolet National Forests' recreation settings and experiences. The modified criteria were used to map potential SPNM areas and rate the degree to which each area met these ROS criteria. Each potential area was rated high, medium, or low. Examples of criteria used to rate potential SPNM areas are the following:

Physical Setting: (1) Distance zones: Areas are greater than ½ mile but less than 3 miles from better than primitive (or better) roads; (2) Size: Area is 2,500 acres or larger in size; (3) Interior roads must be Traffic Service Level D or less; (4) Evidence of humans may

be present but such evidence should mimic natural disturbance and structures should be rare; and (5) Lakes larger than 5 acres in size should not have structures or roads within ¼ mile of shorelines and vegetation management (within ¼ mile) should be for scenery management purposes only.

Experience Characterization: (1) The area provides a moderately high probability of providing an experience of isolation, closeness to nature, and self-reliance; and (2) Access is difficult.

Setting: (1) The environment is predominantly natural appearing; (2) User interaction is low but there is visible evidence of other users; (3) The area is managed with minimum site controls and restrictions are subtle; and (4) Signs are limited (for resource protection and user safety).

There are three management designations used in the revised Forest Plan to provide for non-motorized recreational experience, other than Wilderness designation: (1) Areas that rank relatively high or moderate in meeting the SPNM criteria, and are allocated as Semi-primitive Non-motorized Areas with very little vegetation management and not inventoried as suited lands for timber management - (Management Area 6A); (2) Areas that rank relatively moderate or low in meeting the SPNM criteria, and are allocated as Semi-primitive Non-motorized Areas permitting relatively intense vegetation management (part of the suited lands – for timber production) with specific restrictions (Management Area 6B); and (3) Areas that rank relatively moderate or low in meeting the SPNM inventory criteria, and that are managed for full timber harvesting activities. The third category is not described as a distinct management area. Portions of Management Areas 1-4 are maintained with an open road density of 0 miles / square mile. These areas provide non-motorized experiences in areas of timber management, very compatible with some recreational opportunities such as hunting.

All Terrain Vehicle (ATV) Suitability Inventory and Analysis

Suitability ratings were developed for potential motorized recreation areas. Each land type association (LTA) was analyzed by an interdisciplinary group using existing Threatened, Endangered, and Sensitive species inventories, soils maps, Landscape Analysis and Design inventories, potential Alternative Management Area rankings, and the data on the presence of streams, lakes, and archeological sites.

A second stage of analysis was used to identify sensitive streams, wetlands, and more specific soil and slope characteristics. Sandy soils were considered sensitive on steep slopes where frequent vehicular use causes erosion and the formation of ravines. Silt loam soils are considered particularly susceptible to compaction and rutting. Suitability maps were developed that identified areas of the Forest that have the least suitability, intermediate suitability, or the most suitability for ATV use and new trail locations. These maps will be used in conjunction with Forest Standards and Guidelines to make future decisions on new ATV trail locations.

Forestwide Roads Analysis

The 2002 “Roads Analysis Chequamegon-Nicolet National Forest” completed a scientific and quantitative review of the Forest's Maintenance Level 3, 4, and 5 road system and integrated environmental, social and economic concerns with transportation planning for both existing and future roads. The information in the roads analysis was intended to inform the 2004 Forest Plan, future Forest Plan Amendments, transportation planning and project-level roads analyses. Data was gathered from a variety of sources including GIS

databases of: the Forest Service Road System; streams and lakes; land ownership; threatened, endangered and sensitive species and ecosystems; and soil types. The GIS analyses were used to assess the benefits, problems and risks associated with Forest roads and to identify opportunities and priorities for future management of the primary transportation system within the CNNF.

Although the scope of the roads analysis included the entire Chequamegon-Nicolet National Forest, in some cases, the analysis extended beyond the administrative borders of the Forest because discussions of social, economic, and cultural issues are often at a landscape or regional scale that covers multiple counties and ecological subsections.

Landscape Analysis and Design

Introduction

Inventory, Assessment, and Integration steps comprise the analysis phase of the Landscape Analysis and Design process (LAD). Community, ecosystem, and landscape scale inventory data were needed for revising the Forest Plans, including identification of functional representatives of the Forests' characteristic landscapes. The Assessment step established a process for restoring and protecting landscape features (ecological reference areas and alternative management areas). The integration of numerous ecological and landscape issues, concerns, and opportunities laid the groundwork for incorporating landscape design into the forest planning process. The Design Phase (through Forest Plan Revision) provides the opportunity to redesign the current landscape pattern.

The "Setting" narrative provides a brief description of past and present ecological conditions on the Forests. The "Inventory" section provides a description of the process by which sites were screened, ranked, and prioritized to develop a list of the Forests' best opportunities for ecosystem protection and representation. The "Assessment" identifies the Forests' best opportunities for landscape restoration, and provides the criteria used to rank landtype associations. The "Integration" section incorporates important landscape design issues into the forest plan revision process. The last section, "Recommended Approach for Landscape Design," provides suggestions on how to use the LAD results.

Setting

The Great Lakes Forests, covering the northern regions of Minnesota, Wisconsin and Michigan, contain a wealth of unique and diverse species, communities, and ecosystems (Curtis 1959). These heterogeneous, fragmented forests are dominated by aspen, northern hardwoods, jack pine barrens, boreal forests, peatlands, white pine, red pine and extensive wetlands. They are some of the most productive forested lands in North America. The area provides for a multitude of recreation activities such as hunting, fishing, sight-seeing, wildlife viewing and snowmobiling, and provides a variety of natural resource products such as lumber, pulp, conifer boughs, gravel, huntable wildlife, and clean water.

The Chequamegon-Nicolet National Forests are found within the Southern and Western Superior Uplands Section in the Laurentian Mixed Forest Province (Keys et al 1995). Several major glaciations and many minor ice advances and retreats created the deposits from which its present soils developed. Outwash plains and pitted outwash were dominated by frequent fires. The most frequent disturbance on mesic sites was small-scale windthrow. Approximately 1% of northern hardwood forests were affected by annual gap-phase disturbances (Runkle 1982). The forests were primarily dominated by

old growth northern hardwoods, with aspen-birch pockets on recently disturbed sites. Jack pine, white pine, and red pine persisted on droughty, fire-dominated sites.

Northern Wisconsin's forest communities were shaped by the intensive logging of the 1880s and early 1900s, followed by a brief period of agricultural homesteading. Current timber harvesting practices and the impacts of human settlements continue to shape our forest communities. The most significant changes as a result of these events include: a reduction in acres of natural white pine, red pine, and hemlock; the conversion of northern hardwoods and pineries to aspen-birch types; fragmentation of contiguous interior forest canopies; the conversion of older forests to young pole-sized stands, and the establishment of large red pine plantations (White and Mladenoff 1994, Frelich 1995, Kotar and Eckstein 1995).

Today, fire as a natural process is rare, and is not commonly used as a management tool. Deer over-winter density remains high compared to historical levels. Some plants such as Canada yew and hemlock, sensitive to deer and snowshoe hare herbivory, continue to decline (Alverson et al. 1988, Allison 1990). Road networks are improving and expanding to meet the needs of logging, housing, and recreational wild land interests. The ecological situation has been drastically altered from environmental conditions that existed for hundreds of years prior to intensive human occupation of the Lake States area. This alteration threatens the ability of some species, communities, and ecosystems to persist.

The following animals were extirpated in Wisconsin as a result of unregulated hunting and trapping: elk, wolverine, woodland caribou, Canada lynx, fisher, pine martin, moose, eastern cougar, and eastern timber wolf (in recent years, some wolves have moved back into Wisconsin from Minnesota, small populations of fisher and pine martin have been reestablished, and eastern cougar and moose occur in very low numbers). Eastern timber wolf, black bear, bobcat, moose, and spruce grouse populations are limited by a lack of large blocks of wild land that have a low human presence (Kotar and Eckstein 1995).

The following edge-loving species are considered to be "over-abundant" (as a result of maintaining agricultural lands and young fragmented forests): raccoons, striped skunks, woodchuck, thirteen-lined ground squirrel, eastern cottontail, brown-headed cowbird, American crow, blue jay, beaver, and white tailed deer. Edge effects such as increased levels of parasitism, predation, and competition have been linked to population declines in a variety of other species which nest in the northern forests (Coleman et al. 1997). Furthermore, ongoing studies indicate that "over-browsing" by white-tailed deer suppresses the regeneration of hemlock, Canada yew, and other important northern forest species (Alverson et al. 1988, Allison 1990).

Evidence suggests that several neotropical migrant bird species may be in decline due to fragmentation and conversion of older forest communities (Freemark et al. 1995). Howe and Mossman (1995) have demonstrated that old growth forests provide insurance against the unexpected consequences of forest management, and that some species appear to benefit from human-caused landscape modifications, while others are more likely to persist in an environment that retains the conditions under which they evolved.

Today's commercial northern forest timber types are managed to an economic rotation age—perpetuating simple local and regional forest community age structures. Most northern forest types lack an abundance of snag and den-tree components and the horizontal and vertical structure typical of old-growth stands. The result is a mosaic of many small stands with widely differing age classes. Edges are abundant and large blocks of unbroken mature mesic forest remain rare. In general, managed landscapes lack large

patches, very small patches, natural patch complex shapes, and provide less forest interior habitat (Rusterholz 1994, Mladenoff et al. 1993). In summary, current forest conditions are well outside the estimated Range of Natural Variability (RNV) (Wallin and Swanson 1994, Mladenoff et al. 1993, 1994).

Inventory

Natural areas are tracts of land or water that are so little modified by human activity (or have sufficiently recovered from the effects of such activity) that they contain intact native plant and animal communities believed to be representative of the site's original vegetation. Rare species' habitats are tracts of land or water that support federal or state endangered or threatened species, or species ranked as S1 (critically imperiled because of extreme rarity), S2 (imperiled because of rarity), or S3 (rare or uncommon in the state of Wisconsin). Geologic sites with special scientific and educational values include outstanding examples of glacial landforms, rock outcrops, and exposed bedrock (Southeastern Wisconsin Regional Planning Commission, 1997; and Scientific Areas Preservation Council & WDNR, 1983).

A natural areas inventory (initiated in 1992) identified the Forests' most significant remaining natural areas, and other areas vital to the maintenance of endangered, threatened, and rare plant and animal species. The following were natural area inventory objectives: (1) Map, rank, document, and evaluate occurrences of rare and significant plant and animal species, natural communities, landscape ecosystems, and within-stand features; and (2) Collect historic, current, and potential vegetation information that identify natural communities, forest cover types, and landscape ecosystems.

Chequamegon-Nicolet National Forests' flora, fauna, and natural communities information was compiled from previous natural area and rare species surveys. Information was also obtained from the Wisconsin DNR's Natural Heritage Program database, geologic surveys, wildlife habitat inventories, soil surveys, published and unpublished research, local experts, landowners, and resource managers.

Inventory Methods

The first step in the inventory process was to conduct a records inventory of the Forest Service's Combined Data Systems database (CDS). The pre-field inventory screened over 30 cover types to identify which stands met certain age and diameter criteria. Next, a forest planning task team screened significant sites (or hotspots) for rare, exemplary, or unique natural features. This information was sorted by landtype association (LTA) and the following dominant community types: (1)Northern Dry-Mesic Forest, (2) Northern Dry Forest/Pine Barrens, (3) Boreal Forest, (4) Northern Wet-Mesic Forest, (5) Northern Wet Forest/Calcareous Conifer Swamp, (6) Northern Mesic Forest, (7) Northern Hardwood Swamp, and (8) Short Rotation Types.

The following types of maps were gathered or produced (in addition to stand maps): (1) Total vegetation, ownership/water/roads, and "no disturbance" base maps; (2) Land type associations; (3) Compartment maps; (4) Bedrock glades; (5) Short rotation types; (6) Upland non-forest types; (7) Low representation types; (8) Designated old growth; (9) Hemlock/yellow birch components, stands, and understories; (10) White pine components, stands, and understories; (11) Elm components; (12) Natural red pine understories; (13) Beech components and understories, (14) Mountain ash, yew, and hawthorn components; (15) Lake depth and alkalinity maps; (16) Class I, II, and III

streams and rivers; (17) Threatened, endangered, and sensitive species locations; and (18) Beaver colonies.

Both the CDS database and the aforementioned maps allowed inventory personnel to focus their field inventory efforts on "hotspots" that had concentrations of significant features. The field inventory effort consisted of the following three primary tasks: (1) Formulate procedures for identifying, ranking, and mapping natural community features; (2) Conduct a natural community and landscape ecosystem inventory and ranking; and (3) Conduct a supplemental stand reconnaissance for within stand features. Plant, breeding bird, woodland raptor, aquatic invertebrate, butterfly and moth, frog and toad, and lichen surveys were conducted concurrently with the above-listed basic tasks.

Natural Community Identification and Ranking Procedures

Rare plant and animal species were documented using the Wisconsin Natural Heritage Rare Plant and Animal Reporting Form. Collected field information included associated species and plant communities, habitat description, estimated size of the population, evidence of disturbance or threats, and management/conservation needs. Inventory personnel utilized Wisconsin Natural Heritage Inventory general ranking procedures to evaluate biotic communities. These ranking procedures have also been used for recent biological inventories of the Apostle Islands National Lakeshore, Northern Highland-American Legion State Forest, Brule River State Forest, and the Necedah National Wildlife Refuge.

The Natural Areas Preservation Council (an advisory body to the WDNR Natural Areas Program) developed a classification system for assigning levels of significance based on natural area qualities (from a statewide perspective). The process classifies natural areas in one of the following three categories:

NA-1 Sites: Natural areas of statewide or greater significance. These areas are so little modified by man's activity, or sufficiently recovered, that they contain intact native plant and animal communities believed to be representative of the presettlement landscape. Protection of NA-1 sites is essential for conservation of subsection species, communities, and landscapes. NA-1 site community composition shows little departure from original structure and composition (except in seral or disturbance-dependant communities). These sites are relatively rare on the Forest (totaling less than 4,000 acres).

NA-2 Sites: Natural areas of county-level significance. These areas are slightly modified by man's activities, or insufficiently recovered from past disturbances. NA-2 site quality may be less than the ecologically defined ideal (because of logging, grazing, exotic species invasion, etc.); the vegetation type may be the most abundant or a very common type in the region; or the site may be the best example that qualifies for state scientific area recognition. Protecting NA-2 sites conserves subsection species, communities, and landscapes. NA-2 sites may include exotic species (localized and/or minor community components). There are tens of thousands of acres of NA-2 sites on the Forest.

NA-3 Sites: Natural areas of local significance. These areas are modified by man's activities, retain a moderate degree of natural cover, and are often suitable for educational uses. Adequate protection and management will eventually increase the natural qualities of these areas. An NA-3 site's structure and composition have been altered such that it may not be possible to restore the original vegetative condition (with proper management and time—partial community restoration is possible).

Protecting NA-3 sites helps conserve biotic diversity on a local level. There are hundreds of thousands of acres of NA-3 sites on the Forest.

Natural Community Inventory and Ranking

Potential natural areas were inventoried through queries of the Forests' CDS database, evaluating aerial photographs and past records, and interviewing people with knowledge of significant areas. Ground surveys were conducted for sites with high natural area potential. The following qualitative site information was gathered:

1. Identification, mapping, and ranking of dominant plant communities
2. Observations regarding surface geology and physiography
3. Vascular plant species observations (from selected high-ranking plant communities)
4. Successional trends
5. Adjoining land use information
6. Evidence of natural or artificial disturbance, and degree of recovery from past disturbance
7. Presence and population sizes of critical species
8. Evidence of other animal species
9. Descriptions of notable natural features

Identifying Community Complexes

Reserving landscape ecosystems involved identifying ecosystem complexes in patterns distinct from other LTAs. The Ecological Classification System (ECS) provided a hierarchical framework for stratifying forest landscapes into homogeneous ecological units. LTA community types, soils, uncommon biota, aquatic systems, and landforms helped to identify areas that encompassed relatively natural landscape characteristics. These areas were referred to as natural feature "complexes" because of their heterogenous nature. Large presettlement-like, upland forest landscapes no longer remain on the Forest (because of past land uses). Identifying representative areas invariably required that some marginal and/or low quality stands be included (with long-term restoration goals). The Forests' ecological classification system was used to determine likely successional trends and to make decisions on restoration potential.

The following significant within-stand features were identified: downed logs (and decay class), standing snags, den/cavity trees, large-diameter residual trees, natural canopy gaps, diameter distribution, canopy layers, large woody stream debris, tip up mounds, vernal ponds, spring seeps, intermittent streams, reproduction of browse sensitive species, rock outcroppings, mast trees, mid-tolerant species, and long-lived conifer species. Scattered pockets of relict forest that were too small to meet the minimum stand size were also inventoried. These small inclusions collectively comprise a significant percentage of the CNNFs existing old growth forest.

Ranking and Prioritizing Complexes

There is no universally accepted means to compare the conservation potential of large complex multiple community sites found in relatively unfragmented landscapes. Information provided by the evolving disciplines of conservation biology, landscape ecology, and restoration ecology provide useful guidelines. Ecologically complex area

case studies from around the region were also consulted. These projects utilized several ranking schemes to prioritize sites for protection. The combined approach seemed applicable to the CNNF. Identifying the rarest, least-disturbed sites, and systematically analyzing the context within which they occur—provided the best assessment of conservation potential and significance.

Inventoried complexes were prioritized based on the following intrinsic, extrinsic, and other criteria (TNC unpublished reports 1993, 1995, 1996):

Intrinsic Criteria: (1) High Ranking Element Occurrences: Determines if the site contains high quality native plant and animal species and natural communities; (2) Restoration Potential: Determines if missing or degraded components of the intact landscape can be restored; (3) Size: Small, medium, and large landscapes are ranked; (4) Ecological Unit Representation: Identifies major and minor natural features (natural communities, soils, landforms, uncommon biota, aquatic systems, etc.); (5) Ecological Gradient Protection: Determines the degree to which the site protects ecotones and transitional areas between adjacent community types (and determines to what degree the communities are intact); and (6) Seral Stages: Determines if natural community type disturbance patches and associated developmental stages are present in a distribution that reflects the natural disturbance regime.

Extrinsic Criteria: (1) Compatible Management: Identifies the degree to which complimentary forest management (or the potential for it) exists and in the surrounding landscape; (2) Landscape Context: Identifies if the the surrounding landscape retains (or can be restored to) the minimum threshold of its historic natural processes, still supports its full complement of native species, and has not been irreversibly degraded or fragmented by human land uses; and (3) Connectivity Potential: Determines if the site can be directly linked (or via corridors) with other biologically significant sites to form mutually supportive, functional networks.

Other Criteria: (1) Rare Element Occurrences: Determines the degree to which endangered, threatened, and special concern species and/or very rare community types are present; (2) Prior Land Use Designation: Determines the degree to which the site (or portions of the site) is protected or partially protected with special management designations (wilderness, semi-primitive non-motorized areas, wild and scenic river corridors, visual retention areas, research natural areas, and special management areas); (3) Compatibility With Other Multiple Use Objectives: Determines the degree to which the site will protect or enhance other forest values (wildland recreation, forest aesthetics, wildlife and fisheries habitat, etc.; (4) Timber Base Considerations: Determines to what degree the site includes lands that are classified as "unsuited" or "not appropriate" for timber production (steep terrain, inaccessibility, low productivity, etc.); (5) Administrative Control: Determines the percentage of Forest Service ownership within and adjacent to site boundaries (also determines if the Forest Service has jurisdiction over roads, trails, and utility corridors within and adjacent to site boundaries); and (6) Remoteness: Determines if the site has a low human presence due to limited road and motorized trail access, poor quality roads, or road and trail closures.

Scoring

A scoring procedure was used to prioritize inventoried complexes (Deuver and Noss 1993). For each complex, each criterion was scored on a numerical scale of 1-3 in increments of 0.5, with one being the poorest quality and three being the best. Scoring

decisions were reached through an informal consensus. Intrinsic criteria scores were weighted by a factor of two. A total score was obtained by adding the three criteria category scores. Sites within each LTA were ranked against each other. The complex scores fell into three definable groups—high, medium, and low priorities for conservation.

A list of ecologically significant features (or LAD complexes) for each CNNF District is found in Appendix 11 of a Forest Report entitled "Landscape Analysis and Design on the Chequamegon National Forest" (LAD Report)(April 1999). Appendices 12 and 13 of the LAD Report list the rare element occurrences and detailed summaries of the LAD complexes, respectively. Maps of the complexes are included in Figures 1 and 2 of the LAD Report.

Assessment

The assessment focuses on identifying significant restoration opportunities by Landtype Association (LTA). One of the products of the LAD project is a determination of the best ecological opportunities for protection, restoration, and traditional forest management. A landscape-scale assessment was necessary for identifying restoration opportunities. Historically dominant terrestrial ecosystems were grouped into four broad categories: (1) Pine Barrens, (2) Pine Forest, (3) Northern Hardwood Interior Forest, and (4) Boreal Forest. These areas lend themselves to alternative or complementary forms of management that could restore their structure, function, or composition at landscape, community, and microsite scales.

