Green Mountain National Forest

Roads Analysis Process (RAP) Report

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United States Department of Agriculture

Forest Service

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Executive Summary

Key analysis results and findings

Since this analysis is a broad forest scale analysis, the road system as a whole was reviewed and site-specific improvements will be identified at a smaller scale. In general, the transportation system on the Green Mountain National Forest is currently meeting the strategic intent of the guidance in the current *Forest Plan*. However, as with most road systems there is always room for improvement. The main issues are related to *budget, road management, the environment, recreational opportunities and forest access*. Improvements to forest jurisdiction roads as well as providing financial assistance to state local and other Federal agencies could be implemented with increased budgets. Improving road conditions would in turn improve resource concerns, such as reducing sediment delivery into waterways. Specific results and findings are:

- Green Mountain National Forest receives approximately $240,000 from the Eastern Region of the USDA Forest Service for road maintenance, construction and reconstruction. Our estimate of the most efficient budget level is $400,000. The Green Mountain National Forest cannot meet maintenance requirements of the existing road system with current budgets.

- 57% of the roads on the Green Mountain National Forest are Forest Service system roads; 43% are state, local or private jurisdiction. The Green Mountain National Forest should continue to work forming cooperative agreements with local governments provided the additional needed funds are made available.

- Some roads are not listed under the appropriate jurisdictions. A preliminary review of the database shows roads listed under questionable jurisdiction. However, this was based on data that had not been updated as the Forest acquired legal jurisdiction on roads. During their research for this analysis, the Forest lands staff reviewed and updated some of the jurisdiction information in the database. Efforts to update and correct the data files will continue.

- The Green Mountain Forest is currently following the strategic intent of the *Forest Plan*. Management decisions at the project, watershed, and forest scale meet guidance in the *Forest Plan*.

- There are potential environmental impacts from the road system that need to be prioritized and evaluated for future analyses at a subforest level scale. This roads analysis process identified potential high risk areas for the environment, however, not all high-risk areas are identified at this forest scale review.

- ATV/Snowmobile and Mountain Bike recreational user of the forest would like to see more designated trails for their use. At this time there is no designated ATV trails and very little designated areas for mountain bike users. Snowmobile enthusiast would support additional trails on the forest.

- An extensive transportation network serves the Green Mountain National Forest. The existing road system is meeting current access needs, however, the forest could do a better job of providing access points for dispersed access, additional trailhead parking, and allowing access to water bodies for the elderly or disabled.

- Decommissioning of unneeded roads is a controversial issue, in general, residents and road system users oppose decommissioning roads (permanent closure) but would support closing roads and preserving them for use in the future should the need arise.

Recommendations/Opportunities

Specific opportunities identified in this analysis are:

- Conduct a Roads Management Objectives (RMO) analysis on the entire road network to determine needs and deficiencies. Prioritize the list of needs to optimize the use of limited funds. Once complete, the proper maintenance level for each road segment will be determined and assigned. Roads creating environmental risk which provide limited benefit should be considered for closure or decommission.

- Conduct a Roads Analysis Process (RAP) at the watershed or project scale to determine if roadway construction and maintenance efforts are consistent with the intent of the current Forest Plan.

- Inventory and evaluate road signs and install signage that meets Forest Service or highway standards.

- Assist towns in maintenance of road system. This could include installation of proper drainage structures including ditches, surface treatments, and snow removal through cooperative agreements.

- Seek and obtain National Forest System (NFS) funds to assist towns in road maintenance and reconstruction.

- Seek and obtain other funding sources such as Capital Improvement or Road and Trail Deposit Fund (10% funds).

- Relocate or reconstruct segments of roads that do not have adequate buffer strips or that constantly wash out.

- Review existing special use permit roads to see that road construction and maintenance requirements protect soil and water.

- Conduct scoping studies at transportation facilities near recreational areas to determine if adequate parking and access exist and where additional facilities should be located if needed.