Assessment Tools and Sources of Information

Landtype Associations: LTAs are distinct interacting fine-scaled ecosystem patches (Crow 1991) that are identified by assessing patterns of landscape level physiography, geomorphology, terrain, and topography (Pregitzer and Ramm 1984). Lake States LTA boundaries are influenced most significantly by climate, glacial landforms and soil texture (Rowe 1991). LTAs are normally on the order of thousands to tens of thousands of acres, and reflect significant patterns of post-glacial erosional features such as ground and end moraines, kames, drumlins, outwash plains, and lake plains (Cleland et al. 1997).

GIS Maps: The following maps displayed LTA characterizations: (1) Presettlement vegetation and natural disturbance, (2) Spring pond concentrations, (3) Existing broad cover types (displayed across several classes of landowners), (4) Human settlement concentrations, (5) Forest Service road jurisdiction, (6) Other major landowners, (7) Composite landscape features such as contiguous blocks of forest, areas of regeneration, deer yards, etc., and (8) Special and proposed designations such as wilderness, existing RNAs, potential essential wolf habitat, etc.

National Hierarchical Framework of Ecological Units: The assessment phase relied heavily on this regionalized classification and mapping system for stratifying the Earth into progressively smaller areas of increasingly uniform ecological potentials. Ecological types are classified and ecological units are mapped based on climate, physiography, water, soils, air, hydrology, and potential natural communities.

Forest Habitat Classification System (Kotar et al., 1988). Habitat type classification is a tool for grouping forest sites into units of similar biological potential based on total floristic similarity. Habitat type classifications describe regenerative potentials and the competitive ability of various tree species—thus providing insights into expected successional changes. Understory herbs within these areas are often used as indicators of

site potential. The “Forest Habitat Classification System,” developed for forests in northern Wisconsin, can be used to identify likely successional trends. This system can also serve as a basis for evaluating the potential for restoring rare or uncommon plant communities.

Satellite Imagery: Highly detailed satellite imagery depicts existing vegetation on three Chequamegon Ranger Districts. A second set of classified images, covering most of northern Wisconsin, was produced through WISCLAND (Wisconsin DNR 2004).

Other Sources of Information: The following are other sources of information used in the assessment phase of Landscape Analysis and Design: (1) Satellite photographs, (2) 1:58,000 scale photos, (3) ½ " top down map set, (4) 1" District base and overlay map set, (5) CDS queries, (6) U.S.G.S. quadrangle maps, (7) USFS Compartment base maps, (8) USFS Compartment examination tatum guidelines, (9) List of LAD definitions, (10) Opportunity area and environmental documents, (11) Lists of ecological classifications, elements, etc., (12) Map set descriptions, (13) Prior inventories (soils, Bureau of Endangered Resource elements, Pleistocene maps, etc.), and (14) the “Chequamegon Study Region” map.

Assessment Process Steps

- Gather available information for each LTA
- Describe the LTAs: (1) Review preliminary LTA descriptions, associated Kotar Habitat Types, and forest types by LTA printout; (2) Place a Forest LTA Overlay over each 1/2 "top down" map (review/revise/complete where needed for each specific LTA); and (3) Write a brief statement that describes the LTA (for each of the 1/2 "top down" maps).
- Prepare LTA Characterizations (described below).
- Rank LTAs within each major terrestrial community type. Determine which LTAs best meet the criteria for restoration opportunities. Identify the top ranking LTAs and assign a high, medium, or low status.
- Identify specific areas within identified LTAs that best meet the criteria. Identify the top ranking areas and assign a high, medium, or low status.

LTA Characterizations

The following LTA characterization (or description) headings were identified by using the tools and sources listed above, and referencing ecological unit descriptions from elsewhere in the Region:

- General Description (location, extent, existing management areas, summary / overview of significant characterizations);
- Place in the ECS Hierarchy (list of what is above and below the LTA on the hierarchy of ecological units);
- Geology (major and minor landforms and percentages of each, and soils information);
- Disturbance (historical patterns, types, percentage of LTA, size, interval, existing disturbance patterns);
- Historical Vegetation (successional pathways, dominant community and covertypes, location and percentages of each cover type, percentages of early vs. mid to late successional stages, percentages of open vs. closed community types);

- Existing Vegetation (forested and non-forested cover and community types including wetlands, percentages of each type, forest habitat types, and presence and distribution of exotics);
- Landscape Pattern (homogeneity and heterogeneity, patch size (range), and type distribution across LTA);
- Rare Elements (rare plant communities and species, and their distribution and habitat associations);
- Fauna (distinguishing features, historical vs. current abundances, distribution);
- Hydrology, Water Quality, and Aquatic Features (descriptions of water table, lake and stream patterns, and special features);
- Dominant Uses and Emphasis (roads, pipelines, type / intensity / distribution of timber harvesting, recreational uses, et al.;
- Land Ownership (patterns, percentages, types); and
- Special Designations (RNAs, special management areas, state natural areas, wilderness, et al.).

LTA Ranking Criteria

The following criteria were used to rank LTAs based on opportunities to manage or restore interior northern hardwoods, pine-oak, pine barrens, or early successional boreal/upland mixed conifer forest (these criteria were also used to identify the best opportunities for management and restoration within LTAs):

- *Interior Northern Hardwood Forest:*
  - ✓Less interdigitation of early successional forest
  - ✓Productive site potential: ATM / AviO / AH habitat types
  - ✓Large average patch size (relative to other LTAs / areas)
  - ✓Historic vegetation is hemlock-hardwood or maple-basswood forest
  - ✓Inclusion of high ranking community occurrences
  - ✓High administrative control
  - ✓Compatible adjacent landscape patterns
  - ✓Existing vegetation is hardwood dominated
- *Pine-Oak Forest:*
  - ✓Less interdigitation of early successional forest
  - ✓Productive site potential: Low-ATM / PMV / AVVib / AQE
  - ✓Large average patch size (relative to other LTAs / areas)
  - ✓Historic vegetation is red and/or white pine dominated
  - ✓Inclusion of high ranking community occurrences
  - ✓High administrative control
  - ✓Compatible adjacent landscape patterns
  - ✓Existing vegetation is dominated by natural (fire) origin pine or oak
- *Pine Barrens:*
  - ✓Productive site potential: Dominated by low ATM / PMV / AVVib / AQE habitat types

- ✓Large average patch size (relative to other LTAs / areas)
- ✓Historic vegetation is red and/or white pine dominated
- ✓Inclusion of high ranking community occurrences
- ✓High administrative control
- ✓Compatible adjacent landscape patterns
- ✓Existing vegetation is dominated by natural origin pine or oak

• *Early Successional/Boreal/Mixed Deciduous-Coniferous Upland Forest:*

- ✓Localized cold air drainages
- ✓Productivity/site potential: Low ATM / PMV
- ✓Large average patch size (relative to other LTAs / areas)
- ✓Historic vegetation is pine, hemlock, or spruce dominated or co-dominated
- ✓Inclusion of high ranking community occurrences
- ✓High administrative control
- ✓Compatible adjacent landscape patterns
- ✓Existing vegetation: aspen/birch/fir, aspen/birch/spruce, spruce-fir, lowland mixed conifer, upland black spruce
- ✓Presence of upland black spruce
- ✓Large peatland complexes

LTA Rankings

LTAs were assessed (based on the above criteria) to determine high, medium, and low restoration opportunities for each of the major ecosystem types. The LTAs not assessed were considered to have poor potential for restoration. See the Forest report "Landscape Analysis and Design on the Chequamegon-Nicolet National Forest" (April 1999), pages 49-57, for specific LTA ranking lists.

Integration

The Integration section integrates ecological issues into landscape analysis and design, describes three current LAD approaches (with advantages and disadvantages), and presents some recommendations for incorporating LAD into Forest Planning.

The Chequamegon-Nicolet National Forests' Notice of Intent (announcing the Forest's intent to prepare an environmental impact statement for revising the Forest Plans) addresses two major ecological issue-driven revision topics— biological diversity and special land allocations. These topics serve as a basis for LAD issues (Access and Recreation Opportunities, and Timber Production are the other two NOI major revision topics).

Biological Diversity Issues

Some people feel that the national forests should play a greater role in conserving biological diversity. Other people are concerned that biological diversity protection efforts could result in lower levels of timber production, limits on motorized access, and decreased populations of some game animals. The following are Biological Diversity issues considered in the LAD Analysis:

Lake States Area Spatial Scale of Reference: New scientific information has shown that maximizing biological diversity at a small scale may reduce biological diversity at a broader scale. The revised Plan addresses the unique role of the Chequamegon-Nicolet National Forests in conserving regional biological diversity.

Old Growth: Old growth forests are characterized by older trees, tree cavities, and large coarse woody material on the forest floor. They provide ecosystem conditions necessary for some species and aesthetic values prized by many people. The 1986 Chequamegon and Nicolet Forest Plans had different old growth standards and guidelines. The revised Forest Plan provides a common definition and specific direction for the amount, type, distribution, location, and management of old growth.

Fragmented Habitats: Fragmentation results when a large and contiguous ecosystem is converted to a network of small isolated patches. Activities such as road building, logging, and agriculture can contribute to habitat fragmentation. Increased edge habitat affects forest and open land species that require large patches. The revised Forest Plan provides management direction which will increase the amount of large forest patches over the long-term.

Habitat Linkages: Habitat linkages allow or encourage species movements and may increase the effective size of some species total habitat. Linkages sometimes allow the spread of exotic species, undesirable predators, insects, and diseases. The revised Forest Plan considers habitat linkages for northern hardwood forest and other habitat types through Management Area (MA) designation. *Ecosystem Restoration*: The revised Forest Plan specifies the number and location of ecosystems that require restoration. It also provides specific management direction for restoring and maintaining the structure, function, and composition of native terrestrial and aquatic ecosystems. Ecosystem restoration may also use management activities that mimic natural disturbance regimes (such as fire in a barrens ecosystem).

Management Indicator Species: Management indicator species (MIS) serve as indicators of habitat condition changes and allow us to predict the effects of forest management practices. The MIS identified in the 1986 Forest Plans were highly mobile animals, which made species population change determinations difficult. The revised Forest Plan uses MIS that have narrow niches, show sensitivity to change, and allow accurate monitoring. Management Indicator Communities were also identified that address the long-term persistence of species assemblages including some at-risk.

Scientific Roundtable on Biological Diversity: The Chief of the Forest Service directed the CNNF (in response to forest plan appeals) to establish a "Committee of Scientific Experts" to address biological diversity issues. Many of the committee’s recommendations (Crow et al. 1994) are included in the revised Forest Plan as forestwide Standards and Guidelines and components of management area prescriptions.

Economic, Social and Biological Considerations: The forests of northern Wisconsin have provided people and communities a way of life for many years (thousands of years for Native Americans). Changing National Forest management prescriptions that address complex issues such as biological diversity may impact local communities and area economies. Biological, social, and economic effects (as well as trade-offs and benefits) are addressed in the Final Environmental Impact Statement (FEIS).

Special Land Allocation Issues:

Some people favor additional special land allocation areas because they address issues such as biological diversity conservation, primitive recreation opportunities, scientific research, and protection of unique features. Other people oppose additional special land allocations and want to reduce the current number. They feel that such areas limit recreation uses and access, and reduce timber harvesting and tourism dollar returns to local communities.

Wilderness: The 1984 Wisconsin Wilderness Act requires the Forest Service to analyze wilderness options when Forest Plans are revised. The revision process included inventory and evaluation of roadless areas, and the development of a range of alternatives regarding potential Wilderness Study Areas. The revised Forest Plan offers three areas as potential Wilderness Study Areas. Wilderness Area designations are only accomplished by Congress.

Research Natural Areas: Research Natural Areas (RNAs) are part of a national network of ecological areas designated for research and education purposes and/or for maintaining biological diversity. RNAs may represent unique vegetative conditions or the presence of rare elements, and are valuable for scientific research. The revision process evaluated the suitability of numerous additional RNAs, and the revised Forest Plan designated approximately 32,700 acres as Candidate RNAs, and changed some previous candidate designations to other land uses.

Special Management Areas: Special management areas have unique recreational, geologic, fish and wildlife, botanic, and/or heritage resource characteristics. The revision process included evaluation of the suitability of numerous additional SMAs, and the revised Forest Plan designated approximately 63,900 acres as SMAs,

Economic, Social, and Biological Considerations: Special land allocations such as wilderness, RNAs, and SMAs remove land from commodity production. However, these types of allocations may also provide backcountry experiences and areas for scientific research and monitoring. Special land allocation decisions require a balance between human values, social needs, and species biological needs. The FEIS addresses the establishment and maintenance of CNNF special land areas and their effects on local tourism and timber economies.

Recommended Approach for Landscape Design

The Chequamegon-Nicolet National Forests' prescription for redesigning the forest landscape combines core reserve areas with forestry practices that mimic natural gap-phase disturbances, emphasize minimum road construction, retain coarse woody debris, etc. Use of forest zoning concepts separates the Forest into land use intensity areas (e.g., intensive timber harvesting areas, moderate disturbance semi-primitive non-motorized areas, etc.). Combining the three approaches is synergistic—the whole of the combined approach is greater than the sum of its parts.

The combined landscape design approach reshapes the landscape at multiple scales and attempts to integrate social, economic, and ecological needs. It locates and concentrates forest management activities where the fewest conflicts and greatest opportunities exist. This strategy protects and maintains structural, compositional, and functional elements of ecological diversity at genetic, species, and community scales. The main goals of the strategy are: (1) Establish a network of ecological reference core areas (RNAs, SMAs, old growth complexes, and wilderness) that represent all native ecosystem types and seral stages across their natural range of variation; (2) Use silvicultural prescriptions designed

to manage "Alternative Management Areas," restoring key elements of ecosystems that are considered rare, degraded, or declining in the regional landscape; and (3) Apply forest management practices that strengthen ecosystem productivity, resiliency, and sustainability.

Ecological Reference Area Network

Ecological reference areas represent all native ecosystem types and seral stages across their natural range of variation—stratified by the Landtype Association level of the National Hierarchy of Ecological Units. The ecological reference area network provides:

- Refugia for rare species
- Potential recovery areas for rare species
- Control or reference areas for monitoring and research
- Contributions to the Regional Representative RNA Network
- Baseline areas for measuring long term ecological changes
- Protection for remnant ecosystems
- Interpretive and educational opportunities

See the Forest Report *Landscape Analysis and Design on the Chequamegon-Nicolet National Forest* (April 1999), pages 77-83, for additional details on ecological reference areas.

Managing Alternative Management Areas (AMAs) with a Ecological Restoration Emphasis

Appropriately designed silvicultural prescriptions and other creative strategies can be used to manage some areas of the forest with an emphasis on restoring key elements of composition, structure, and function. The following AMAs provide the best opportunities for restoring ecosystems that are rare or degraded at local and regional scales:

- Northern hardwood/hemlock
- Pine-oak
- Pine barrens
- Boreal/mixed coniferous / early successional forest

See the Forest Report *Landscape Analysis and Design on the Chequamegon-Nicolet National Forest* (April 1999), pages 85-88 for details concerning alternative management area composition, structure, and function.

Designing Forest Management Practices to Help Conserve Biological Diversity

Many recommendations for conserving and improving biological diversity can be implemented by the application of appropriate forest management practices. The following actions provide opportunities for modifying Forest Plan management prescriptions and Standards and Guidelines:

- Use innovative silvicultural techniques to restore or mimic natural disturbance regimes and landscape processes.
- Avoid management practices that introduce or encourage the establishment of exotic species.

- Increase structural diversity by creating multilayered stands.
- Maintain or restore canopy gap patterns that are typical of mature and uneven-aged forests.
- Promote sustainable species populations at microhabitat scales.
- Mitigate the effects of timber harvesting on ground flora diversity.
- Minimize forestry operation impacts on the forest floor and mineral soils.
- Maintain or restore levels of coarse woody debris that are typical of mature and old growth forests.
- Improve structural complexity and spatial heterogeneity by creating or maintaining old growth areas and uneven-aged forests.
- Minimize the disruption of natural hydrologic functions (includes flooding regimes, watertables, and impoundments).

See the Forest Report *Landscape Analysis and Design on the Chequamegon-Nicolet National Forest* (April 1999), pages 96-99, for more details concerning recommendations related to each of the above-listed actions.

Species Viability Evaluation

Introduction

The 1982 Code of Federal Regulations (36 CFR 219.19), which promulgate the National Forest Management Act of 1976, require the Forest Service to meet the following specific minimum fish and wildlife habitat management requirements in developing or revising a Land and Resource Management Plan:

> *"Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area. For planning purposes, a viable population shall be regarded as one that has the estimated numbers and distribution of reproductive individuals needed to ensure its continued existence…in the planning area. In order to insure that viable populations will be maintained, habitat must be provided to support, at least, a minimum number of reproductive individuals and the habitat must be well distributed so that those individuals can interact with others in the planning area."*

The Department of Agriculture Regulation 9500-4 also requires the Forest Service to manage *"habitats for all existing native and desired non-native plants, fish, and wildlife species in order to maintain at least viable populations of each species."*

Each set of alternative management activities must meet the minimum standards for viability of native and desired plants, non-native birds, mammals, fish, amphibians, and reptiles. This is accomplished by establishing appropriate Forest Plan standards and guidelines and model constraints. Species viability has become a science unto itself with an emphasis on management related to the conservation of biological diversity.

The Chequamegon and the Nicolet National Forests, during the first round of forest planning in the 1980s, used similar approaches for addressing this minimum management requirement. They both used an indicator species approach where a subset of known species were used as surrogates for a larger set of species assumed to have similar habitat requirements and similar responses to management activities. The CNNF (as one National Forest) have a number of species that have population sizes, distribution patterns, or demographic features that provide concerns for viability. These include

species currently or likely to be listed under the Endangered Species Act (gray wolf, bald eagle, and Fassett's locoweed); and species listed on the Regional Forester's Sensitive Species list (northern goshawk, cerulean warbler, lake sturgeon, et al.).

The Forest Service does not estimate population sizes, track population trends, or develop demographic parameters for the numerous fish and wildlife species on the Forest. Some data is available through the Wisconsin Department of Natural Resources, the U.S. Fish and Wildlife Service, and various Indian tribes. Information about fish and wildlife species habitat features is generally lacking (understory vegetation information, structural features such as number of snags and down logs, etc.).

To gather critical information on species habitat and ecological process needs, the CNNF organized and conducted expert panel sessions. The Forest used a viability assessment process that was a combination of approaches based on the Tongass Population Viability Assessment for Land Management Planning, the Columbia River Basin Assessment, the Committee of Scientists Report, Forest Service Region 1 and 4 Terrestrial Protocols, and input from the Forest Service Ecosystem Management Assessment Team, a Forest Service Washington Office review, and the Conservation Breeding Specialists Group.

Identification and Recruitment of Species Experts

Viability assessment expert panels convened in Duluth, Minnesota in January of 2000 and again in April/May 2002. The following expert panels addressed species of concern needs: (1) Birds, (2) Fish, (3) Herpetiles, (4) Insects, (5) Mammals, (6) Mollusks, and (7) Plants. A selection of 4-10 recognized experts were recruited for each panel. Their peers recognized each species expert as an objective person that has expertise (research, education, study, or experience) in the biology/ecology of the species or species groups under review. The experts included representatives from: USDA-North Central Forest Experiment Station; Minnesota and Wisconsin Departments of Natural Resources; U.S. Fish and Wildlife Service; Universities of Minnesota, Wisconsin, and Michigan; Great Lakes Indian Fish and Wildlife Commission; several individual Indian reservations; Potlatch Corp.; Boise Cascade Corp.; Natural Resources Research Institute; Academic institutions and other private and public organizations.

Species Selection Process

The species selected for viability assessment fell into one or more of the following categories: (1) Listed as Region 9 Regional Forester Sensitive Species (RFSS); (2) Listed as Federally Threatened, Endangered, or Proposed; (3) Focal species representing ecosystems of concern; and (4) Other species of viability concern that could become RFSS-listed during the planning period.

Species automatically considered for the RFSS List included U.S. Fish and Wildlife Service listing candidates under the Endangered Species Act (ESA), species removed from the list in the last five years under ESA, and species designated by The Nature Conservancy as G1-G3, T1-T3 and N1-N3. Natural Heritage Program S1, S2, State Threatened and Endangered, and species considered at risk on individual forests were screened using a risk evaluation process that included categories of abundance, distribution, population trend, habitat integrity, and population vulnerability.

The following two criteria were used to identify and evaluate additional species of near-future viability concern: (1) The species generated an extremely high public concern (as indicated by its recommendation through a number of published sources and comments from the public); and (2) The species' populations are in decline and trends indicate that

they could possibly become Regional Forester Sensitive Species-listed during the upcoming planning period (next 10-15 years).

Scientific literature reviews and informal consultations with experts were conducted for most of the species selected for evaluation. Much of the available published information on the species' biology and ecology was collected. Informal contacts with species experts also yielded expert opinions and some additional literature sources. This information was available for each of the appropriate expert panels (serving as backup information).

Focal Species and Ecosystems of Concern

Reviewing literature and consulting some of the species experts produced a preliminary list of focal species for ecosystems of concern. Focal species serve an umbrella function because their habitat is also needed by numerous other species, they play key roles in ecological processes, and they convey information about the status and integrity of the larger ecosystem in which they occur. The planning team working on viability ranked the preliminary list of suggested focal species based on their sensitivity to likely threats within the ecosystem, their fidelity to the ecosystem or a component of the ecosystem, and the likelihood of being able to collect enough information about the species to design a conservation strategy around it. Management standards and guidelines were developed or modified to help provide the amount, composition, and configuration of habitat needed by the various focal species.

The lists of species that ranked high or medium-high were presented to the panel experts. Proposed focal species information was gathered by asking panelists to answer a questionnaire. Nearly all the species selected in the initial screening process received general approval from the panelists. The panelists also made recommendations regarding additions or deletions of proposed focal species. Overall, the first SVE panel (2000) helped to identify focal species but the focal species concept was not used by the second panel (2002) because the number of species considered made focal species unnecessary.

Ecosystems of concern were identified through a review of literature that included: the Natural Heritage Program; National Forest Assessments, National Forest Analyses of the Management Situation, other Issue Papers, the Wisconsin Biodiversity Report; the Scientific Roundtable on Biological Diversity; the Endangered Ecosystems Report; and Minnesota's Generic Environmental Impact Statement.

Panel Processes

The Viability Assessment Team and Conservation Breeding Specialist Group directed the overall assessment process. Each of the expert panels had a facilitator and scribe to aid the process of gathering and recording information. Resource management specialists were also available to answer questions, as needed.

The experts compiled and synthesized information on habitat needs and ecological processes needed for selected species. The quality, quantity, distribution, and connectivity of habitats were identified along with the quality and quantity of ecological processes needed to maintain the species. The synthesis of published and unpublished information from experts was a major accomplishment of the work session. Species experts provided needed information for the following subjects: habitat needs, landscape structure requirements, ecological processes, alleviation of threats, and existing population conditions.

The panelist questions were tied to pre-described standard species Outcomes, A through E, with an emphasis on Outcomes A and C. The Outcomes were based on the associated

quality, quantity, and distribution of habitat as well as the level of selected species interactions. For example, Outcome A habitat was described as being “distributed broadly across the taxon's historic range and is of sufficient quality to support the type and degree of intrademe and metapopulation interactions that the taxon would characteristically engage in if it were not habitat limited.” Outcome C habitat was described as reduced in quality or quantity across the taxon's historic range with the extirpation of local demes, metapopulation interactions adversely altered throughout most of the taxon's range, and the geographic extent of the taxon reduced. See the Species Viability Evaluation section for additional details about Outcome Levels A-E.

Incorporating Panel Information into Forest Plan Alternatives and Standards and Guidelines

The information obtained from the first set of expert panels was compiled and delivered to the Forest Plan Interdisciplinary Team for refining the draft alternatives, goals, and standards and guidelines. The Team processed the panel information and (1) Identified the types, amounts, distribution, and connectivity of habitats as well as the ecological processes needed to maintain the species; (2) Identified conservation practices needed to ensure species viability; (3) Suggested a coarse-filter approach that provides suitably distributed habitat for the persistence of species of viability concern; (4) Suggested a fine-filter approach that provides suitably distributed habitat for “fine filter process species;” (5) Suggested landscape linkages that provide for the persistence of the viability assessment selected species; (6) Suggested ecological processes that maintain viable populations; and (7) Identified the management practices that are effective in maintaining species viability.

Coarse-Filter Approach

The coarse-filter and fine-filter approaches can provide favorable habitat conditions for many native species. The coarse-filter approach helps maintain or restore ecological processes necessary for ecosystem sustainability, and is an appropriate strategy for conserving multiple species within the same area. The Nature Conservancy calls its community strategy a coarse filter (Noss, 1987). They estimate that 85-90% of area species can be protected by conserving samples of natural communities (without separate inventory and management strategies for each species).

Ecosystems exist at multiple spatial scales. Scale is a consideration in conservation strategies designed to maintain the diversity of native plant and animal communities and the productive capacity of ecological systems. The coarse-filter approach is designed to represent dominant land cover types that still exhibit the characteristic smaller landscape patch associations. Within-stand structure is also considered because many species require large down logs, tip-up mounds and pits, conifer components, etc. Many fine scale features can be provided by management prescriptions and standards and guidelines, or can be allowed to develop through natural processes in the coarse filter.

The historical range of variability (HRV) may be used in addition to focal species to develop the coarse-filter approach. The HRV, is roughly equivalent to the natural range of variability concept, and refers to the expected variation in physical and biological conditions caused by natural climatic fluctuations and disturbance regimes, e.g., flooding, fire, and windthrow.

Fine-Filter Approach

The fine-filter approach is used when the coarse filter does not provide a high likelihood of species viability maintenance. The fine filter approach provides conservation strategies that maintain fine-scale ecosystem components for individual species (e.g., fens, vernal ponds, caves, and other rare habitats and microhabitats). The following criteria identify species that probably require a fine-filter approach: (1) Narrow endemic species; (2) Species that have highly specialized/unique habitats; (3) Wide-ranging species; and (4) Other species that are not predictably associated with specific habitat types or seral stages.

Some species are rare for reasons beyond human control. Conditions of rarity include species that are very specialized and require unusual microhabitats, species populations at the edge of their range, and species that are relicts of former climatic regimes. The Forest, for the most part, can only improve habitat conditions for rare species where populations are in decline because of habitat loss or degradation. Habitat degradation includes direct changes in the physical or biological environment (e.g., wetland drainage), biotic imbalance (e.g., herbivory impacts), or disruption of disturbance regimes (e.g., fire suppression).

Landscape Linkages

Providing functional landscape linkages, or connectivity, between blocks of habitat is another aspect of population viability maintenance. Landscape linkages may reduce problems associated with habitat fragmentation, increase the effective size of species habitats (Harris 1984), serve as pathways for genetic interchange, and extend species ranges. Landscape linkages are also important for daily, annual, and seasonal movements, and permit dispersal to breeding, foraging, and wintering grounds.

The following elements are considered when identifying and prioritizing landscape linkages for critical plant and animal movements:

Corridor width: The line corridor consists of a narrow stringer of trees that provides some security and shelter for traveling wildlife species that need to use them. Strip corridors are wider and provide some interior habitat conditions. Strip corridors accommodate travel and provide foraging and reproduction habitat for a broad range of wildlife species.

Extent and richness of corridor habitat: High quality habitat within landscape linkages provides forage, cover, and other essential needs during species dispersal. Important structural characteristics include large trees, snags, logs, etc.

Riparian habitats: The *Roundtable* scientists (Crow et al 1994) recommended providing ecological conditions that maintain native riparian and aquatic ecosystems. The needs of threatened, endangered, and sensitive riparian and aquatic species highlight the overall ecological conditions of watersheds, and represent a driving force in developing Forest goals and standards and guidelines for streamside areas.

Corridors that require limited or no restoration: Natural ecosystems should be maintained or restored where possible. Recreate at least some of the components of a natural ecosystem where existing corridors are insufficient to meet ecological needs, or were lost due to catastrophic disturbances (Thomas et al. 1988).

Corridors that are buffered by limited-intensity management activities: Corridors can be combined with buffer zones to provide high quality wildlife habitat intermingled

with human land uses (Harris 1984, Noss 1987). A zone of low intensity land use minimizes core area impacts from surrounding higher intensity land uses.

Redundancy: Improve the likelihood of persistent linkages by providing more than one linkage between blocks of habitat. Corridors may be impacted by disturbances such as catastrophic blow down or fire.

Connectivity with blocks of habitat outside of the National Forest boundaries: Enhance population viability, increase the effective size of total habitat, and facilitate genetic interchange, range extensions, and dispersal to breeding, foraging, and wintering grounds by establishing corridors that link blocks of National Forest land to blocks of habitat outside National Forest boundaries.

Ecological Assessments

Ecological assessments provide information pertinent to the development of conservation strategies for maintaining population viability. Ecological assessments include, but are not limited to, breeding bird surveys; potential habitat and habitat suitability maps for wolves and other species; transect survey information; harvest data; Department of Natural Resources wildlife, fisheries, and botanical resources surveys; Natural Heritage Program inventories of threatened, endangered, and sensitive species; and Forest Service surveys of plant and animal resources and associated habitat features.

Eco-regional assessments characterize ecosystem processes, composition, and structure. This type of assessment provides an understanding of the planning area ecological integrity under current policies and across ownerships. Technical elements include historical conditions, current conditions and trends, and estimates of future conditions and trends. The Great Lakes Assessment (an eco-regional assessment) maps and describes the terrestrial and aquatic ecosystems of the national forests in Minnesota and Wisconsin. Ecological unit boundaries (delineate areas with different types of potential vegetation and different ecosystem processes) and existing land use / land cover data, provides a framework for analyzing habitats at landscape and regional scales.

Species Viability Evaluation

Species viability evaluation (SVE) expert panels convened in Duluth, Minnesota in April/May 2002. The following SVE expert panels addressed the needs of species of concern: (1) Mammals, amphibians, and reptiles, (2) Birds: non-raptors, (3) Birds: raptors, (4) Fish and mollusks, (5) Insects, (6) Upland plants, and (7) Lowland/Aquatic plants. The SVE panel experts evaluated the potential effects on species of concern by reviewing the first panel's viability information (January 2000) and the revised Forest Plan Alternatives, Goals, and Standards and Guidelines. They evaluated the likelihood that each of the conditions described in the outcome statements would be achieved under each of several draft alternatives. The experts used their professional judgments to: (1) Determine the likely distribution of each species and its habitat; (2) Conduct likelihood assessments based on National Forest habitat conditions and the natural history characteristics of the species; and (3) Conduct cumulative effects assessments of the likely conditions of species populations across all ownerships.

The SVE Process

The SVE expert panelists used structured and reasoned judgments about projected amounts and distributions of habitat to determine the likelihood that such habitat will allow selected species to persist over the long run. The SVE process: (1) Provided forest

planners and decision makers with information about the expected effects of the preliminary Draft Environmental Impact Statement (FEIS) Alternatives on species populations and ecological conditions; (2) Aided forest planners in analyzing and documenting the effects detailed in the FEIS; (3) Contributed information that helped decision makers and forest planners make informed decisions regarding the alternatives; and (4) Provided information needed to assess alternatives relative to requirements specified in the National Forest Management Act, the Endangered Species Act, the National Environmental Policy Act, and the Decision Criteria.

Species Outcomes

Expert judgments were registered through a process of likelihood rating using a structured scale that depicted five possible outcomes for each species and its associated ecological conditions (Schenck et al 2004). The outcomes represent points along a gradient ranging from broadly distributed with a high likelihood of persistence to poorly distributed with a high likelihood of extirpation. The following outcomes are based on likely effects and conditions that are influenced by activities on the National Forest:

Outcome A: Suitable ecological conditions are broadly distributed and of high abundance across the species' historical range within the planning area. The distribution and abundance of ecological conditions provides opportunities for continuous or nearly continuous intraspecific interactions.

Outcome B: Suitable ecological conditions are either broadly distributed or of high abundance across the species' historical range within the planning area. However, there are gaps where suitable ecological conditions are absent or only present in low abundance. Disjunct areas are typically large enough and close enough to permit dispersal among subpopulations and potentially allow the species to interact as a metapopulation across its historical range within the planning area.

Outcome C: Suitable ecological conditions are distributed as frequent patches and/or exist in low abundance within gaps. Gaps are large enough to isolate some subpopulations and limit opportunities for species interactions. There are opportunities for subpopulations to interact as a metapopulation, however, some subpopulations are so disjunct or of such low density that they are essentially isolated from other populations. Reductions in overall species ranges from planning area historical conditions may have resulted from this kind of isolation.

Outcome D: Suitable ecological conditions are frequently isolated and/or exist in very low abundance. Some subpopulations associated with these ecological conditions may be self-sustaining. However, there are limited opportunities for population interactions among many of the suitable environmental patches. Reductions in overall species ranges from planning area historical conditions may have resulted from this kind of isolation.

Outcome E: Suitable ecological conditions are highly isolated and exist at very low abundance. There is little or no possibility of population interactions among suitable environmental patches. Extirpations may result within many of the patches with little likelihood of patch re-colonization. There is a strong likelihood that the planning area species range has reduced from historical levels (except for some rare, local endemics that may have persisted in this condition since the historical period).

A second set of similar outcomes (A-E) was based on the conditions of all ownerships within the cumulative effects analysis area. These outcomes are inclusive of

conditions that are not within the control of the Forest Service (see the Planning Program Files for detailed descriptions of these outcomes).

Expert Judgments

The experts were instructed to base their judgments on the species' response to conditions that exist on National Forest lands. Expert judgments were based on the following factors: (1) Amount and distribution of ecological conditions on National Forest System lands; (2) Current population status on National Forest lands; (3) Population conditions (trends) associated with ecological conditions; and (4) Random environmental disturbances and variations that influence the likelihood of species' attaining specified outcomes.

The experts were also instructed to base the cumulative effects judgments on likely population responses to of the following factors: (1) Ecological conditions on National Forest System lands and other ownerships; (2) Estimated population changes associated with ecological conditions on both National Forest System lands and other ownerships, and (3) Random environmental disturbances and variations on all ownerships that influence the likelihood of species attaining specified outcomes.

Analysis and Interpretation of the Expert Panels' Judgments

The analysis of the expert panels' outcome assessments describes likely future conditions for species populations and provides a comparison with current and historic conditions. Two primary analyses of the expert panels' judgments were performed. First, the mean likelihood scores were calculated for all experts for each of the outcomes described above. The weighted mean outcome was also calculated by assigning a value to each of the outcome categories (e.g., Outcome A, value = 1; Outcome B, value = 2; etc.), multiplying the mean likelihood of that outcome by its assigned value, adding these products for all outcomes, and then dividing by 100. The resulting weighted mean can be compared across time periods and alternatives. Second, expert panel data was processed to show if species outcomes improved, stayed the same, or declined under each of the alternatives (compared to the current outcomes). Species would only be tallied as improving or declining if their weighted mean outcome changed by a value of at least 0.5 (corresponds to one standard deviation of the mean outcome). Uncertainty of the results was calculated using the variation of likelihood distributions among panelists and the spread of likelihood points among each panelist's outcomes.

The Forest Planning Team made the final interpretation and determination of effects on species. Expert panel data was gathered together, processed, and incorporated into the FEIS as final results. The finalized panel data was reviewed to insure that it reflected an adequate understanding of the alternatives and the landscape being analyzed. Some expert panel judgments were modified because they were inconsistent with projected ecological trends, and (or) with the Forest Plan Standards and Guidelines. Incomplete or inconsistent findings may have resulted from an unclear understanding of management proposals, incomplete information on the effects of proposed management activities, or an incomplete understanding of the species status. Providing final results involved reviewing alternatives data, panel notes and scores, species background literature, and consultation with team members and some species experts.

Limitations of the Analysis

Several cautions must be applied to the interpretation of these analyses. The following four basic kinds of limitations apply to the SVE process (adapted from Quigley *et al*., 1997): (1) The scale of the analysis covers broad geographic areas and time frames; (2) Forest Plan management area prescriptions and Standards and Guidelines are programmatic and thus lack detailed site specificity; (3) Inferred population results from habitat assessments and other management effects should be viewed as tentative working hypotheses; and (4) Many species have limited studies done on them and are not well understood.

Effects of Alternatives

Formulating Alternatives

The National Forest Management Act Planning Regulations specify a number of requirements with respect to formulating alternatives. The interdisciplinary team is required to use National Environmental Policy Act (NEPA) procedures to formulate a broad range of reasonable alternatives and provide a basis for identifying the alternative that comes nearest to maximizing net public benefits. The Planning Regulations further specify that the alternatives must: (1) Reflect a full range of major commodity and environmental resource uses and values that can be produced on the Forest (alternatives distributed between the minimum and maximum resource potentials); (2) Facilitate an analysis of opportunity costs resource uses, and environmental tradeoffs among alternatives; (3) Facilitate the evaluation of present net value, and the benefits and costs of achieving various monetary and non-monetary outputs and values; (4) Provide a variety of ways to address and respond to major public issues, management concerns, and resource opportunities; (5) State the conditions and uses that will result from implementing alternatives; and (6) State the resource management Standards and Guidelines that will be used and the purpose of the management direction. Additionally, at least one alternative must reflect the Forest's current level of goods and services and the most likely level of future goods and services if current management direction were to continue. Each alternative must represent, to the extent practicable, the most cost efficient combination of management prescriptions that satisfy the objectives of the alternative.

The Notice of Intent (NOI) to revise the Forest Plans, the Analysis of the Management Situation documents, problem statements, and decision criteria all helped identify, define, and develop a range of forest plan revision alternatives. The NOI explained the need to change the Forest Plans. It identified what needed improving and what was missing, e.g., direction for gathering special forest products, more protection for riparian habitat and rare plant species. The NOI displayed the nature and scope of the decisions to be made, and provided a description of the issues and the changes that may result from plan revision. The document also explained how the Forest would interact with individuals, organizations, tribes, and government agencies. Finally, the NOI explained how the Forest would design a process for developing draft alternatives. Four major revision topics (Access and Recreation, Biological Diversity, Special Land Allocations, and Timber Production) were identified in the NOI. They were derived from a list of potential revision topics that received public review at 13 open house meetings held throughout Wisconsin in July and August of 1995.

The Analysis of the Management Situation phase of forest plan revision determined the ability of the Forest to respond to forest planning problems, which are sub-categories of

the 4 primary issues to be addressed in this revision as per the NOI. Individual AMS reports addressed the potential range of reasonable response to addressing the issues during alternative development. National Forest Planning Regulations require the development of an alternative that reflects the current and expected levels of goods and services should the current management situation be continued (the No Action Alternative). The following AMS reports were compiled: (1) All Terrain and Off-Road Vehicles; (2) Aquatic, Riparian, and Wetland Ecosystems; (3) Ecosystem Restoration; (4) Landscape Patterns; (5) Old Growth; (6) Special Land Allocations; (7) Special Forest Products; (8) Timber Resources; (9) Wilderness and Semi-Primitive Non-Motorized Areas; and (10) Wildlife. Each problem defined in the individual AMS reports was summarized in a Problem Statement, used to share the content of these reports with the public.

National Forest Management Act Planning Regulations require the Forest Service to establish planning criteria to guide the planning process. These criteria apply to the collection and use of inventory data and information, analysis of the management situation, and the design, formulation, and evaluation of alternatives. Planning criteria guide the overall planning process. Planning criteria, including tentative evaluation criteria were developed and presented at an August 1998 public meeting in Wausau, WI. These criteria continued to evolve through the plan revision process, aiding in alternative design and providing the basis for evaluation of the net public benefits of the different Forest Plan revision alternatives.

Nine alternatives were developed and analyzed in the FEIS. Alternative 1 is the No-action alternative, and represents a combination of the two 1986 Plans into a single alternative. All other alternatives represent a set of changes addressing the NOI issues, and the associated Problems, as described in the Purpose and Need, Chapter 1. There was a reasonable range of responses designed for resolving each Problem, and then these individual Problem responses are combined in various mixes to form the range of alternatives. The Comparison of Alternatives in Chapter 2 provides an excellent overview of how these Alternatives vary from one another.

Estimating the Effects of Alternatives

The Planning Regulations (1982 version of 36 CFR 219) specify that the physical, biological, economic, and social effects of implementing each alternative must be estimated and compared according to NEPA procedures. In addition, the following effects must be specifically analyzed: (1) The expected outputs for the planning period, including marketable goods and services, as well as non-market items such as recreation and wilderness use, wildlife and fish values, and the protection and enhancement of soil, water, and air resources; (2) The direct and indirect benefits and costs that provide expected real dollar costs and values (discounted when appropriate); (3) The economic effects of the alternatives (including present net value); (4) The monetary opportunity costs associated with each alternative's management standards and resource outputs that were not assigned monetary values; and (5) The significant resource tradeoffs and opportunity costs associated with achieving alternative resource objectives.

The purpose of forest planning is to identify and select for implementation the plan alternative that most nearly maximizes net public benefits. Net public benefits are defined in the Planning Regulations as the…"overall long-term value to the nation of all outputs and positive effects (benefits) less all associated inputs and negative effects (costs) whether they can be quantitatively valued or not…consistent with the principles of multiple use and sustained yield."

Biological Evaluations

The Biological Evaluation (BE) (Appendix J) documents the analysis of the potential effects of the Alternatives on species included on the Regional Forester's Sensitive Species (RFSS) and the Threatened and Endangered Species (TES) lists.

The USDA Forest Service developed policy regarding the designation of plant and animal species (Forest Service Manual (FSM) 2670; Supplement 2600-2001-1). The RFSS list contains taxa only when they meet one or more of the following three criteria: 1) The species is declining in numbers or occurrences and evidence indicates it could be proposed for federal listing as threatened or endangered if action is not taken to reverse or stop the downward trend; 2) The species' habitat is declining and continued loss could result in population declines that lead to federal listing as threatened or endangered if action is not taken to reverse or stop the decline; and 3) The species' population or habitat is stable but limited.

Under FSM 2672.41, objectives for completing Biological Evaluations for proposed Forest Service programs and activities are: 1) To ensure that Forest Service actions do not contribute to loss of viability of any native or desired non-native plant or animal species, 2) To ensure that Forest Service activities do not cause any species to move toward federal listing, and 3) To incorporate concerns for sensitive species throughout the planning process, reducing negative impacts to species and enhancing opportunities for mitigation.