Introduction

Background

In August 1999, the Washington Office of the USDA Forest Service published Miscellaneous Report FS-643 titled Roads Analysis: Informing Decisions about Managing the National Forest Transportation System (USDA-FS 1999). The objective of roads analysis is to provide decision makers with critical information to develop road systems that are safe and responsive to public needs and desires, affordable and efficiently managed, have minimal negative ecological effects on the land, and are in balance with available funding for needed management actions. Roads analysis is not a decision process nor does it constitute a Federal action. It will serve to guide future project-scale analyses by identifying conditions, changes, and effects relevant to implementing forest plans.
In January 2001, the agency published the Transportation Final Rule and Administrative Policy, authorizing units to use, as appropriate, the road analysis procedure embodied in FS-643 to assist land managers in making major road management decisions.

Process

Roads analysis is a six-step process. The steps are designed to be sequential with the understanding that the process may require feedback among steps, over time, as an analysis matures. The amount of time and effort spent on each step differs by project, based on specific situations and available information. The process provides a set of possible issues and analysis questions for which the answers can inform choices about road system management. Decision makers and analysts determine the relevance of each question, incorporating public participation as deemed necessary. The six steps are:

- Step 1. Setting up the Analysis
- Step 2. Describing the Situation
- Step 3. Identifying Issues
- Step 4. Assessing Benefits, Problems and Risks
- Step 5. Describing Opportunities and Setting Priorities
- Step 6. Reporting

Additional information on the roads analysis process is available at
http://www.fs.fed.us/r9/gmfl/nepa_planning/plan_revision/rap/rap.htm

Products

The product of a roads analysis is a report for decision makers and the public that documents the information and analyses used to identify opportunities and set priorities for future national forest road systems. Included in the report is a map displaying the known road system for the analysis area, and the risks, needs, and opportunities. A complete list of all the maps is included in Step 6.

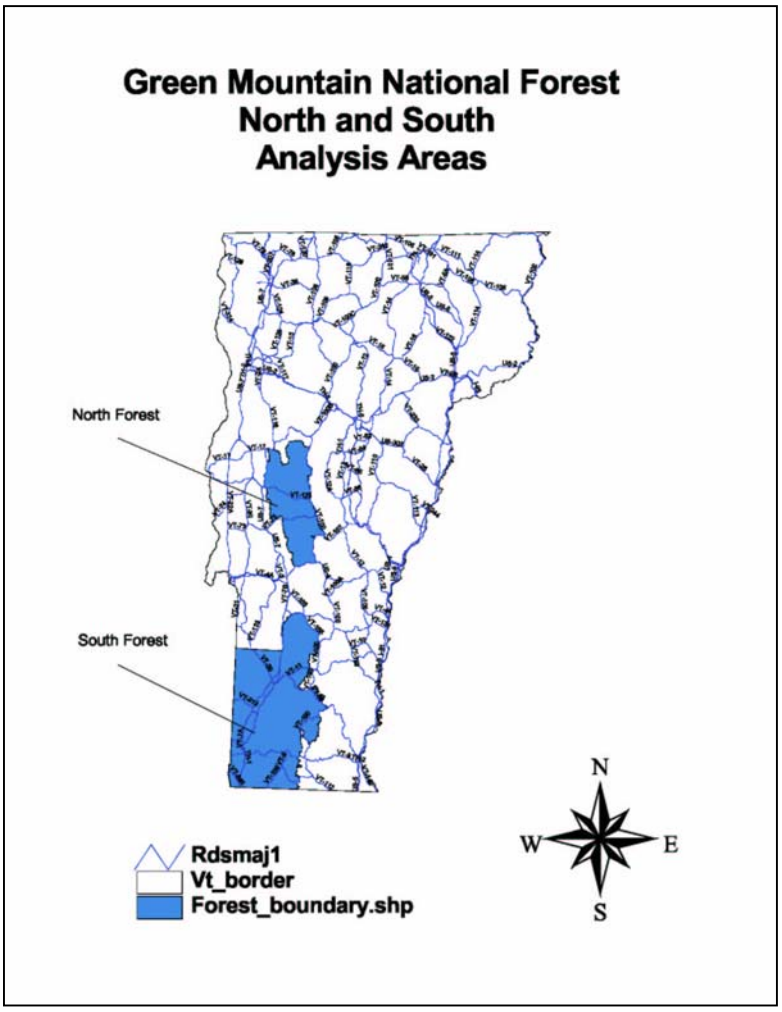
This report will:

- Identify needed and unneeded roads;
- Identify road-associated environmental and public safety risks;
- Identify site-specific priorities and opportunities for road improvements and decommissioning;
- Identify areas of special sensitivity or any unique resource values.

This Report

The area addressed in this roads analysis is not a contiguous land unit. The Green Mountain National Forest has almost 385,000 acres and represents six percent of the landmass in Vermont. In general , the GMNF is located in two areas. The North Forest is located in central Vermont and the Southern Forest is located in the south-west corner of the State (Figure 1). It is managed by the Forest Service, U.S. Department of Agriculture, for a variety of uses with an emphasis on resources and services that private lands cannot provide. This report is a living document and reflects the conditions of the Forest at the time of writing. This report will be updated as conditions warrant.

Figure 1. Vicinity Map of the Green Mountain National Forest Roads Analysis Area, 2002.



History of the Green Mountain National Forest

Vermont's Green Mountain National Forest encompassing a boundary area of approximately 815,000 acres, roughly 383,000 (or 61%) of which is federally-owned, the Green Mountain is one of only two National Forests in New England.

Unlike western National Forests which were established on land already held by the federal government, the Green Mountain is one of the Forests that required, and still requires, the purchase of privately-owned land. Over the past seven decades, Forest Service personnel have worked hard to acquire a land base on which to practice modern forest management, thus providing the state of Vermont and the New England area with wood for local industries; natural recreation areas; a vibrant watershed for local tributaries; game and fish management; and protection of unique ecological and wilderness areas.

But the implementation of various programs and the people who have been involved with them are not the only story that should be told. Befitting the occasion, this section will look at the events that led to the establishment of this important National Forest in 1932.

The first proposal to pit a large section of the Green Mountain range under federal supervision originated within Vermont. From the philanthropic efforts of a few prominent citizens, to the state government requesting the establishment of a National Forest before the National Forest Reservation Committee (NFRC, the federal tool by which new National Forest's are approved), and, finally, to President Hoover signing the proc1amation in April of 1932, the process took roughly twenty-nine years.

Marshel J. Hapgood is believed to be the first to envision a federal forest reserve in Vermont and take action to investigate its possibi1ity. An innovative owner of several mills producing lumber and semi-crafted wood products such as piano sounding boards, Hapgood was one of the few who believed in and practiced what is often referred to as scientific forestry: i.e., the select-cutting of stands to provide for regeneration of trees while limiting soil erosion and other forms of ecological damage.

Use of such modern logging practices by Hapgood was unusual for private land owners. The norm for generations of farmers and loggers, often one in the same, was to use clear-cutting techniques on softwood stands, leaving barren land with no plans for regeneration.

Demonstrating his concern for the Green Mountain region, Hapgood remarked publicly that mountain land "should be absolutely reserved as public property, for combined watershed, game, scenic and lumber uses." In 1905, he approached the administration of Theodore Roosevelt, offering to sell at a low price substantial portions of his land near Bromley mountain for federal supervision.

Although there were attempts by certain congressmen to introduce a bill, at that time no federal legislation, and thus no funds, existed for the purchase of private land for inclusion into the federal forest system.

Five years after Hapgood's first offer, Joseph Battell considered donating or willing some 30,000 Green Mountain acres to Middlebury College (his almamater), to the state, or to the *federal* government. Proprietor of the Breadloaf Inn and owner of stables containing highly—prized Morgan horses, Battell eventually gave a majority of his holdings to Middlebury College — the remainder being five hundred acres donated to the Department of Agriculture to manage the stables.