Transportation Assumptions

Subsequent to the Forestwide roads analysis (USDA Forest Service 2002) described above, there were discrepancies between the two Forests in the classification of Maintenance Level 1 and 2 roads. On the Nicolet side of the Forest, some roads were classified as Maintenance Level 1, 2, or 3 despite the fact that they were closed to public traffic. On the Chequamegon side, closed roads were classified as Maintenance Level 1. Because of this discrepancy, roads on the Nicolet side were re-evaluated to establish the appropriate maintenance level designation, particularly for roads within non-motorized areas. This was done using the road closure entry in the Forest's GIS database for each road on the Nicolet. With this updated GIS data set, some of the road mileage totals were changed between the Draft and Final version of the Environmental Impact Statement.

Models

HARVEST

HARVEST is a spatially explicit timber harvest model developed by E. J. Gustafson (1997) that was used to simulate management of the Chequamegon-Nicolet National Forest under Alternatives 1-9 over the first 100 years of implementation. The HARVEST model relied on another model, SPECTRUM (described below), to optimize timber harvest schedules within constraint limitations. In general, the HARVEST model was used as a tool for displaying the relative effects on forest cover types of each alternative.

SPECTRUM (Forest Planning Model)

Introduction

SPECTRUM is a software package developed by the Forest Service's Ecosystem Management staff, in cooperation with the Rocky Mountain Forest and Range

Experiment Station. The model optimizes management area prescriptions and allocations, and schedules activities and outputs. SPECTRUM chooses among alternative solutions given a set of constraints and an objective such as maximizing income or timber volume. The model evolved from the FORPLAN optimization model that was used in the initial round of forest planning. SPECTRUM Versions 1.5 and 2.6 were used for revising the Chequamegon and Nicolet National Forest Plans. As a tool, the model is flexible and can be adapted to the needs of each individual planning problem.

The Forest used SPECTRUM as a timber harvest-scheduling tool that reports timber outputs, costs, and benefits. The model scheduled timber harvesting for 15 decades and provided an estimate of long-term sustained yield (LTSY) capability for each of the alternatives. The model was designed to allow differentiation by District and timber land suitability (suitable or unsuitable lands). The initial model was designed to analyze the entire Forest and suitable timber lands.

SPECTRUM is a linear programming model. It assumes that the relationship between outputs and the land base are linear, e.g., twice the number of similar acres yields twice the outputs. Other resource programs such as recreation are not addressed by SPECTRUM because their relationship with the land base is not linear. SPECTRUM builds a matrix of coefficients and transfers the file to a linear programming package for problem solution. The model then writes a report and produces a data file that contains the results. The data file can then be analyzed through comparisons with information in other databases.

Model Design

Model design identified questions the model needed to answer and assessed what information was available for model input. The Planning Team identified the following factors that needed to be considered in SPECTRUM:

- Complex timber markets that involve multiple products with variability in demand and price;
- Variety of species/product yields;
- Forest type acreage projections by one or more sub-categories;
- Age class distributions by forest type/species; and
- Varied social and economic conditions across the Forest.

The following land attributes were used to stratify the model's land base: (1) Management area prescriptions, (2) Forest cover types, and (3) 10-year age-classes (with one exception).

Management Areas

A management practice is a site-specific action, measure or treatment (tree planting, trail construction, etc.) designed to implement management prescriptions. A management prescription is a combination of management practices applied to a specific management area.

Management areas are parcels of land that have a specific management prescription. The Forest was stratified into management areas with each one having its own description, prescription, and set of Standards and Guidelines. Land allocations (acres) were assigned to each management area and transferred to the model. The model selected one or more activities for each management area. The Forest Leadership Team decided early in the revision process to base management area boundaries (as much as possible) on Land

Type Associations. Given the emphasis for each management area, the model determined what type of timber harvesting should be done and when. The assignment of management area prescriptions to each alternative was based on a combination of ecological, economic, and social factors. These factors were varied across the alternatives in order to explore a range of options. SPECTRUM's allocation capabilities were applied to the management actions and timing of choices. The model estimated, by decade and management area, the following outputs and conditions:

- Maximum timber harvest totals or Allowable Sale Quantity (ASQ);
- Species/product timber harvest volumes;
- Forest cover type acres;
- Forest cover type age class distributions;
- Timber harvest methods by acres;
- Standing timber volume.

Forest Cover Types

Review of the forest cover types described in the 1986 Forest Plans and consultation with the Forest Silviculturist and other resource management specialists helped the Planning Team select the following forest types for stratifying the suitable timber landbase:

- Aspen (includes quaking and bigtooth aspen)
- Balsam fir
- Jack pine
- Paper birch
- Northern hardwoods (predominantly sugar maple, but includes several other species)
- Oak (predominantly northern red oak)
- Red pine
- White pine
- Upland spruce
- Upland openings

Age Class Distributions

Forest type age classes are needed for analyzing ecological, silvicultural, and biological information. Ten-year age classes were widely used in the preparation of forest plans and the accompanying environmental impact statements prepared in the 1980s. A decision was made to incorporate 10-year age classes into SPECTRUM since fine-scale data can be aggregated at a later time (disaggregating data is often very difficult or impossible). However, wider age classes were applied for northern hardwoods. Significant acres of northern hardwoods are being managed for an uneven-aged structure. The revised Plan will continue to emphasize managing uneven-aged northern hardwoods. The Forest Vegetation Simulator (FVS) was used to make preliminary yield projections for northern hardwood stands using 10-year age classes. Yield projection results did not justify 10-year age class differentiation. Age classes of 0-39, 40-79, and 80+ years were applied to northern hardwood types. Eventually, one set of uneven-aged yield tables for all ages was applied when it was determined that the above differentiation still did not provide significant increases in the precision of yield estimates.

Forming the Land Layer and Developing Yield Tables

The land layer is a stratified computer map of the distribution of areas (across the Forests) that affect management options and their associated environmental, social and economic effects (e.g. management areas, river corridors, and visual corridors). The level of detail contained within the land layer determines, to a large extent, the questions that the model can address. The land layer was developed early in the forest plan revision process, and contains the major spatial descriptions that affect the application of Standards and Guidelines, and application of management prescriptions across the landbase.

The development of yield tables was another major early step that took considerable time and attention. SPECTRUM "chooses" among the management actions available from a combination of land layer attributes called analysis units. The model also has management action timing choices that are defined in the management action schedule. Yield tables are combinations of land layer attributes, management actions, timing choices, and associated streams of output that are of interest. Age-dependent, time-dependent, and uneven-aged tables are three types of SPECTRUM yield tables. Age-dependent tables (for even-aged species such as aspen that are typically managed without intermediate harvests) are simply listings of projected yields by age over the range of ages of interest. Red pine and other types that are usually thinned several times over a rotation show the projected yields from the thinnings, as well as the total volumes before each scheduled thinning. A discussion among Forest timber management specialists resulted in a decision to estimate yields for the following species / products:

- Aspen pulpwood
- Balsam fir pulpwood
- Paper birch pulpwood
- Mixed hardwood pulpwood
- Spruce pulpwood
- Red and jack pine pulpwood
- White pine pulpwood
- Pine sawtimber
- Hardwood sawtimber

White pine pulpwood was separated from other pine pulpwood because, historically, it has been a low value product. Spruce and fir pulpwood were also separated because of differences in their respective values.

The Forest did not make use of time-dependent yield tables except as a technique to track age classes. Uneven-aged yield tables (as the name implies) show expected yields for uneven-aged management of northern hardwoods.

Management actions were identified after the land base was stratified and basic yield tables were developed. Management actions and timing are the options among which the model "chooses" for each analysis unit. Management actions are primarily driven by management area cover type composition objectives and are constrained by biological considerations. For example, in some management areas, the northern hardwood type occupies fewer acres than the long-term objective. In order to work toward the composition objectives, it was necessary to have management action options that convert other forest types to northern hardwoods. Management action options are sometimes

constrained by management area Standards and Guidelines. For example, some roads, trails, and streams have corridors superimposed upon management area prescriptions. Some activities are prohibited within these areas.

The Timber Activity and Control System (TRACS) is a Forest Service tool used for monitoring existing forest plans and contains timber sale yield data from the past several years. TRACS data are maintained by "working group" and harvest method for each fiscal year, and can be used to help estimate future yields. TRACS data does not include information about harvest ages. The Combined Data Systems (CDS) database provided information for harvest ages and cutting prescriptions beyond historic rotation ages. CDS has stored plot data for nearly 18,000 stands on the Forest. Random samples of CDS plots were drawn for each of the forest type/ age class combinations used to stratify the SPECTRUM model land base. Plot data needed to be processed using the Forest Vegetation Simulator model (FVS) because CDS plot data doesn't have tree height information. The above combination of TRACS, CDS, and FVS produced tabular listings of average total cubic foot volumes (by ten-year age classes) for each forest type. The confidence interval was calculated using a statistics feature of FVS applied to each stand that was processed. The mean annual increment (MAI), the average annual cubic foot volume of growth, was also displayed.

The above process tends to over estimate species product yields. Forest Inventory and Analysis (FIA) data was used to validate yield numbers. The North Central Forest Experiment Station in St. Paul, Minnesota manages the FIA program in Wisconsin. The FIA program periodically records measurements on permanent plots throughout the forested portions of the U.S. FIA plots provided unbiased samples on a systematic grid with random start locations. As an example, the Figure B-1 provides a graphical comparison of Chequamegon-Nicolet NF aspen age-based timber yields based on CDS and FIA data:

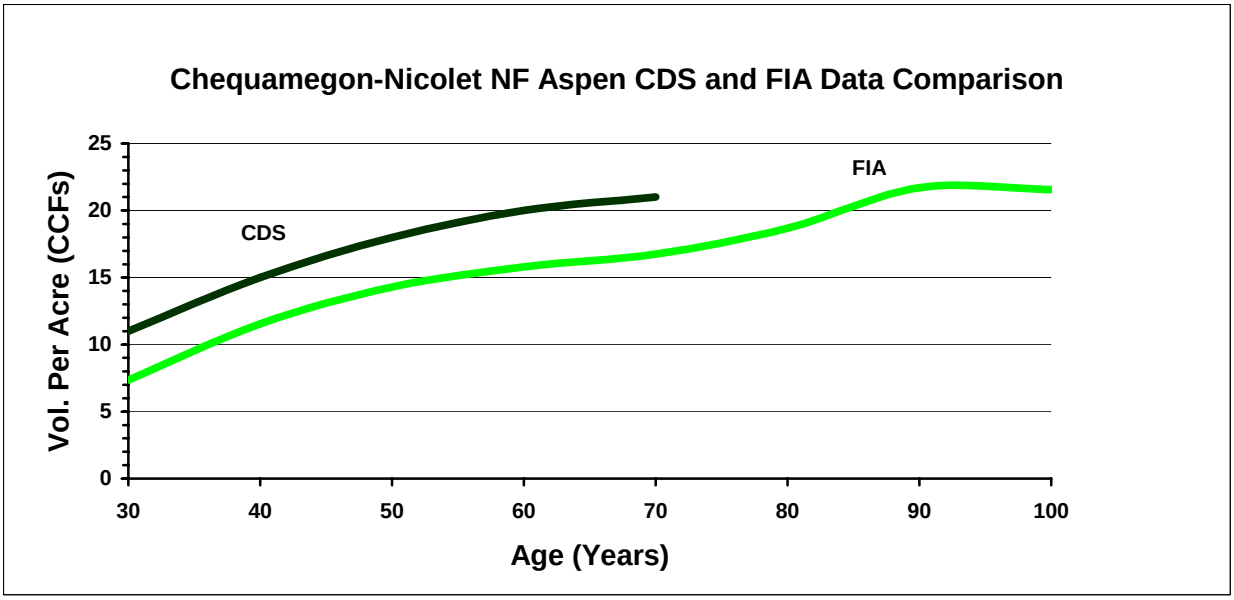

Figure B-1. Chequamegon-Nicolet NF Aspen CDS and FIA Data Comparison

The shapes of the two curves are in close agreement between the ages of 30 and 60 years. However the CDS-based yields were consistently 4-5 CCFs higher than the yields based on FIA data. The same pattern of consistently higher CDS yields was also found to exist for the other timber types. The Forest timber management staff decided to establish yield

quantities (for aspen and other species) between the CDS and FIA curves but slightly closer to the FIA-based yields. Extrapolations were made for volume determinations beyond the ages for which there was reliable data. This process provided satisfactory results for those species that are normally grown to a rotation age without an intermediate harvest (aspen, jack pine, paper birch, and balsam fir). Another process refinement was needed for accurately determining yields for even-aged species that are usually thinned one or more times in the decades preceding regeneration cuts (red pine, white pine, and white spruce).

FVS provided growth and yield projections for even-aged species that are thinned prior to regeneration cuts. FVS includes a feature known as an "event monitor" to program various types of harvests and other treatments into the projection. Using these tools, the Forest produced intermediate and regeneration harvest volume estimates for various species / products at various ages.

SPECTRUM includes a provision for uneven-aged yield tables (yields that follow projection cycles but are not based on age). CNNF northern hardwood stands are predominantly even-aged in origin but most current prescriptions are aimed at developing an uneven-aged structure. The revised Forest Plan alternatives allocate the majority of northern hardwood acres to management areas that predominantly prescribe uneven-aged management cutting prescriptions. Uneven-aged northern hardwood yield projections processed using FVS programs in a process that was similar to the one used for even-aged species. Spreadsheets were used to automate the processing and display the FVS-derived data.

The SPECTRUM menu displays a feature called Management Action Attributes. This feature is comprised of two elements – "Emphasis" and "Intensity." The Forest used Emphasis to indicate existing cover types and Intensity to show the desired type. For example, a management action with an Emphasis of jack pine and an Intensity of oak would be converted from jack pine to oak. The Table B-2 displays the Management Action Attributes and schedules used in the Chequamegon-Nicolet NF model. Each even-aged management action specifies the decade in which thinnings will begin (if applicable) and a range of decades within which regeneration will occur (for the existing analysis units and for regeneration stands until the end of the planning horizon). The schedule specifies which of the first four decades to begin harvesting under uneven-aged management.

Table B-2. Even Aged Management Options and Schedules

Emphasis Stands	Intensity	Definition	Application	Decade to Begin Thin	Decades to Regenerate	Decades to Regenerated
ASP	Aspen	Maintain Aspen	Not applied in corridors	NA	4-7	4-7
ASP	BF	Aspen to balsam	Not in corridors	NA	4-7	4-8
ASP	HDWCOV	Aspen to N. hdwds	Applied to any suit. land	NA	4-7	9-20
ASP	JP	Aspen to jack pine	Not in corridors	NA	4-7	5-7
ASP	OAK	Aspen to oak	Not in corridors	NA	4-7	9-12
ASP	Open	Aspen to upland open	Not in corridors/6B areas	NA	4-7	NA
ASP	RP	Aspen to red pine	Not in corridors	NA	4-7	8-19
ASP	WPUP	Aspen to white pine	Non-6B areas	NA	6-9	12-23
ASP	WPUP	Aspen to white pine	6B areas	NA	6-15	12-23
BF	BF	Maintain balsam	Not in corridors	NA	4-7	4-8
BF	ASP	Balsam to aspen	Not in corridors	NA	4-7	4-7
BF	HDWCOV	Balsam to N. hdwds	Any suitable land	NA	4-7	9-20
BF	RP	Balsam to red pine	Not in corridors	NA	4-7	8-19
BF	WPUP	Balsam to white pine	Any suitable land	NA	4-7	12-23
Hdwd	BF	N. hdwds. to balsam	Not in corridors	4+	6-15	4-8
Hdwd	OAK	N. hdwds to oak	Not in corridors	4+	10-14	10-14
Hdwd	Open	N. hdwds to up. open	Not in corridors/6B areas	4+	6-15	NA
Hdwd	WPUP	N. hdwds to wt. pine	Any suitable land	4+	9-14	11-23
JP	JP	Maintain jack pine	Not in corridors	NA	4-8	5-7
JP	ASP	Jack pine to aspen	Not in corridors	NA	4-8	4-7
JP	HDWCOV	Jack pine to N. Hdwds	Any suitable land	NA	4-8	9-20
JP	OAK	Jack pine to oak	Not in corridors	NA	5-8	7-14
JP	Open	Jack pine to upland op.	Not in corridors/6B areas	NA	5-8	NA
JP	RP	Jack pine to red pine	Not in corridors	NA	4-8	8-19
JP	WPUP	Jack pine to wt. pine	Any suitable land	NA	5-8	11-23
OAK	OAK	Maintain oak	Any suitable land	6+	9-12	9-12
OAK	ASP	Oak to aspen	Not in corridors	6+	7-10	4-7
OAK	HDWCOV	Oak to N. hdwds	Any suitable land	6+	7-10	9-20
OAK	JP	Oak to jack pine	Not in corridors	6+	7-10	5-7
OAK	RP	Oak to red pine	Not in corridors	6+	7-10	8-19
OAK	WPUP	Oak to white pine	Any suitable land	NA	8-10	12-23
Open	BF	Open to balsam	Succession of upland opens	NA	N/A	4-8
PB	PB	Maintain paper birch	Not in corridors	NA	6-9	6-9
PB	ASP	Paper birch to aspen	Not in corridors	NA	6-8	4-7
PB	HDWCOV	P. birch to N. hdwds	Any suitable land	NA	6-9	10-20
PB	OAK	P. birch to oak	Not in corridors	NA	6-8	9-12
PB	RP	P. birch to red pine	Not in corridors	NA	6-8	8-19
PB	WPUP	P. birch to white pine	Any suitable land	NA	6-8	11-22
RP	RP	Maintain red pine	Not in corridors	3+	9-20	9-20
RP	ASP	Red pine to aspen	Not in corridors	3+	9-20	4-7
RP	HDWCOV	Red pine to N. hdwds	Any suitable land	3+	9-20	9-20
RP	JP	Red pine to jack pine	Not in corridors	3+	9-20	5-7
RP	OAK	Red pine to oak	Not in corridors	3+	9-20	9-12
RP	Open	Red pine to open	Not in corridors/6B areas	3+	9-18	N/A
RP	WPUP	Red pine to wt. pine	Only in corridors	3+	9-20	12-23
SP	SP	Maintain up. spruce	Any suitable land	5+	8-12	8-13
SP	ASP	Spruce to aspen	Not in corridors	5+	8-12	4-7
SP	HDWCOV	Spruce to N. hdwds	Any suitable land	5+	8-12	9-20
SP	JP	Spruce to jack pine	Not in corridors	5+	8-12	5-7
SP	RP	Spruce to red pine	Not in corridors	5+	8-12	9-20
SP	WPUP	Spruce to white pine	Any suitable land	5+	8-12	12-23

Model Assumptions and Constraints

Assumptions made for modeling management area prescriptions, allocations, outputs, and scheduling activities are listed below. Following this list of assumptions is a table (Table B-3) that lists the constraints included in the SPECTRUM model in order to represent these assumptions.

- All management area (MA) species composition objectives are met within the 150 year horizon;
- Standard rotation ages are used for all timber harvesting prescriptions (except Alternative Management Areas);
- Maximum rotation ages are used for all Alternative Management Area (AMA) prescriptions (MAs 2B, 3B, 4B; and 4C);
- Desired age class diversity objectives are met as soon as possible for aspen, paper birch, balsam fir, red oak, even-aged hardwoods, white pine, and white spruce species;
- The specifications in Table X (Forestwide Standards and Guidelines) are used for all uneven-aged hardwood prescriptions (except within AMAs);
- The specifications in Table Y (Forestwide Standards and Guidelines) are used for all uneven-aged hardwood prescriptions within AMAs;
- Hemlock, lowland conifers, lowland hardwoods, and upland openings are classified as unsuitable forest lands;
- Clearcutting is not allowed within visual, trout stream, and “Best Management Practices” corridors;
- Reserve islands within clearcuts and overstory removal cuts are at least ½ acre for every 10 acres harvested;
- Timber harvest volumes are reduced 4.3% for protecting known threatened, endangered, and sensitive species sites;
- Timber harvest volumes are reduced 2.2% for road acreage;
- Reserve tree guidelines are built into timber harvesting prescriptions;
- Allowable Sale Quantity (ASQ) only includes timber harvest volumes within MAs 1-4 and 6B;
- Aspen acreage reductions (for species composition objectives) are greatest during decades 2-6 (75% of planned reduction). The remaining reduction occurs (evenly spaced) in decades 7-15;
- The range of MA aspen acreage reductions are as follows: MAs 1A & 4C reduce 0-10%; MAs 1B, 1C, and 4A reduce 5-15%; MAs 2A, 2C, 3A, and 3C reduce 10-20%; and MAs 2B, 3B, and 4B reduce 60-80%;
- Species conversions are limited to 5% of the previous decade’s total;
- Do not convert target species to non-target species (don’t convert oak to white pine or aspen in MA 3C; don’t convert red pine to aspen or oak in MA 4A; and don’t convert aspen, paper birch, or jack pine to northern hardwoods in MA 4C);
- Allow natural conversions of upland openings (where conversions are planned or needed);
- Maintain 80% of the existing jack pine within MA 4A;
- Emphasize white pine regeneration within MAs 4A and 4B;
- Emphasize jack pine regeneration within MAs 4A and 4C;

- Emphasize red oak and white pine regeneration within MAs 3B and 3C;
- Assume that aspen, paper birch, jack pine, and white spruce will all convert to other long-lived species if they are not maintained with management prescriptions;
- The allowable sale quantity will not go down between decades.

Table B-3. SPECTRUM Model Constraints by MA

Description (program code*)	Values	Reason
Acres of aspen in MA 2A (not in corridors) (2aa)	Decades 10-15 maintain <= 40% of decade 1	Allow at least 60% of aspen in this MA to convert to other types
Acres of aspen in MA 2B (not in corridors) (2ba)	Decades 10-15 maintain <= 25% of decade 1	Allow at least 75% of aspen in this MA to convert to other types
Acres of hardwoods in MA 3B (flow constraint) (2h3b)	Maintain >= 100% of previous decade	Model converts hardwoods w/o constraint
Acres of aspen in MA 3B (not in corridors) (3ba)	Decades 10-15 maintain <= 30% of decade 1	Allow at least 70% of aspen in this MA to convert to other types
Acres of aspen in MA 4B (not in corridors) (4ba)	Decades 10-15 maintain <= 25% of decade 1	Allow at least 75% of aspen in this MA to convert to other types
Acres clearcut in MA 6B (outside of corridors) (6BCC)	Decade 1-15 <= 5% of 6BCT	Limit clearcuts to 10 acres
Acres of shelterwood harvest in MA 6B (including corridors) (6BSC)	Decade 1-15 <5% of 6BST	Limit timber harvesting to no more than half of upland acres in any given 6B area
Acres of aspen in MA 1A (a1a)	Decade 15 maintain 50-75% of upland aspen	Forest type composition objective (MA 1A)
Acres of aspen in MA 1A (a1a)	Decade 15 maintain <= 100% of decade 1	Allow some aspen in MA 1A to convert to other forest types
Acres of aspen in MA 1A (a1a2)	Maintain >= 80% of previous decade	Limits conversions in any one decade
Acres of aspen in MA 1B (a1b)	Decade 15 maintain 35-55% of upland aspen	Forest type composition objective (MA 1B)
Acres of aspen in MA 1B (a1b)	Decade 15 maintain <= 95% of decade 1	Allow at least 5% of aspen in MA 1B to convert to other forest types.
Acres of aspen in MA 1B (a1b2)	Maintain >= 80% of previous decade	Limits conversions in any one decade
Acres of aspen in MA 1C (a1c)	Decade 15 maintain 35-55% of upland aspen	Forest type composition objective (MA 1C)
Acres of aspen in MA 1C (a1c)	Decade 15 maintain <= 95% of decade 1	Allow at least 5% of aspen in MA 1C to convert to other forest types
Acres of aspen in MA 1C (a1c2)	Maintain >= 80% of previous decade	Limits conversions in any one decade
Acres of aspen in MA 2A (a2a)	Decade 15 maintain 5-20% of upland aspen	Forest type composition objective (MA 2A)
Acres of aspen in MA 2C (a2c)	Decade 15 maintain 15-30% of upland aspen	Forest type composition objective (MA 2C)
Acres of aspen in MA 2C (a2c)	Decade 15 maintain <= 90% of decade 1	Allow at least 10% of aspen in MA 2C to convert to other forest types
Acres of aspen in MA 2C (a2c2)	Maintain >= 80% of previous decade	Limits conversions in any one decade
Acres of aspen in MA 3B (a3b)	Decade 15 maintain 5-10% of upland aspen	Forest type composition objective (MA 3B)
Acres of aspen in MA 3C (a3c)	Decade 15 maintain 20-40% of upland aspen	Forest type composition objective (MA 3C)
Acres of aspen in MA 3C (a3c)	Decade 15 maintain <= 90% of decade 1	Allow at least 10% of aspen in MA 3C to convert to other forest types
Acres of aspen in MA 3C (a3c2)	Maintain >= 80% of previous decade	Limits conversions in any one decade
Acres of aspen in MA 4A (a4a)	Decade 15 maintain 10-30% of upland aspen	Forest type composition objective (MA 4A)
Acres of aspen in MA 4A (a4a)	Decade 15 maintain <= 95% of decade 1	Allow at least 5% of aspen in MA 4A to convert to other forest types
Acres of aspen in MA 4A (a4a2)	Maintain >= 80% of previous decade	Limits conversions in any one decade
Acres of aspen in MA 4B (a4b)	Decade 15 maintain <= 7% of aspen upland	Forest type composition objective (MA 4B)
Acres of aspen in MA 4C (a4c)	Decade 15 maintain 20-35% of aspen upland	Forest type composition objective (MA 4C)
Acres of aspen in MA 4C (a4c)	Decade 15 maintain <= 100% of decade 1	Allow some aspen in MA 4C to convert to other forest types
Acres of aspen in MA 4C (a4c2)	Maintain >= 80% of previous decade	Limits conversions over time
Amount of aspen pulpwood (ap)	Maintain 80-140% of previous decade volume	Species/product flow
Aspen 0-9 Years, suitable lands (MA's with clearcutting) (as1)	Maintain 85-115% of previous decade	Limits conversions over time
Acres of balsam fir 0-9 Years (bf1)	Decade 5-15 maint 15-25% of bf type in 0-9 years	Desired age class diversity for species
Acres of balsam fir 0-9 Years (bf1)	Decade 10-15 maint 80-120% of previous decade	Limits conversions over time
Acres of balsam fir in MA 1A (bf1a)	Decade 15 maintain <= 10% of upland	Forest type composition objective (MA 1A)
Acres of balsam fir in MA 1B (bf1b)	Decade 15 maintain <= 10% of upland	Forest type composition objective (MA 1B)

Description (program code*)	Values	Reason
Acres of balsam fir in MA 1C (bf1c)	Decade 15 maintain <= 10% of upland	Forest type composition objective (MA 1C)
Acres of balsam fir in MA 2A (bf2a)	Decade 15 maintain <= 3% of upland	Forest type composition objective (MA 2A)
Acres of balsam fir in MA 2B (bf2b)	Decade 15 maintain <= 3% of upland	Forest type composition objective (MA 2B)
Acres of balsam fir in MA 2C (bf2c)	Decade 15 maintain <= 3% of upland	Forest type composition objective (MA 2C)
Acres of balsam fir in MA 3B (bf3b)	Decade 15 maintain <= 3% of upland	Forest type composition objective (MA 3B)
Acres of balsam fir in MA 3C (bf3c)	Decade 15 maintain <= 5% of upland	Forest type composition objective (MA 3C)
Acres of balsam fir in MA 4A (bf4a)	Decade 15 maintain <= 3% of upland	Forest type composition objective (MA 4A)
Acres of balsam fir in MA 4B (bf4b)	Decade 15 maintain <= 3% of upland	Forest type composition objective (MA 4B)
Acres of balsam fir in MA 4C (bf4c)	Decade 15 maintain <= 3% of upland	Forest type composition objective (MA 4C)
Softwood pulpwood (conp)	Maint 80-150% of previous decade volume	Species / product flow
Hardwood pulpwood (including paper birch) (hdwp)	Maint 80-140% of previous decade volume	Species / product flow
Acres of all hardwoods in MA 1A (hh1a)	Maintain 80-120% from previous decade	Limits conversions over time
Acres of all hardwoods in MA 1A (hh1a)	Decade 15 maint 5-20% of hardwood upland ac	Forest type composition objective (MA 1A)
Acres of all hardwoods in MA 1B (hh1b)	Decade 15 maint 5-15% of hardwood upland ac	Forest type composition objective (MA 1B)
Acres of all hardwoods in MA 1C (hh1c)	Decade 15 maint 15-40% of hardwood upland ac	Forest type composition objective (MA 1C)
Acres of all hardwoods in MA 2A (hh2a)	Decade 15 maint 40-70% of hardwood upland ac	Forest type composition objective (MA 2A)
Acres of all hardwoods in MA 2B (hh2b)	Decade 15 maint 50-80% of hardwood upland ac	Forest type composition objective (MA 2B)
Acres of all hardwoods in MA 2C (hh2c)	Decade 15 maint 30-50% of hardwood upland ac	Forest type composition objective (MA 2C)
Acres of all hardwoods in MA 3B (hh3b)	Decade 15 maintain >= 10% of upland	Forest type composition objective (MA 3B)
Acres of all hardwoods in MA 3B (hh3b)	Maintain >= 100% from previous decade	Emphasizes hardwoods in MA 3B
Acres of all hardwoods in MA 3C (hh3c)	Decade 15 maint 10-25% of hardwood upland ac	Forest type composition objective (MA 3C)
Acres of all hardwoods in MA 4A (hh4a)	Maint <= 100% hardwoods from previous decade	Allow some conversion to other forest types
Acres of all hardwoods in MA 4A (hh4a)	Decade 15 maintain <= 25% of upland acres	Forest type composition objective (MA 4A)
Acres of all hardwoods in MA 4B (hh4b)	Decade 15 maint <=10% of hardwood upland ac's	Forest type composition objective (4B)
Acres of all hardwoods in MA 4C (hh4c)	Maintain <= 100% of hdwd from previous decade	De-emphasizes hardwoods in MA 4C
Acres of all hardwoods in MA 4C (hh4c)	Decade 15 maint <=10% of hardwood upland ac's	Forest type composition objective (MA 4C)
Hardwood sawtimber (hws)	Maintain 80-150% of previous decade volume	Species / product flow
Acres of jack pine 0-9 years (jp1)	Decade 5-15 maintain 10-20% of jp type 0-9 yrs	Desired age class diversity for species
Acres of jack pine 0-9 years (jp1)	Decade 10-15 maint 80-120% of previous decade	Limits conversions over time
Acres of Jack pine in MA 1A (j1a)	Decade 15 maintain <= 2% of upland	Forest type composition objective (MA 31A)
Acres of Jack pine in MA 1B (j1b)	Decade 15 maintain <= 10% of upland	Forest type composition objective (MA 1B)
Acres of Jack pine in MA 1C (j1c)	Decade 15 maintain <= 5% of upland	Forest type composition objective (MA 1C)
Acres of Jack pine in MA 2A (j2a)	Decade 15 maintain <= 2% of upland	Forest type composition objective (MA 2A
Acres of Jack pine in MA 2B (j2b)	Decade 15 maintain <= 2% of upland	Forest type composition objective (MA 2B)
Acres of Jack pine in MA 2C (j2c)	Decade 15 maintain <= 2% of upland	Forest type composition objective (MA 2C)
Acres of Jack pine in MA 3B (j3b)	Decade 15 maintain <= 5% of j. pine upland acres	Forest type composition objective (MA 3B)
Acres of Jack pine in MA 4A (j4a)	Decade 15 maintain >= 80% of decade 1 jp acres	Allow up to 20% of jack pine in MA 4A to convert to other forest types
Acres of Jack pine in MA 4B (j4b)	Decade 15 maintain 3-5% of j.pine upland acres	Forest type composition objective (MA 4B)
Acres of Jack pine in MA 4C (j4c)	Decade 15 maintain >= 35% of j.pine upland acres	Forest type composition objective (MA 4C)
Acres of Jack pine in MA 4C (j4c)	Decade 15 maintain >= 100% of decade 1 jp acres	Allow conversion to jack pine in MA 4C
Acres of oak 0-9 Years (ok1)	Decade 10-15 maint 80-120% of previous decade	Limits conversions over time
Acres of oak 0-19 Years (ok1)	Decade 5-15 maint 15-25% of oak type 0-19 yrs	Desired age class diversity for species
Acres of oak in MA 1A (ok1a)	Decade 15 maintain <= 5% of oak upland acres	Forest type composition objective (MA 1A)
Acres of oak in MA 1B (ok1b)	Decade 15 maintain <= 5% of oak upland acres	Forest type composition objective (MA 1B)
Acres of oak in MA 1C (ok1c)	Decade 15 maintain <= 10% of oak upland acres	Forest type composition objective (MA 1C)
Acres of oak in MA 2A (ok2a)	Decade 15 maintain <= 5% of oak upland acres	Forest type composition objective (MA 2A)
Acres of oak in MA 2B (ok2b)	Decade 15 maintain <= 3% of oak upland acres	Forest type composition objective (MA 2B)
Acres of oak in MA 2C (ok2c)	Decade 15 maintain <= 10% of oak upland acres	Forest type composition objective (MA 2C)
Acres of oak in MA 3B (ok3b)	Decade 15 maintain 20-45% of oak upland acres	Forest type composition objective (MA 3B)
Acres of oak in MA 3C (ok3c)	Decade 15 maintain 20-40% of oak upland acres	Forest type composition objective (MA 3C)
Acres of oak in MA 4A (ok4a)	Decade 15 maintain <= 25% of oak upland acres	Forest type composition objective (MA 4A)

Description (program code*)	Values	Reason
Acres of oak in MA 4B (ok4b)	Decade 15 maintain 10-25% of oak upland acres	Forest type composition objective (MA 4B)
Acres of oak in MA 4C (ok4c)	Decade 15 maintain 10-25% of oak upland acres	Forest type composition objective (MA 4C)
Acres of aspen 50+ years (olda)	Decade 10-15 maint >= 5% of aspen type in old gr	Desired age class diversity for species
Acres of birch 60+ years (oldb)	Decade 10-15 maint 20-30% of birch type in old gr	Desired age class diversity for species
Acres of balsam fir 50+ years (oldf)	Decade 10-15 maint 5-15% of bf type in old gr	Desired age class diversity for species
Acres of jack pine 50+ years (oldj)	Decade 10-15 maint 15-25% of jp type in old gr	Desired age class diversity for species
Acres of oak 80+ years (oldo)	Decade 10-15 maint 20-30% of oak type in old gr	Desired age class diversity for species
Acres of red pine 100+ yrs (oldr)	Decade 10-15 maint 15-35% of rp type in old gr	Desired age class diversity for species
Acres of spruce 80+ yrs (olds)	Decade 10-15 maint 20-30% of sp type in old gr	Desired age class diversity for species
Acres of white pine 120+ yrs (oldw)	Decade 10-15 maint 20-40% of wp type in old gr	Desired age class diversity for species
Acres of upland open's in MA 1A (op1a)	Maint >= 100% of openings from previous decade	Emphasizes openings in MA 1A
Acres of upland open's in MA 1B (op1b)	Decade 15 maintain 1-3% of openings	Forest type composition objective (MA 1B)
Acres of upland open's in MA 1C (op1c)	Decade 15 maintain 1-4% of openings	Forest type composition objective (MA 1C)
Acres of upland open's in MA 2A (op2a)	Decade 15 maintain <= 1% of upland openings	Forest type composition objective (MA 2A)
Acres of upland open's in MA 2B (op2b)	Decade 15 maintain <= 1% of upland openings	Forest type composition objective (MA 2B)
Acres of upland open's in MA 2C (op2c)	Decade 15 maintain 1-2% of openings	Forest type composition objective (MA 2C)
Acres of upland open's in MA 3B (op3b)	Maintain 100% of openings from decade 1	Emphasizes openings in MA 3B
Acres of upland open's in MA 3C (op3c)	Decade 15 maintain 1-3% of openings	Forest type composition objective (MA 3C)
Acres of upland open's in MA 4A (op4a)	Decade 15 maintain >= 1% of upland openings	Forest type composition objective (MA 4A)
Acres of upland open's in MA 4B (op4b)	Decade 15 maintain 2-8% of upland openings	Forest type composition objective (MA 4B)
Acres of upland open's in MA 4C (op4c)	Decade 15 maintain 6-8% of openings	Forest type composition objective (MA 4C)
Acres of upland open's in MA 6B (no corridors) (op6b)	Decade 5-15 maint <= 1% of upland openings	Limits opening constr / maint in MA 6B
Acres of paper birch 0-19 years (pb12)	Decade 10-15 maint 20-30% of pb 0-19 years	Desired age class diversity for species
Acres of paper birch (pb15)	Decade 15 maintain 40-50% pb from decade 1	Limits conversions over time
Acres of paper birch in MA 1A (pb1a)	Decade 15 maintain <= 5% of pb upland acres	Forest type composition objective (MA 1A)
Acres of paper birch in MA 1B (pb1b)	Decade 15 maintain <= 5% of pb upland acres	Forest type composition objective (MA 1B)
Acres of paper birch in MA 1C (pb1c)	Decade 15 maintain <= 10% of pb upland acres	Forest type composition objective (MA 1C)
Acres of paper birch in MA 2A (pb2a)	Decade 15 maintain <= 5% of pb upland acres	Forest type composition objective (MA 2A)
Acres of paper birch in MA 2B (pb2b)	Decade 15 maintain <= 2% of pb upland acres	Forest type composition objective (MA 2B)
Acres of paper birch in MA 2C (pb2c)	Decade 15 maintain <= 5% of pb upland acres	Forest type composition objective (MA 2C)
Acres of paper birch in MA 3B (pb3b)	Decade 15 maintain <= 10% of pb upland acres	Forest type composition objective (MA 3B)
Acres of paper birch in MA 3C (pb3c)	Maintain 70% of paper birch from decade 1	Emphasizes PB in MA 3C
Acres of paper birch in MA 4A (pb4a)	Decade 15 maintain <= 5% of pb upland acres	Forest type composition objective (MA 4A)
Acres of paper birch in MA 4B (pb4b)	Decade 15 maintain <= 5% of pb upland acres	Forest type composition objective (MA 4B)
Acres of paper birch in MA 4C (pb4c)	Decade 15 maintain <= 5% of pb upland acres	Forest type composition objective (MA 4C)
Acres of red, white and jack pine (pn4a)	Decade 15 maint >= 30% r w & j pine upland acres	Forest type composition objective (MA 2B)
Acres of red pine 0-9 years (rp1)	Decade 10-15 maint 80-120% of previous decade	Limits conversions over time
Acres of red pine 0-19 years (rp12)	Decade 5-15 maint 10-20% of rp 0-19 years	Desired age class diversity for species
Acres of red pine in MA 1A (rp1a)	Maintain <=100% of decade 1 red pine	Reduces emphasis on rp, increases wp % in MA 1A
Acres of red pine in MA 1B (rp1b)	Maintain <=100% of decade 1 red pine	Reduces emphasis on rp, increases wp% in MA 1B
Acres of red pine in MA 1C (rp1c)	Maintain <=100% of decade 1 red pine	Reduces emphasis on rp, increases wp% in MA 1C
Acres of red pine in MA 2A (rp2a)	Maintain <=100% of decade 1 red pine	Reduces emphasis on rp, increases wp% in MA 2A
Acres of red pine in MA 2B (rp2b)	Maintain <=100% of decade 1 red pine	Reduces emphasis on rp, increases wp% in MA 2B
Acres of red pine in MA 2C (rp2c)	Maintain <=100% of decade 1 red pine	Reduces emphasis on rp, increases wp% in MA 2C
Acres of red pine in MA 3B (rp3b)	Maintain <=100% of decade 1 red pine	Reduces emphasis on rp, increases wp% in MA 3B
Acres of red pine in MA 4A (rp4a)	Maintain <=100% of decade 1 red pine	Reduces emphasis on rp, increases wp% in MA 4A
Acres of red pine in MA 4B (rp4b)	Maintain <=100% of decade 1 red pine	Reduces emphasis on rp, increases wp% in MA 4B

Description (program code*)	Values	Reason
Acres of red pine in MA 4C (rp4c)	Maintain 90-110% of decade 1 red pine	Limits conversions in any one decade
Acres red & white pine in MA 1B (rw1b)	Decade 15 maint 5-30% of rp/wp upland acres	Forest type composition objective (MA 1B)
Acres red & white pine in MA 1C (rw1c)	Decade 15 maint 5-20% of rp/wp upland acres	Forest type composition objective (MA 1C)
Acres red & white pine in MA 2A (rw2a)	Decade 15 maint 5-20% of rp/wp upland acres	Forest type composition objective (MA 2A)
Acres red & white pine in MA 2B (rw2b)	Decade 15 maint <= 10% of rp/wp upland acres	Forest type composition objective (MA 2B)
Acres red & white pine in MA 2C (rw2c)	Decade 15 maint 10-30% of rp/wp upland acres	Forest type composition objective (MA 2C)
Acres red & white pine in MA 3B (rw3b)	Decade 15 maint 10-25% of rp/wp upland acres	Forest type composition objective (MA 3B)
Acres red & white pine in MA 3C (rw3c)	Decade 15 maint 5-15% of rp/wp upland acres	Forest type composition objective (MA 3C)
Acres red & white pine in MA 4A (rw4a)	Decade 15 maintain 10-50% of rp/wp upland ac's	Forest type composition objective (MA 4A)
Acres red & white pine in MA 4B (rw4b)	Decade 15 maintain 45-70% of rp/wp upland ac's	Forest type composition objective (MA 4B)
Acres red & white pine in MA 4C (rw4c)	Decade 15 maintain 20-30% of rp/wp upland ac's	Forest type composition objective (MA 4C)
Tree planting (plnt)	Tree planting >= 6,000 acres per decade	Artificial regeneration of white pine and other species
Underplanting white pine (wpup)	Decade 1-5 underplant wp >= 2,000 ac/decade	Regenerate white pine
Underplanting white pine (wpup)	Decade 6-15 underplant wp >= 800 ac/decade	Regenerate white pine
Site preparation (psp)	Prepare sites for planting >= 6,000 ac/decade	Artificial regeneration of white pine and other species
Conversion of short to long-lived types (shlg)	Maintain 90-110% of previous decade treatment	Limits conversions in any one decade
Acres of Spruce 0-19 years (sp12)	Decade 5-15 maint 15-25% of Spruce 0-19 years	Desired age class diversity for species group
Acres of upland spruce in MA 1A (sp1a)	Decade 15 maint <= 5% of spruce upland acres	Forest type composition objective (MA 1A)
Acres of upland spruce in MA 1B (sp1b)	Decade 15 maint <= 10% of spruce upland acres	Forest type composition objective (MA 1B)
Acres of upland spruce in MA 1C (sp1c)	Decade 15 maint <= 10% of spruce upland acres	Forest type composition objective (MA 1C)
Acres of upland spruce in MA 2A (sp2a)	Decade 15 maint <= 15% of spruce upland acres	Forest type composition objective (MA 2A)
Acres of upland spruce in MA 2B (sp2b)	Decade 15 maint <=15% of spruce upland acres	Forest type composition objective (MA 2B)
Acres of upland spruce in MA 2C (sp2c)	Decade 15 maint <=15% of spruce upland acres	Forest type composition objective (MA 2C)
Acres of upland spruce in MA 3B (sp3b)	Decade 15 maint <= 10% of spruce upland acres	Forest type composition objective (MA 3B)
Acres of upland spruce in MA 3C (sp3c)	Decade 15 maint <= 5% of spruce upland acres	Forest type composition objective (MA 3C)
Acres of upland spruce in MA 4A (sp4a)	Decade 15 maint <= 5% of spruce upland acres	Forest type composition objective (MA 4A)
Acres of upland spruce in MA 4B (sp4b)	Decade 15 maint <= 10% of spruce upland acres	Forest type composition objective (MA 4B)
Acres of upland spruce in MA 4C (sp4c)	Decade 15 maint <= 10% of spruce upland acres	Forest type composition objective (MA 4C)
Acres of white pine 0-9 years (wp1)	Decade 10-15 maint 80-120% of previous decade	Limits conversions in over time
Acres of white pine 0-19 years (wp12)	Decade 5-15 maint 10-20% of wp 0-19 years	Desired age class diversity for species
Acres white pine in MA 4A (wp4a)	Maintain >= 100% of wp from previous decade	Emphasizes white pine in 4A
Acres white pine in MA 4B (wp4b)	Maintain 90-150% of wp from previous decade	Limits conversions in any one decade
Acres white pine in MA 4C (wp4c)	Maintain >= 100% of wp from previous decade	Limits conversions in any one decade

**Program code is the shorthand notation for the constraint used in the SPECTRUM program.*

The following constraints were required to set minimum management levels for SPECTRUM benchmark runs (Alternative 2 was used as a baseline for establishing thresholds):

Constraints Related to Species Viability Concerns:

- Maintain 80% or more of the existing jack pine in Management Area (MA) 4A for Connecticut warbler habitat;
- Maintain 100% of the existing jack pine habitat or at least 35% of the upland acres (whichever is less) in MA 4C for Connecticut warbler habitat;
- Protect Connecticut warbler habitat by maintaining 3-6% of the upland jack pine acres in MA 4B with 15-25% of jack pine at least 50 years old;
- Reduce suitable timber land acres by 4.3% for threatened, endangered, and sensitive species habitat protection;

- Exclude hemlock, lowland conifers, lowland hardwoods, research natural areas (MA 8E), and special management areas (MA 8F) from the suitable timber base;
- Utilize "Wisconsin's Forestry Best Management Practices" (BMPs) for managing forest riparian zones;
- Maintain one 50,000-acre block of uneven-aged hardwoods on each side of the Forest.
- Maintain Alternative 2 MA 2B acres (current composition objectives and desired age age-class structure); and
- Maintain at least a combined total of 100,000 acres of MA 2A and 2B acres for Alternative 2 (current composition objectives and desired age age-class structure).

Other Constraints for Minimum Land Allocation Requirements:

- Exclude existing wilderness areas (MA 5); the Argonne Experimental Forest (MA 8A), the Oconto River Seed Orchard (MA 8B); the Moquah Barrens and Riley Lake Wildlife Areas (MA 8C); and existing and candidate wild, scenic, and recreation river corridors (MA 8D) the from the suitable timber base;
- Maintain 2.2% of the reduction in suitable timber lands for areas occupied by roads; and
- Add recommended wilderness areas (MA 5B) and old growth (MA 8G) to the suitable timber base.

Timber Volume Constraints Released:

- Minimum rotation lengths will not be applied;
- No requirement for one-half acre reserve areas (1/2 acre for every 10 acres clearcut);
- No requirement for reserve trees
- Allow aspen management within trout stream corridors (up to the BMP set back area);
- Allow clearcutting within visual corridors; and
- Allow tree planting within currently forested openings

Revenues and Costs

Table B-4 displays the weighted average price per MBF (thousand board feet) and CCF (hundred cubic feet) for ten species products (based on 1999-2001 timber sale receipts):

Table B-4. Weighted Average Price per MBF

Species / Product	Value / MBF ($)	Value / CCF ($)
Aspen Pulpwood	$55.61	$35.20
Balsam Fir Pulpwood	$29.34	$18.58
Spruce Pulpwood	$58.04	$36.74
Pine Pulpwood	$75.02	$47.49
Pine Sawtimber	$213.57	$115.33
Paper Birch Pulpwood	$41.77	$26.44
Northern Hardwoods Pulpwood	$31.58	$19.99
Northern Hardwoods Sawtimber	$260.37	$140.60
Lowland Hardwoods Pulpwood	$30.97	$19.60
Lowland Conifer Pulpwood	$21.42	$13.56

Table B-5 displays the average timber sale planning, preparation, and administration costs used in SPECTRUM (three-year averages for Fiscal Years 1999-2001):

Table B-5. Average Timber Sale Planning, Preparation and Administration Costs

Activity	Average Costs Per Acre	
	Clearcut	Other Harvest Methods
Sale Planning	$185	$185
Sale Preparation	$70	$140
Sale Administration	$39	$59
Total Costs / Acre	$294	$384

Table B-6 displays the average per acre cost for timber post sale activities, by forest type objective, used in SPECTRUM (averages for 1999-2001):

Table B-6. Costs of Post Sale Activities by Forest Type Objective

Forest Type Objective	Avg. Post Sale
Aspen	$49
Balsam Fir	$69
Northern Hardwoods (Uneven-aged and	$28
Spruce	$478
Jack Pine	$363
Paper Birch	$150
Oak	$114
Red Pine	$658
White Pine	$915
Hemlock	$1,408
Opening (maintenance)	$195

Projections

Minimum Management Requirements

All Forest Plan alternatives considered in detail in the FEIS must meet minimum management requirements (described in the 1982 Planning Regulations, 36 CFR 219.27). These requirements guide the development, analysis, approval, implementation, monitoring, and evaluation of the Forest Plan. Minimum management requirements need to be achieved with the implementation of the selected alternative. Minimum management requirement categories include resource protection, vegetative manipulation, silvicultural practices, even-aged management, riparian areas, soil and water, and diversity. Minimum management requirements are most effectively addressed through management prescriptions and forestwide and management area standards and guidelines.

The costs associated with achieving the minimum management requirements were incorporated into the analysis with the SPECTRUM Model. The costs reflect the personnel, equipment, and other factors needed to meet the various requirements. The costs of achieving the minimum management requirements reflect the influence of different site characteristics as described by the management areas.

Benchmarks

Benchmarks analyses provide baseline data to support formulation of alternatives, and aid in defining the range within which alternatives can be constructed. Benchmarks estimate the Forest's physical, biological, and technical capabilities to produce goods and services. The Planning Regulations specify that as a minimum, the Analysis of the Management Situation shall include benchmark analyses that define: (1) the range within which alternatives can be constructed; (2) the minimum level of management needed to maintain and protect the unit as part of the National Forest System together with associated costs and benefits; (3) the maximum physical and biological production potentials of individual significant goods and services together with associated benefits and costs; and (4) monetary benchmarks that estimate the maximum present net value of those resources having established market value or an assigned value.

The present net values (PNV) of all benchmarks are listed in Table B-12, along with the timber production associated with each. Recreation visitor days (RVDs) were assumed to be constant across all alternatives, with the exception of big and small game hunting RVDs. Hunting RVDs varied according to the timber types harvested and maintained on the landbase.

Maximum Timber Benchmarks: These benchmarks provide baseline timber production capability references, based on several different sets of assumptions as per the description of each benchmark listed below. The Maximum Timber Benchmarks utilize the maximum potential area of the Forest that can be classified as suitable for timber production. Forest land not considered as suitable for timber production in these benchmark analyses include non-forested land, land that is defined as physically unsuitable for timber management (according to the Planning Regulations), and land removed through statute or administrative action (such as designated wilderness). Maximum timber benchmarks were developed both with and without non-declining even flow requirements for timber production, and with and without the requirement that even-aged harvesting occur at or beyond the culmination of mean annual increment.

Maximum Present Net Value (PNV) Benchmarks: These benchmarks reflect the maximum value of discounted revenues minus discounted costs. Monetary benchmarks estimate the PNV for resources with established market values and those with assigned values. PNV calculations are made using a discounting formula with a 4% discount rate. The PNV for major market-priced outputs is maximized by estimating the mix of uses combined with a schedule of outputs and costs. Benchmarks for major market-priced outputs were developed both with and without non-declining even flow requirements for timber production, and with and without the requirement that even-aged harvesting occur at or beyond the culmination of mean annual increment.

Minimum Level Benchmarks: The Planning regulations require the identification of a Minimum Level Benchmark (minimum maintenance and protection of the Forest). This benchmark represents only those costs and outputs associated with protecting and managing activities and investments where there is little or no management discretion. Incidental outputs are permissible, but there will be no management action-related timber or recreation outputs. Forest vegetation will evolve through natural succession.

The Minimum Level Benchmark represents the least amount of management needed to maintain and protect the Forest as part of the national forest system. The following are minimum management objectives: (1) Protect the life, health, and safety of forest users; (2) Conserve soil and water resources; (3) Prevent significant or permanent impairment of the productivity of the land; (4) Administer legally required special uses and mineral

leases, permits, contracts, and operating plans; and (5) Prevent environmental damage to the land and resources of adjoining and (or) downstream lands under other ownership. In addition, facility maintenance will be done only to support activities and use that cannot be reasonably discouraged (all other facilities are allowed to deteriorate). Dispersed recreation use will be permitted when and where control activities are not needed. Critical habitat for threatened and endangered species will be protected. And, heritage resource management will be limited to the identification and protection of resources associated with proposed ground disturbing activities.

Thirteen benchmarks were analyzed, as listed below, in addition to considering the benchmarks analyzed in the 1986 Plans. The timber portions of the benchmark PNVs were calculated within the SPECTRUM model, so that the model could optimize for maximum value or volume, and schedule the outputs over time. Benchmarks 5-through-8 also included big and small game assigned values related to particular forest types maintained on the ground within the SPECTRUM model solutions.

Benchmark 1—Maximum Present Net Value (PNV) **with both** non-declining even-flow (NDEF) and culmination of mean annual increment (CMAI) requirements

Benchmark 2—Maximum PNV **with** NDEF and **without** CMAI

Benchmark 3—Maximum PNV **without** NDEF and **with** CMAI

Benchmark 4—Maximum PNV **without** both NDEF and CMAI

Benchmark 5—Maximum PNV **with** Hunting Assigned Values, and **with both** NDEF and CMAI

Benchmark 6—Maximum PNV **with** Hunting Assigned Values, **with** NDEF, and **without** CMAI

Benchmark 7—Maximum PNV **with** Hunting Assigned Values, **without** NDEF, and with CMAI

Benchmark 8—Maximum PNV **with** Hunting Assigned Values, and **without** both NDEF and CMAI

Benchmark 9—Maximum Timber **with both** NDEF and CMAI

Benchmark 10—Maximum Timber **with** NDEF and **without** CMAI

Benchmark 11—Maximum Timber **without** NDEF and **with** CMAI

Benchmark 12—Maximum Timber **without both** NDEF and CMAI

Benchmark 13—Minimum Level Management

Determination of Culmination of Mean Annual Increment

Silvicultural prescriptions were developed with consideration for the timing of harvests. NFMA requirement, 36CFR219.16(a)(2) states that “all even-aged stands scheduled to be harvested during the planning period will generally have reached culmination of mean annual increment of growth.” The calculation of CMAI is based on the total amount of biomass accumulated in a stand (to a specific date) divided by age. Because stand age must be known, mean annual increment must be calculated at the stand level, and not on individual trees. Even-aged harvests include clearcuts, shelterwood cuts, and overstory removal cuts. In a three-step process, it is the accepted practice to apply the CMAI standard to the timing of the overstory removal step. The stand age at CMAI will vary depending on site quality, forest type, management intensities, and utilization standards.

Even-aged harvesting prior to CMAI is permitted if "overall multiple-use objectives would be better attained." Pre-commercial thinning and improving habitat conditions for certain wildlife species, providing for biological diversity, and improving scenic quality are some situations that permit even-aged harvests before CMAI.

Social and Economic Analysis

Introduction

This section is designed to give the reader a further explanation of procedures and methods used in the Social and Economic Effects section of the FEIS for the Chequamegon-Nicolet National Forests (CNNF) Land Management Plan (LMP). It is divided into Social Analysis and Economic Analysis. However, the explanations provided here about the analysis process is not enough information to completely replicate the calculations and their results in the FEIS (i.e. computer modeling program specifics, etc.). If that level of detail is desired, the specialist reports in the planning record should be consulted.

Social Analysis

The following describes in more detail the information used in the Social Effects section of the FEIS.

Pam Jakes, "People of Northern WI"

This research was widely used in all indicators in the Social Effects Analysis in the FEIS. It provided key information about the specifics of the attitudes and values of the communities in and surrounding the CNNF. The North Central Forest Research Station in St. Paul, Minnesota prepared this functional community assessment, entitled "People of Northern Wisconsin, Social Assessment of the Chequamegon-Nicolet National Forest" (Jakes, 1998). The need for such an assessment was implied in recommendations from the Chequamegon-Nicolet National Forest's (CNNF) Socioeconomic Roundtable (Jakes and Harms, 1995). The document uses U.S. Census data and personal interviews to describe functional communities that represent areas on or near the Forest where people's perceptions and use of the Forest are similar or compatible.

Forty-six key informant interviews were conducted in September and October of 1996. Fifteen "functional communities" were identified based on interview information and community maps drawn by the informants. Community profiles include issues and concerns that people raised about the management of the CNNF. Key informant interviews contributed to Forest Plan revision public involvement efforts in general and to the depth of knowledge for revision issues. The interviews also provided much needed local perspectives on issues, concerns, opportunities, and needs of the people and communities within and near Forest boundaries.

Key Informant Interview Discussion Themes:

- Positive and negative feelings about the influx of new residents into local communities (retirees, second homeowners, and those starting new jobs who may or may not have the same values and lifestyle as long-time local residents);
- High property taxes and the belief that they result from national forest and other public lands that are not on the tax rolls; However, there was a general consensus that high

taxes are the price one pays for the high quality of life available to those living near or surrounded by the Chequamegon-Nicolet National Forest;

- Feelings of pride or loss concerning local community public schools (the public school system provides a strong sense of identity for many local community residents);
- Controversy surrounding the use of ATVs across the Forest (many people believe that as a result of Forest Plan revision—there will be more use restrictions on the Chequamegon side of the Forest and some new ATV use opportunities on the Nicolet side);
- Many people expressed a desire to participate more in forest management decisions and the revision of the Forest Plan; and
- Key informants generally feel that people are an important part of ecosystems (maintaining and improving ecosystem health and productivity also maintains and improves the health of local communities).

See the FEIS, Social Background and Analysis for specific key informant interview details for the communities of Ashland, Drummond, Eagle River, Florence, Gilman, Glidden, Hayward, Lakewood, Land O' Lakes, Laona, Long Lake, Medford, Park Falls, Phillips, and Washburn.

U.S. Census Data

U.S. Census data was widely used in the Background of both Social and Economic Analysis in the FEIS. In the Social Effects however, it played a larger role in the actual analysis. In the 'Economic Background and Analysis', U.S. Census data was presented on employment by industry, unemployment, and per capita income.

Data on housing patterns, housing values, population numbers, racial composition within the population, and age of population were used in the 'Background of the Social Environment', as well as in the Social Analysis. (Some of these demographics were also used in describing the economic background of the three EIAs). For Social Indicator #3 in particular, the seasonal housing and the 65 and older population data was central to the analysis. All of the U.S. Census data was retrieved from the U.S. Census website (U.S. Census, 2003).

Economic Analysis

The analysis for the Economic Effects required the use of several components. This section gives further details on the computer models, methods and data used for this analysis.

Defining Economic Impact Analysis Areas in the Eastern Region

A model, called IMPLAN, was used to estimate economic impacts of forest management activities under the various alternatives. IMPLAN is a non-survey based, demand driven, input-output tool. It is unique among input-output models in that its technology matrices are fully developed for each county in the United States. "County accounts" were developed with statistics and national input-output information published by the Bureau of Economic Analysis (BEA). Analysis can therefore be conducted at the level of a single county, a group of counties, or up to the national level. For the purposes of forest planning, IMPLAN economic impact areas (groups of counties modeled as a single economic unit) were constructed of groups of counties with common attributes in relation to forest management decisions and activities.

Defining IMPLAN economic impact areas is a blend of art and science. Designated economic impact areas (EIAs) never perfectly represent the complex economic interactions between individuals, firms, and governments. An EIA embodies a set of decisions that offers the best available answers to some of the economic questions that the public, decision-makers, and economists commonly ask. Relevant questions for delineation of impact areas for forest planning include considerations of functional economies, state/local planning regions, national forest supply-based regions, Forest Service expenditures, and other related factors (see Table B-7) such as: county level recreation visitor purchases; timber, minerals, and other forest product purchases; forest product processing and removals; location of logging firms, sawmills, and pulp mills, along with employee residences; and the location of important labor supplies.

Information needed for approaching these questions is a mix of quantitative and spatial data, as well as anecdotal/qualitative information. The "soft", or qualitative, information obtained through discussions with knowledgeable people is often more insightful than "hard" data in helping define EIAs simply because of the common lack of hard data and the difficulty in interpreting it. Data sources considered for each question are provided in Table B-7. The questions in this table are generally listed in the order that they were asked.

Discussions among economists, analysts, forest planners, and other resource specialists, considering the data, interpretations of the data, modeling implications, and the questions contained in Table B-7, led to delineation of the EIA boundaries. It is important that technical correctness, practical time and staffing requirements, and public acceptance of procedures and results be incorporated into the modeling decision. The process and results must stand up to criticism from interested publics, elected officials, and discipline experts.

Process

Impact areas for the Chippewa-Superior National Forests (NF) and the Chequamegon-Nicolet NFs were defined in June 1999. Counties in Minnesota, Wisconsin, and Michigan were the building blocks for constructing the impact areas – traditionally, counties have been the building blocks for IMPLAN models. The questions, data sources, and discussions are listed in the following table. Impact area delineations follow the table.

Table B-7. Factors and questions considered in defining economic impact areas.

Considerations/Questions	Data Sources	Discussion
Contiguous Areas • *Can results from non-contiguous impact areas be interpreted for ease of understanding?*		A contiguous, place-oriented area is usually more easily understood than several non-contiguous areas. The latter may be technically valid, but may be difficult to explain and understand.
Functional Economies • *Should all counties in a BEA Component Economic Area be included to fully & fairly represent indirect effects?* • *Should all counties in an ERS Labor Market Area be included to fully & fairly represent induced effects?*	• Bureau of Economic Analysis Component Economic Areas – Great Lakes Ecological Assessment • Economic Research Service Labor Market Areas – Great Lakes Ecological Assessment	The BEA and ERS are recognized experts in delineating functional economies. These delineations consider influence of all industries and labor supply in the economy, not just those related to NF. Separating counties the BEA and ERS have recognized as joined should be done thoughtfully. In both MN & WI, these areas were initially considered for impact area delineation.

Considerations/Questions	Data Sources	Discussion
State/Local Planning Regions • *Are state-defined regions for economic development or planning meaningful for NF impact analysis purposes?*	• Discussions with MN & WI tourism agencies.	Some states have stable & economically designed planning areas that are used by state and local government agencies alike. This is not strongly the case in WI, and less so in MN. The areas may be changeable, driven by state/local politics, and/or vary by state/local government agency. They serve purposes not in line with economic modeling of NF activities.
NF Supply-Based Regions • *What counties are affected by the "sale" of NF goods and services?*	See individual resource (Recreation, Timber/Minerals)	Include only those counties where recreation visitor local purchases are made, timber/minerals are removed and processed, and where important labor supplies for these industries reside. Grazing is normally considered as well, but it is not a use of NF in the Great Lakes states.
Timber/Mineral Resources • *Where are the commodity removal firms & employees based?* • *Where are the mills?*	• Forest product mills by type, size, location – Great Lakes Ecological Assessment • Discussions with NF timber specialists	Only those loggers removing and mills processing NF timber are relevant. Recent history and anticipated future log/pulp flows were considered. Location of the logging firms, mills, and general residence of employees is important. In MN, all are included in one model; in WI, all are included in one of two models.
Recreation Resources • *Who is the overnight visitor?* • *What is the visit-related perimeter for local expenditures*?	• 30-mile "buffer" around the NF boundary (Stynes' visitor studies) – Great Lakes Ecological Assessment • 50-mile "buffer" around the NF boundary (PARVES recreation surveys) – Great Lakes Ecological Assessment • MN and WI Office of Tourism studies • Discussions with NF recreation specialists • Major travel routes	Only non-local visitor expenditures (e.g., overnight accommodations) are relevant for supporting local economies from an export-base perspective. If the area is within convenient proximity to large population centers, non-local day use may also be important. Only trip-related expenditures in the local area are relevant. All counties receiving visit-related expenditures are included in the Chippewa-Superior NF and Chequamegon-Nicolet NF impact areas.
FS Expenditures • *Where are the agency offices?* • *Where do the employees live & spend?*	• Discussions with NF personnel • Forest Service directory	Often the largest effect of FS presence is personal expenditures by FS personnel. Counties where FS personnel live have been included in all MN & WI models.

Considerations/Questions	Data Sources	Discussion
Urban Areas • *Would the inclusion of urban areas dilute impacts so that they no longer represent their importance to local rural areas that surround the NF?*	• Cities with populations > 1,000 and their boundaries – Great Lakes Ecological Assessment	Metropolitan areas, large or small, should be added only if they are unavoidably tied by data boundaries (counties) or if they are important resource-processing sites. To avoid dilution of local rural areas, separate models should be considered. In MN, the Duluth-Superior metro area could not be separated from rural northern MN. In WI, the Duluth-Superior, Wausau-Stephens Point-Wisconsin Rapids, and Green Bay-Appleton metro areas were separated from the "local," more rural areas of northern WI.
Local Impacts • *What do the interested publics regard as local?*	• Discussions with Forest & RO planners and specialists.	To be credible with many interested publics, the impact area must be generally consistent with their perceptions of what constitutes "local". In MN this area included all economic activities, while in WI many mill centers were mostly outside the area generally regarded by northern Wisconsinites as "local".
One Broad Area v. Multiple Specific Areas • *What counties are common to all resource impact questions?* • *What counties are included to assess only one resource?* • *Would inclusion or exclusion of single-resource-related counties distort answers for other resources?*	No additional data.	Where counties are in common with all resources there is no issue. Where a county is important to one resource and not related to another, the positive value of including it for one resource must be weighed against the negative dilution effect for the second resource.
Additive Potential of Multiple Impact Areas • Would publics or agency officials desire or expect to add the results from multiple impact areas? • *Can results be presented and interpreted collectively without distortion to facilitate their proper use by publics?*	No additional data.	If multiple impact areas are <u>overlapping</u> to any great extent, then results from multiple models may not be added because of the high potential for double counting. <u>Mutually exclusive</u> impact areas are generally more conducive to adding results. The FS generally wants to add results, when larger scale analysis is conducted and consistency with Forest-level analysis is desired. All MN & WI areas are mutually exclusive.
Sub-areas • *Are there important sub-areas within a larger area that merit consideration for either separate models or distribution considerations within the larger area?*	• Discussions with forest planner and specialists.	The area around a NF sometimes embodies distinct sub-cultures and economies that are important and related to the spatial distribution of NF activities & impacts. None of these were identified for NFs in MN & WI.

Considerations/Questions	Data Sources	Discussion
Local Impacts • *What do the interested publics regard as local?*	• Discussions with Forest & RO planners and specialists.	To be credible with many interested publics, the impact area must be generally consistent with their perceptions of what constitutes "local". In MN this area included all economic activities, while in WI many mill centers were mostly outside the area generally regarded by northern Wisconsinites as "local".
One Broad Area v. Multiple Specific Areas • *What counties are common to all resource impact questions?* • *What counties are included to assess only one resource?* • *Would inclusion or exclusion of single-resource-related counties distort answers for other resources?*	No additional data.	Where counties are in common with all resources there is no issue. Where a county is important to one resource and not related to another, the positive value of including it for one resource must be weighed against the negative dilution effect for the second resource.
Additive Potential of Multiple Impact Areas • Would publics or agency officials desire or expect to add the results from multiple impact areas? • *Can results be presented and interpreted collectively without distortion to facilitate their proper use by publics?*	No additional data.	If multiple impact areas are overlapping to any great extent, then results from multiple models may not be added because of the high potential for double counting. Mutually exclusive impact areas are generally more conducive to adding results. The FS generally wants to add results, when larger scale analysis is conducted and consistency with Forest-level analysis is desired. All MN & WI areas are mutually exclusive.
Sub-areas • *Are there important sub-areas within a larger area that merit consideration for either separate models or distribution considerations within the larger area?*	• Discussions with forest planner and specialists.	The area around a NF sometimes embodies distinct sub-cultures and economies that are important and related to the spatial distribution of NF activities & impacts. None of these were identified for NFs in MN & WI.

Conclusions of Economic Impact Area definition

Three impact areas were identified for the purposes of describing the contributions of current national forest activities and evaluating the consequences of possible changes in national forest activities on relevant economies. Specifics and rationale for delineating these areas are presented below; resulting areas are shown in Figure B-2.

For recreation, timber and other impacts associated with Minnesota national forest activities, a 13-county impact area was recommended. For "local" recreation- and timber-related activities on the Wisconsin national forest, a 15-county impact area centered on the national forests was recommended. However, timber processing impacts farther from the Wisconsin national forest require two additional impact areas: a 9-county Wisconsin Metro/Pulp/Paper area and the 13-county Minnesota area. Impacts in these areas must be added to "local" impacts to estimate total economic impacts. Each impact area is described below.

Minnesota National Forests Economic Impact Area

• Chippewa-Superior NF Area (13 counties) (Also called the Northern Minnesota EIA)

MN: Aitkin, Beltrami, Carlton, Cass, Clearwater, Cook, Crow Wing, Hubbard, Itasca, Koochiching, Lake, St. Louis

WI: Douglas

Rationale for one impact area: Due to their close proximity and overlapping economic activities (i.e., BEA and ERS areas, recreation activities, and timber supply regions), one economic impact area encompassing both the Chippewa and Superior NFs is recommended.

Rationale for including perimeter counties that do not contain or are not adjacent to NFs: The inclusion of Clearwater and Crow Wing Counties is based on two factors. First, they contain mills that may process a small amount of NF timber. Second, they are part of the same ERS Labor Market Area and BEA Component Economic Area as Beltrami, Cass, and Hubbard Counties. The inclusion of Carlton County is based on its close economic association with Duluth (BEA & ERS areas) and a large pulp mill in Cloquet that processes a sizable portion of NF timber. Douglas County was included primarily for its close economic association with Duluth.

Wisconsin National Forests Economic Impact Areas

• Northern Wisconsin Economic Impact Area (15 counties) (NWEIA)

WI: Ashland, Bayfield, Forest, Florence, Langlade, Lincoln, Marinette, Oconto, Oneida, Price, Sawyer, Taylor, Vilas

MI: Dickinson, Iron

All counties receiving CNNF visit-related expenditures were included in the Northern Wisconsin Economic Impact Area

Rationale for including perimeter counties that do not contain or are not adjacent to NF land: Lincoln County, WI is part of the central access corridor to both Forests, and was identified by both recreation and timber specialists as being associated with activities on the NF. Dickinson County and Iron County, MI are included because the ERS, BEA, Forest recreation and timber specialists agreed that the ties to northern WI forests are very close. Menominee County, MI is excluded on the recommendation of NF recreation and timber specialists, despite being associated with the same ERS and BEA areas as Iron and Dickinson Counties.

Rationale for excluding perimeter counties that do contain or are adjacent to NF land: Rusk County, although adjacent to the Chequamegon, is not identified by either recreation or timber specialists as associated with activities on the NF. Iron County, WI is more culturally and economically tied with the MI Upper Peninsula. ERS and BEA areas, as well as all NF personnel were in agreement to exclude this county.

• Wisconsin Pulp and Paper Economic Impact Area (9 counties) (WPPEIA)

WI: Brown, Calumet, Marathon, Outagamie, Portage, Shawano, Waupaca, Winnebago, Wood

Rationale for area delineation: This area is mostly urban and contains the largest complex of pulp and paper mills in the world. It includes both the Wisconsin River and Fox River valleys. Much NF timber is processed here, but the area is clearly not a part of the smaller and more rural communities that are closely associated with NF recreation

and timber. Thus, a separate model was deemed necessary to account for the processing impacts in WI of NF timber. Shawano and Waupaca Counties are included to make the area contiguous and for labor supply reasons. Winnebago and Calumet Counties were included because both the ERS and BEA consider these counties integral to the Fox River valley economy.

- Northern Minnesota Economic Impact Area (13 counties) (NMEIA)

Rationale for inclusion of area: For the Chequamegon-Nicolet NF timber processed in the Duluth-Superior area, the same impact area used for the Minnesota national forests is recommended (rationale for area delineation is presented above). Total economic impacts associated with timber processing on this area would include those based on contributions from Minnesota and Wisconsin national forests. But only the WI portion will be attributed to the Chequamegon-Nicolet NF Forest Plan alternatives.

Three IMPLAN models, one for each of the distinct geographic areas, were developed. Economic relationships generated within IMPLAN were extracted and used in the newly developed Forest Economic Analysis Spreadsheet Tool (FEAST) models. The FEAST models will be used at the Forest-level to analyze the impacts of Forest Plan alternatives.

Broader, more diverse impact areas, such as those recommended, provide a truer picture of economic interactions within a regional economy. There is strong interest by local government units and others to look at the finest economic scale possible (e.g., the county level). However, this finer scale misrepresents the interactions among many local areas and underestimates total impacts associated with the national forests. In addition, finer-scale impact areas require resource specialists to disaggregate recreation and timber activities to the finer scale – this is likely beyond the level of precision available in Forest Plan alternatives.

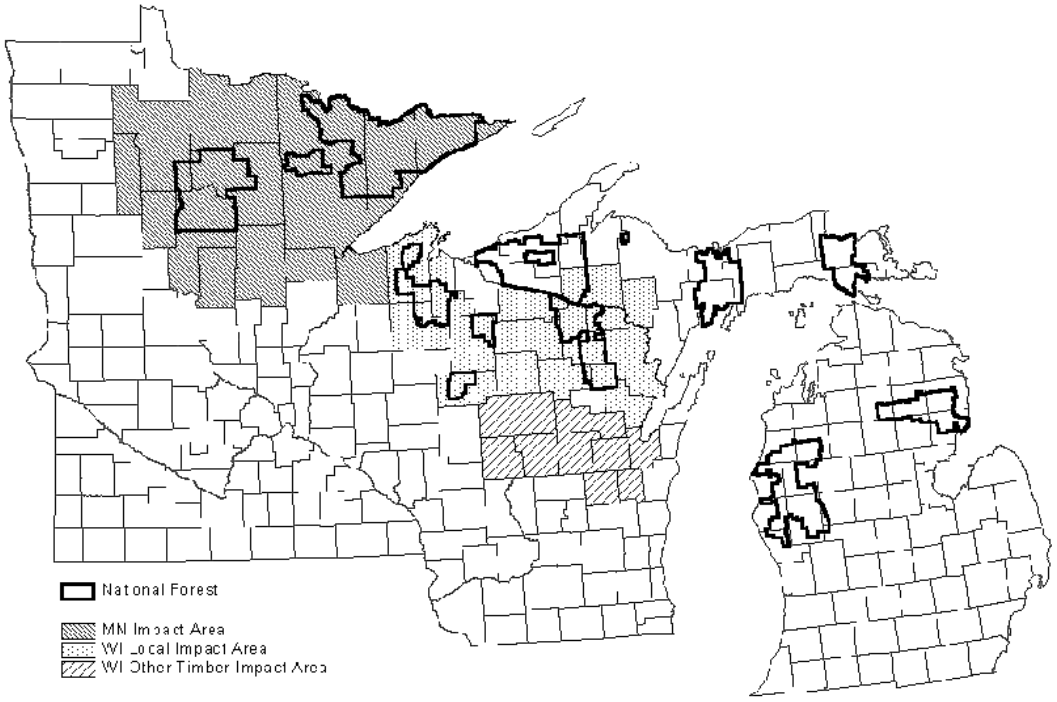

Figure B-2. Economic Impact Areas for Lake States' National Forests in Minnesota and Wisconsin

Authors and Participants in developing Economic Impact Areas

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Economic Impact Analysis

Model

Economic effects to local counties were estimated using an economic input-output model developed with IMPLAN Professional 2.0.1017 (IMPLAN). IMPLAN is a software package for personal computers that uses the latest national input-output tables from the Bureau of Economic Analysis, secondary economic data at the county level from a variety of public sources, and proprietary procedures to develop an input-output model for a study area. The model was originally developed by the USDA-Forest Service and is now the property of the Minnesota IMPLAN Group (MIG, Inc.).

Three economic impact models were developed using 1999 IMPLAN data. These were the most recent data available at the time the models were developed. One model was developed for each of the three economic impact areas defined above. A full discussion of model area delineation is available in the project record.

Forest Contribution and Economic Impact Analysis

Impact analysis describes what happens when a change in final sales (e.g. exports and consumer purchases) occurs for goods and services in the model area. Changes in final sales are the result of multiplying units of production (e.g., hundred cubic feet of timber harvest or recreation visitor days (RVDs) of recreation use) times sales per unit. Economic impacts were estimated using the best available production and sales data. The source of each are listed below.

The Chequamegon-Nicolet National Forests contribute jobs and income to the three analyzed economic impact areas through various resource management programs.

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. The number of jobs is computed by averaging monthly employment data from state sources over one year. The income measure used was labor income expressed in 1999 dollars. Labor income includes both employee compensation (pay plus benefits) and proprietors' income (e.g. profits by self-employed).

The planning area model was used to determine the employment and income consequences throughout the economy of one-million-dollar changes for each kind of impact. The results are called response coefficients. 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 output. Spreadsheets were used to calculate total effects by multiplying the response coefficients by estimated levels of dollar activity. A customized Excel workbook called Forest Economic Anaysis Software Tool (FEAST) was developed and used for this purpose. Details of FEAST may be examined in the project record. Specifications for developing response coefficients and levels of dollar activity are stated below.

Timber

Sales Data

Timber sales revenue and expenditure data was obtained from Forest timber sales records. Five basic kinds of timber products are harvested from the Chequamegon-Nicolet National Forest, and processed by various sectors (distribution estimate details are available in the IMPLAN Spreadsheet Tool). Stumpage values were determined for softwood sawtimber, softwood pulpwood, hardwood sawtimber, hardwood pulpwood, and aspen pulpwood. Direct information on the shipped value of finished timber products for all processing sectors was not available from any source. The IMPLAN model was used to derive these production values.

Use of the Model

There is a diverse mix of timber processing firms in northern Minnesota. Of the possible eighteen different types of timber processing sectors, fifteen can be found in this area. Employment in the lumber and wood products industry was estimated by the IMPLAN model. Paper mills are by far the largest employer (4,300), followed by reconstituted wood products (1,600), and logging camps (800). Seven different kinds of timber products are harvested off National Forests in Minnesota, and processed by nine sectors. Details of distribution estimates are available in FEAST, which is located in the project record.

One million dollars of exports were modeled through each timber processing sector to determine a "response coefficient." Timber volume from the National Forests was multiplied by historical stumpage prices and multiplied by the response coefficient for "Logging Camps" to obtain the total economic impact. The distribution of National Forest timber processors and model relationships between "Logging Camps" and other sectors were then used to derive the export value for each timber sector. This value was then multiplied by the appropriate response coefficient to determine total economic impact for each sector. All results were then summed for presentation in the EIS. This process was repeated for each alternative.

Recreation & Wildlife/Fish

Data

Local tourism and other recreation impacts are attributable to expenditures by people who do not reside in the local area. Local tourism is in effect an export of goods and services that result in the import of new money that supports (or maintains) wages, salaries, profits, and jobs. These impacts are generated in IMPLAN by introducing additions to final demand. If recreation exports increase, jobs are created and population increases follow (constant rate of unemployment is assumed, or unemployment decreases if locals fill new jobs). Local economic activity increases with new area jobs and added income. This is reflected in IMPLAN through the household sector as induced effects.

Visitors to the National Forests in Wisconsin often engage in a variety of activities during a trip. Commonly these activities cross over boundary lines between public and private lands. Consequently, a general tourism/recreationist expenditure pattern can reliably represent visitors to the National Forests. Recreation & wildlife/fish revenue and expenditure data and several northern Wisconsin tourist surveys were used to build general spending profiles (varying by type of lodging for recreationists on the Forest). General expenditure profiles, by type of lodging, were used in the northern Wisconsin model when more specific studies were not available. Specific mountain biking and snowmobiling studies were available and used to model expenditures for visitors engaging in these specific activities.

Recreation use is measured in “recreation visitor days” or RVDs. The tourism studies used either days or nights as the unit of measure. RVDs were multiplied by two to convert use to the tourism study unit of measure and provide total spending for each alternative. Further details regarding the expenditures may be found in the project record.

The U.S. Fish & Wildlife Service periodically conducts a national survey (by state) to obtain, among other information, data on recreation expenditures for hunting, fishing, and other wildlife-related recreation. The agency’s Inventory and Monitoring Institute organized these expenditures profiles for use in IMPLAN. Expenditures were collected on a “per trip” basis, and converted to a “person-day” basis for use in IMPLAN. These expenditures were run through the model in increments one million dollars. The results were then incorporated into the FEAST workbook where they were multiplied by total expenditures for each category. Only non-local recreation expenditures (tourism exports) are considered for impact analysis. Details regarding the expenditures may be found in the project record.

Use of the Model

One million dollars of expenditures for three categories of recreation discussed above were run through the model. The results were then incorporated into the FEAST workbook where they were multiplied by total expenditures for each category. Only non-local recreation expenditures (tourism export) use is considered for impact analysis.

Federal Expenditures & Employment

Expenditure Data

The Forest applied budget constraints to every alternative. This budget constraint was used to estimated total Forest expenditures, some of which had local economic effects. Total Forest obligations by budget object code for FY 1999 were obtained from the

National Finance Center through the agency's Inventory and Monitoring Institute, and used to estimate how the budget would be spent. Forest Service employment was estimated by the Forest staff based on examination of historical Forest Service obligations. Details regarding the expenditures may be found in the project record.

Use of the Model

To obtain an estimate of total impacts from Forest Service spending, salary and non-salary portions of the impact were handled separately. Non-salary expenditures were determined by using the budget object code information noted above. This profile was run through the model for non-salary expenditures per one million dollars, and the results multiplied by total Forest non-salary expenditures. Sales to the Federal Government are treated in the same manner as exports.

Salary impacts result from Forest employees spending a portion of their salaries locally. IMPLAN includes a profile of personal consumption expenditures for several income categories; the average compensation for an employee on the Chippewa and Superior National Forest fell in the category of $40,000-$49,999. Across the U.S., Americans typically spend about 67% of their total salary plus benefits. Therefore, total Forest Service salaries were multiplied by 0.67 before being multiplied by the one-million-dollar response coefficient.

Revenue Sharing -- 25% Fund Payments

Expenditure Data

Federal law requires that a portion of current or historical revenues be returned to the States and Counties within which the revenues were received (Economic Indicator #1 in the FEIS specifically addressed this issue). These payments may be used for a variety of purposes, primarily for local school and road expenses (for more details see FEIS Social/Economic Effects analysis). It was assumed that 25% of all National Forest revenues would be returned to the local impact area, and that a split of 50% for schools and 50% for roads would represent how local governments spend these revenues. A profile of expenditures for each of these purposes was derived from the model itself. National expenditure profiles for state/local education (schools) and a local profile for road construction and maintenance are found in the IMPLAN model. One million dollars of each profile was used to estimate a response coefficient for Forest Service payments to impact area counties. The results were incorporated into a FEAST spreadsheet and multiplied by total expenditures. Within these calculations, sales to local governments are treated in the same manner as exports.

Use of the Model

The national expenditure profile for state/local government education (schools) and local model estimates for road construction (roads) are provided within IMPLAN. One million dollars of each profile was used to obtain an estimate a response coefficient for these Forest Service payments to impact area counties. The results were then incorporated into a spreadsheet where they were multiplied by total expenditures. Sales to local government are treated in the same manner as exports.

Output Levels

Output levels are specified in the FEAST Excel workbook, located in the project record.

Federal Expenditures and Employment

For this analysis, the Forest applied budget constraints to every alternative. Budget constraints were used to estimate total Forest expenditures, some of which had local economic effects. Total Forest obligations by budget object code for Fiscal Year 1999 were obtained from the National Finance Center through the agency's Inventory and Monitoring Institute, and used to estimate how the budget would be spent. The Forest staff estimated Forest Service employment—based on an examination of historical Forest Service obligations.

Salary and non-salary portions of impacts were handled separately to estimate total impacts from Forest Service spending. Non-salary expenditures were determined by using the budget object code information noted above. This profile was run through the model for non-salary expenditures per one million dollars. The results were multiplied by total Forest non-salary expenditures. Sales to the Federal Government are treated in the same manner as exports. Salary impacts result from Forest employees spending a portion of their salaries locally. Americans typically spend about 67% of their total salary plus benefits. Total Forest Service salaries were multiplied by 0.67 before being multiplied by the one-million-dollar response coefficient.

These expenditure and employment values, as well as other values were all used in the IMPLAN/FEAST computer programs. Table B-8 gives a detailed look at these numbers for all of the Alternatives presented in the FEIS.

Table B-8. Average Values Used in IMPLAN (Decade 1 Values for Each Alternative)

Activity	Current (2002)	Alternatives (2012)								
		1	2	3	4	5	6	7	9	SA
Recreation Activity Use Levels										
Mountain Biking (RVD's)	15,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Snowmobiling (RVD's)	97,700	117,300	117,300	117,300	117,300	117,300	117,300	117,300	117,300	117,300
Camping at Campgrounds (RVD's)	439,600	527,500	527,500	527,500	527,500	527,500	527,500	527,500	527,500	527,500
Fresh Water Fishing (RVD's)	502,800	477,700	477,700	477,700	477,700	477,700	477,700	477,700	477,700	477,700
Non-Consump. Fish & Wildlife (RVD's)	9,300	11,200	11,200	11,200	11,200	11,200	11,200	11,200	11,200	11,200
Timber Volume Processed in NWEIA**										
Harvest Softwood Sawtimber (CCF)#	13,278	9,739	9,263	8,699	8,428	9,059	9,122	8,524	8,835	8,556
Harvest Softwood Pulpwood (CCF)	3,839	5,364	5,144	4,843	5,163	5,121	5,068	5,288	5,457	4,872
Harvest Hardwood Sawtimber (CCF)	7,500	13,798	11,415	10,342	9,767	11,133	10,772	10,710	70,894	11,122
Harvest Hardwood Pulpwood (CCF)	5,592	9,533	8,340	7,799	7,374	8,177	7,997	7,970	8,003	8,614
Harvest Aspen Pulpwood (CCF)	13,270	18,808	18,639	16,812	16,764	17,521	17,767	17,235	17,639	17,635
Timber Volume Processed in WPPEIA**										
Harvest Softwood Sawtimber (CCF)#	2,213	1,623	1,544	1,450	1,405	1,510	1,520	1,471	1,473	1,426
Harvest Softwood Pulpwood (CCF)	30,711	42,913	41,152	38,746	41,301	40,968	40,542	42,304	43,654	38,977
Harvest Hardwood Sawtimber (CCF)	417	767	634	575	543	619	597	595	605	618
Harvest Hardwood Pulpwood (CCF)	47,536	81,026	70,888	66,295	62,681	69,505	67,978	67,744	68,022	73,218
Harvest Aspen Pulpwood (CCF)	18,958	26,869	26,628	24,018	23,949	25,031	250,382	24,621	25,199	25,193
Timber Volume Processed in NMEIA**										
Harvest Softwood Sawtimber (CCF)#	6,639	4,870	4,632	4,349	4,214	4,530	4,561	4,412	4,418	4,278
Harvest Softwood Pulpwood (CCF)	3,839	5,364	5,144	4,843	5,163	5,121	5,068	5,288	5,457	4,872
Harvest Hardwood Sawtimber (CCF)	416	767	534	575	543	619	598	595	605	618
Harvest Hardwood Pulpwood (CCF)	2,796	4,766	4,170	3,900	3,687	4,089	3,999	3,985	4,001	4,307
Harvest Aspen Pulpwood (CCF)	5,687	8,061	7,988	7,205	7,185	7,509	7,615	7,386	7,560	7,558
Forest Program Revenues										
Recreation Program Revenues (M$)###	616	744	744	744	744	744	744	744	744	744
NWEIA Timber Prog. Rev's (M$)	2,755	3,922	3,493	3,206	3,102	3,396	3,350	3,307	3,356	3,045
WPPEIA Timber Prog. Rev's (M$)	3,254	4,658	4,350	4,051	4,100	4,262	4,223	4,275	4,365	4,231
NMEIA Timber Prog. Rev's (M$)	1,022	1,163	1,097	1,018	1,012	1,269	1,068	1,056	1,073	1,039
Other Program Revenues (M$)	92	92	92	92	92	92	92	92	92	92
Forest Program Expenditures										
Recreation Program Expend's (M$)###	3,913	3,913	5,363	4,113	3,913	4,588	4,588	4,413	5,363	4,838
Timber Program Expenditures (M$)	8,111	8,111	8,435	7,271	7,083	7,764	7,822	7,510	7,578	8,111
Soil, Water, Air Prog. Expend's (M$)	1,110	1,110	1,110	1,110	1,110	1,110	1,110	1,110	1,110	1,110
Minerals Program Expeditures (M$)	175	175	175	175	175	175	175	175	175	175
Protection Program Expend's (M$)	2,773	2,773	2,773	2,773	2,773	2,773	2,773	2,773	2,773	2,773
Wildlife & Fish Prog. Expend's (M$)	935	935	935	935	935	935	935	935	935	935
Forest Service Employment										
Permanent Postitions (FTE's)##	214	214	214	214	214	214	214	214	214	214
Other than Permanent Postiions (FTE's)	30	30	30	30	30	30	30	30	30	30
Total Employment (FTE's)	244	244	244	244	244	244	244	244	244	244

* RVD's=Recreation Visitor Days (one RVD= one 12 hour visit)

** NWEIA=Northern Wisconsin Economic Impact Area' WPPEIA= Wisconsin Pulp & Paper EIA; NMEIA= Northern Minnesota EIA

CCF= 100 cubic feet of timber volume

FTE= One full time equivalent position

M= One thousand

Economic and Financial Efficiency

Economic Indicator #4 in the FEIS focused entirely on Economic and Financial Efficiency as a measure of possible effects of Forest Service management activities. Economic efficiency defines how well the dollars invested in each alternative produce benefits to society, and addresses benefits that do not generate actual dollar transactions. Forest Service economic efficiency analyses attempt to address this problem by identifying "assigned values" for specific activities. Table B-9 displays assigned values for Region 9 of the Forest Service.

The National Forest Management Act (NFMA) states that net public benefits are an important concept for accomplishing a Forest Plan Revision. These 'net public benefits' are included in and are a part of economic efficiency. To clarify, net public benefits are defined as the overall value to the nation of all outputs and positive effects (benefits) minus all the associated Forest Service inputs and negative effects (costs) for producing primary benefits.

Financial efficiency is similar to economic efficiency, but only activities that generate revenues are considered in the analysis (i.e. campsite fee collections, timber sale receipts, etc.). Financial efficiency is further defined by how well the dollars invested in each alternative produce revenues to the agency.

To measure both Economic and Financial efficiency, present net value (PNV) was used as an indicator. PNV was calculated using spreadsheets that track costs, revenues, and benefits over a 100-year period. Predicted increases and decreases in output levels (over time) were built into the spreadsheets. A four-percent annual discount rate was used.

The Forest Service identified recreation activity categories and assigned values for the 1990 Resources Planning Act Program. The assigned values for the analysis of effects were updated to the present using an inflation factor of 1.3246 (NASA website, 2002). The assigned values were provided by the Regional Office, and were used for calculating the PNV for both the alternatives and the benchmarks.

Table B-9. 2002 Assigned Recreation Values ($/RVD) Calculated for Region 9*

Activity	Year & Value	
	1989	2002 #
Camping, Picnicking, Swimming	$14.02	$18.57
Mechanized Travel and Viewing Scenery	$10.53	$13.95
Hiking, Horseback Riding, & Water Travel	$16.27	$21.55
Winter Sports	$42.62	$56.45
Resorts	$17.54	$23.23
Wilderness	$20.94	$27.74
Other Recreation (except wildlife and fish)	$61.43	$81.37
Hunting	$45.05	$59.67
Fishing	$76.20	$100.93
Nonconsumptive Wildlife Uses	$43.60	$57.75

**Source of information: "Resource Pricing and Valuation Procedures for the Recommended 1990 RPA Program (USDA-Forest Service document).*

 # 1989-2002 Inflation Factor = 1.3246 –NASA website (http://www.jsc.nasa.gov/bu2/inflateGDP.html)

Economic Efficiency

Economic present net values describe the economic efficiency of the alternatives. The economic PNV for each alternative was calculated by discounting the total annual assigned values for non-market activities such as hunting and fishing (fees are not collected) over a 100-year period at a rate of 4% per year. Present recreation activity use levels were based on a CNNF 1997 recreation resources inventory. Future increases in use were based on, "Projections of Outdoor Recreation Participation to 2050," by Bowker, English, and Cordell. Market cost and revenue PNV totals were added to assigned value PNV totals to determine the total economic PNV of the alternatives. The following Table B-10 displays Economic Efficiency Present Net Values for Alternatives 1-7, 9, and the Selected Alternative:

Table B-10. Economic Efficiency Present Net Values for Alternatives

Alternative	Economic PNV (M $)
1	$2,653,263
2	$2,567,005
3	$2,591,406
4	$2,595,512
5	$2,586,918
6	$2,585,395
7	$2,589,645
9	$2,566,293
SA	$2,575,259

Financial Efficiency

Financial efficiency is similar to economic efficiency, but only activities that generate revenues are considered in the analysis. Financial values were based on actual revenues and costs. Financial efficiency is further defined by how well the dollars invested in each alternative produce revenues to the agency. The following Table B-11 displays the Financial Efficiency Present Net Values for Alternatives 1-7, 9 and the Selected Alternative:

Table B-11. Financial Efficiency Present Net Values for Alternatives

Alternative	First Decade Prog. Revenues (M$)	First Decade Program Costs (M$)	First Decade Net Revenues (M$)	Market Cost and Revenue PNV's * (M$)
1	$104,961	$217,971	-$113,010	-$167,555
2	$97,710	$232,460	-$134,750	-$253,813
3	$90,770	$208,317	-$117,547	-$229,412
4	$89,454	$204,438	-$114,984	-$225,306
5	$95,436	$217,998	-$122,562	-$233,900
6	$94,760	$218,585	-$123,825	-$235,423
7	$93,956	$213,712	-$119,756	-$231,173
9	$95,130	$223,890	-$128,760	-$254,559
SA	$93,930	$223,969	-$130,039	-$245,559

Values calculated over 100-year period.

Present Net Values for the Benchmarks

Benchmark Analysis is required by NFMA (36 CFR 219.12e) to provide a basis for formulating a broad range of reasonable alternatives for the Forest Plan. Benchmarks serve to define the region within which reasonable alternatives can be constructed. Benchmarks estimate the forest's physical, biological and technical capabilities to produce goods and services. The development of benchmarks is not limited by Forest Service policy or budget, discretional constraints, or program and staffing requirements. They must be physically and technically feasible to implement, even though it may not be prudent to do so (FSH 1909.12 § 3.41). As such, they are not themselves, treated as reasonable alternatives and were therefore, not included in the FEIS.

To meet these requirements the CNNF planning team developed 13 different benchmarks. These benchmarks include a 'Minimum Management Level' benchmark to help define the low-end of the range of alternatives, and by variations on non-declining even-flow and culmination of mean annual increment timber harvesting requirements, the physical and biological maximums of PNV are reached to provide the high-end of the range of alternatives. The benchmarks are defined below:

- Benchmark 1- Maximum Present Net Value (PNV) with both non-declining even-flow (NDEF) and culmination of mean annual increment (CMAI) requirements
- Benchmark 2- Maximum PNV with NDEF and without CMAI
- Benchmark 3- Maximum PNV without NDEF and with CMAI
- Benchmark 4- Maximum PNV without both NDEF and with CMAI
- Benchmark 5- Maximum PNV with Hunting Assigned Values and with both NDEF and CMAI
- Benchmark 6-Maximum PNV with Hunting Assigned Values, with NDEF, and without CMAI
- Benchmark 7- Maximum PNV with Hunting Assigned Values, without NDEF, and with CMAI
- Benchmark 8- Maximum PNV with Hunting Assigned Values, and without both NDEF and CMAI
- Benchmark 9- Maximum Timber with both NDEF and CMAI
- Benchmark 10- Maximum timber with NDEF and without CMAI
- Benchmark 11- Maximum Timber without NEDF and with CMAI
- Benchmark 12- Maximum timber without both NDEF and CMAI
- Benchmark 13- Minimum Level Management

To check for sensitivity of the range of alternative, PNV Benchmarks were calculated that included the assigned values for hunting on the CNNF (with NDEF and CMAI scenarios varied). The hunting assigned values information is not well documented (hence the rational for removing those values from the PNV calculations for the range of Alternatives), however to ensure that the range that was considered for Benchmark analysis would include all possible values, these assigned values were incorporated. Table B-12 displays a summary of the Present Net Values for Benchmarks 1-13:

Table B-12. Present Net Values for Benchmarks 1-13

Benchmark	Total PNV (1,000's of $)	1st Decade Timber Production (MMBF)*	Long-term Sustained Yield (MMBF)*
1	$2,857,553	228	273
2	$2,864,115	229	263
3	$2,904,693	182	226
4	$2,901,981	182	225
5	$2,993,440	229	275
6	$3,001,184	231	266
7	$3,045,585	227	233
8	$3,048,369	227	231
9	$2,591,686	195	318
10	$2,577,579	199	312
11	$2,564,788	190	309
12	$2,577,491	190	310
13 (Min. Level)	$2,807,587	0	0

Minimum Management Benchmark PNV (Benchmark 13)

This section gives clarification of the Minimum Level Benchmark (minimum maintenance and protection of the Forest) and how it was derived. This benchmark represents only those costs and outputs associated with protecting and managing activities and investments where there is little or no management discretion. Incidental outputs are permissible, but there will be no management action-related timber or recreation outputs. Forest vegetation will evolve through natural succession in this benchmark.

Minimum management level costs (Table B-13) are based on the 3-year average of 2000-2002 experienced program costs (except where an asterisk indicates that the costs have been reduced). Removing Forest Plan revision and timber sale monitoring costs reduced planning, inventory, and monitoring costs. Removing developed recreation and wilderness management costs from the recreation program—left the heritage resources program. Only suppression and hazard fuels are included in wildfire protection. General Administration (GA) salaries are based on $75,000 annual Cost-To-Government for manager positions and $50,000 annual costs for clerical positions. Soil, water, and air protection costs were reduced to remove timber management activities.

The minimum management benchmark represents the least amount of management needed to maintain and protect the Forest as part of the national forest system. The following are minimum management objectives: (1) A facilities manager, two Supervisor's Offices, and the retention and maintenance of the district offices; (2) A road maintenance engineer and a 4-person road crew (with contract administration); (3) A recreation trail maintenance manager and an assistant archeologist; (4) A hazardous materials coordinator (with contract administration); (5) A wildlife biologist and an ecologist (with contract administration); (6) An engineer and a soil scientist to administer the soil, water, and air program; (7) A fire program administrator with seasonal crews and two engines; (8) A law enforcement officer with vehicle and equipment; (9) A forest

planner, operations research analyst, and information specialist (with contract administration); and (10) A forest supervisor, deputy forest supervisor, an administrative officer, and two clerical people.

Table B-13. Minimum Management Benchmark Operating Costs

2002 Determination	FTE's	2002 Basis $
Facilities Maintenance	1	$588,000
Road Maintenance	5	$1,432,000
Trail Maintenance	2	$204,000
Heritage Protection Program *	1	$30,000
Hazardous Waste Program	1	$113,000
Protection of T & E Species	2	$743,000
Protection of Soil, Water, & Air *	2	$392,000
Lands Maintenance	0	$542,000
Minerals Administration	0	$175,000
Wildfire Protection *	11	$488,000
Law Enforcement	1	$89,000
Planning, Inventory, & Monitoring *	3	$400,000
GA Salaries *	6	$325,000
Totals	35	$5,481,000

* Costs have been further reduced from the 2000-2002 experienced program.

Program Expenditures

The CNNF program expenditures were used in IMPLAN, FEAST, and Benchmark calculations. These expenditures by the Forest are presented here in three forms, the first three columns in Table B-14 are the actual historical expenditures for the CNNF, the next three columns are those expenditures converted into 2002 dollars, and in the final column is the 3-year average of the converted expenditures. The 3-year average expenditures for certain programs create the 'base-level operating costs'.

Table B-14. Chequamegon-Nicolet National Forest Program Expenditures by Fiscal Year

	Actual Expenditures ($)				CPI Corrected Expenditures (2002) ($) *			
Program	2000 (without GA#)	2000 (with GA#)	2001	2002	2000	2001	2002	3-Yr Avg
Facilities Maint.		481,861	967,497	1,013,056	506,486	988,802	1,013,056	836,115
Deferred Maint.		n/a	24,981	258,256	n/a	25,531	258,256	141,894
Roads Maint.		1,512,527	2,196,704	3,381,847	1,589,822	2,245,078	3,381,847	2,405,582
Trails Maint.		250,836	275,454	327,341	263,654	281,520	327,341	290,838
Inven. & Monitoring	354,433	429,377	598,807	880,201	451,319	611,993	880,201	647,838
Law Enforcement	72,141	87,395	82,758	91,267	91,861	84,580	91,267	89,236
Lands Maint.	456,668	553,229	497,349	535,481	581,501	508,301	535,481	541,761
Minerals	119,779	145,106	159,099	208,659	152,521	162,603	208,659	174,594
Forest Planning	709,130	859,073	848,263	1,219,952	902,974	866,943	1,219,952	996,623
Rec / Wildern./ Heritage	1,532,544	1,856,595	1,710,719	1,915,745	1,951,473	1,748,391	1,915,745	1,871,869
Veg./Soil/Water/Air	778,484	943,092	1,027,668	992,426	991,287	1,050,298	992,426	1,011,337
Wildlife / Fish	472,222	572,072	790,687	819,682	601,306	808,099	819,682	743,029
KV-Other		117,140	122,345	101,374	123,126	125,039	101,374	116,513
Rec. Fee Demo		443,326	664,009	543,804	465,981	678,631	543,804	562,805
Hazardous Waste		71,443	126,543	134,742	75,094	129,330	134,742	113,055
Quarters Maint.		23,284	38,866	8,901	24,474	39,722	8,901	24,366
Trails/Roads/10% Fund		424,384	376,183	367,759	446,071	384,467	367,759	399,432
Wildland Fire		1,856,385	1,661,116	1,736,538	1,951,252	1,697,695	1,736,538	1,795,162
Timber	2,356,285	2,854,514	5,049,938	5,310,285	3,000,389	5,161,143	5,310,285	4,490,605
Timber (Salvage)		2,917,801	1,272,657	1,058,219	3,066,909	1,300,682	1,058,219	1,808,604
Timber (Refor. Trust)		182,848	234,596	191,809	192,192	239,762	191,809	207,921
Timber (KV-Ref / TSI)		541,918	597,330	494,944	569,612	610,484	494,944	558,346
Timber (Ref. / TSI)		395,000	127,000	298,000	415,186	129,797	298,000	280,994
Oconto Seed Orchard		330,000	330,000	330,000	346,864	337,267	330,000	338,044
Totals	6,851,686	17,849,206	19,780,569	22,220,288	18,761,354	20,216,158	22,220,288	20,446,563
Expenditures Not Included in Base Forest Program								
GA Carryover #		n/a	30,739	-15,069	n/a	31,416	-15,069	8,173
Disaster Funds			260,383	152,006	0	266,117	152,006	139,374
Lands Acquisition		55,350	1,632,127	1,632,727	58,179	1,668,068	1,632,727	1,119,658
Other Coop Funds		350,173	444,095	234,676	368,068	453,874	234,676	352,206
SCSEP Prog. (NFSA)		142,594	486,977	190,275	149,881	497,701	190,275	279,286
SCSEP Prog. (NFSD)		483,845	192,623	614,494	508,571	196,865	614,494	439,977
Working Capital Fund		996,980	1,574,256	1,332,134	1,047,929	1,608,923	1,332,134	1,329,662
Hwy. Admin. Funds		18,435	16,175	18,978	19,377	16,531	18,978	18,295
Timber “Pipeline”		117,187	68,332	0	123,176	69,837	0	64,337
Reimbursable Accounts		227,353	195,640	293,133	238,971	199,948	293,133	244,018
Bequests		6,106	7,687	16,481	6,418	7,856	16,481	10,252
Totals		2,398,023	4,909,034	4,469,835	2,520,570	5,017,136	4,469,835	4,005,238
Grand Total	6,851,686	20,247,229	24,689,603	26,062,125	21,281,924	25,233,294	26,690,123	24,451,801

* Consumer Price Index source: www.bls.gov/cpi/home.htm . CPI Inflation Factor = 1.086435 for 1999–2002; 1.051103 for 2000-2002; and 1.022021 for 2001–2002. # GA = General Administration

Base level costs are those costs contributed to running the CNNF without direct timber and recreation program expenditures. These costs also assist the planning team in understanding the lower-end of the forest management spectrum (also accomplished by the Minimum Management Level Benchmark). The following table (B-15) lists the programs and expenditures that the CNNF experiences minus those expenditures that are due to direct timber and recreation programs.

Table B-15. Base-Level Operating Costs

Program	Cost (2002 Basis)
Facilities—Construction and Maintenance	$836,000
Deferred Construction and Maintenance	$142,000
Roads—Construction and Maintenance	$2,406,000
Inventory and Monitoring	$648,000
Law Enforcement	$89,000
Lands Maintenance	$542,000
Minerals	$175,000
Forest Planning	$997,000
Heritage	$30,000
Vegetation, Water, Soil, and Air Resources	$392,000
Wildlife and Fish	$743,000
KV-Other (Knutsen-Vandenberg Funds)	$117,000
Hazardous Waste	$113,000
Quarters Maintenance	$24,000
Trails / Roads—10% Funds	$399,000
Wildland Fire	$1,795,000
Total	$9,448,000