Both Hapgood's and a majority of Battell's acreage were destined to become key parts of the Green Mountain National Forest — Hapgood's property being the first purchase unit in 1932. Their concern for conservation of the mountains, and subsequent attempts to gain public ownership of upland tracts, surfaced in light of Vermont's dwindling forest reserves.

The Green Mountain state, like other Eastern sections of the nation, experienced reckless logging during the 1800s. Such activity was the result of settlers clearing woods for farms, and later loggers capitalizing on the shortage of wood in the East—a shortage caused, in part, by logging which had destroyed a majority of the East's forest reserves.

In Vermont, deforestation first occurred in the Champlain Valley where farmers struggled to create fields, and loggers cut giant softwoods like Spruce and Pine for shipment to Quebec, and later to markets to the south; markets that developed in conjunction with the industrial revolution. In these early years, the rugged mountain areas experienced limited cutting by farmers who struggled to make it in the rocky terrain.

The industrial revolution eventually brought the locomotive, in turn bringing two important changes to Vermont. One, by the mid-1800s it facilitated the mass migration of Vermont farmers to the alleged splendors of the west. And two, after this migration which left thousands of abandoned farms, the iron horse and other steam contraptions enabled loggers to enter the uplands and log large tracts of land.

As a result of farming and logging activity, Vermont's forests went under a drastic transition. From a largely softwood forest with timber often reaching some 140 feet high, Vermont has become a hardwood forest within a predominantly rural setting. This transition was caused by the natural regeneration of logged areas and abandoned farms with crowded and, for years, less valued stands of Pin Cherry, Poplar, Beech, White Birch, and other fast growth hardwoods.

As early as 1847, famed conservationist and resident of Woodstock, George Perkins Marsh, remarked on the speed with which this transition occurred. The ecological damage sustained by farming and logging, noted Marsh, was "too striking to have escaped the attention of any observing person."

Marsh observed that Vermont's economy was historically tied to the resources and aesthetics qualities of its local forests (a thesis he expounded on in his book ***Man and Nature***). But not until around the turn of the 20th century did more people begin to fully comprehend this reality.

By the turn of the century, the process of deforestation caused severe ecological damage to

mountain woods—the last bastion for mature stands of Pine and Spruce—leading to the gradual deterioration of local watersheds. Historian Rowland E. Robinson observed this deterioration, sadly remarking that "the havoc of deforestation is not stayed, nor like it be while forest tracts remain."

Partly as a result, Vermont experienced unprecedented fires during the first decade of this century. Most of these fires ripped through upland regions, sometimes started by the sparks from locomotives, often fed by dry slash left by loggers.

"Owners of timber lands in our state are pursuing a ruinous policy in the method used in harvesting timber," Governor Urban H. Woodbury angrily proclaimed before the State Legislature in 1894. The Governor recognized that the deterioration of forest land in Vermont also meant an insecure future for the state's major industry: timber and wood products.

"There is no more valuable crop produced from the land than timber." Woodbury commented in the same speech. "Every decade will see timber more valuable and it is of great importance to the state as a whole…that some measure should be adopted to lessen the wanton destruction of our forests."

As the state of Vermont had no legal power to force scientific forestry upon the public, and no land base on which to practice it, some people, like Marshel Hapgood and later Joseph Battell, envisioned public ownership of valuable mountain land.

In what proved to be the first of many efforts to alter the destructive path thus far followed, the state legislature designated funds for an experimental reforestation and fire protection program in 1904. Later in 1909, with the potential of acquiring land from Joseph Battell and others, the State Park system was established along with the office of the Vermont State Forester.

An aspiring manner to gain a land base for public management, the State Park system was seen as a means to preserve watersheds, provide natural recreation areas, and demonstrate the advantages of modern forestry management to both small and large logging interests.

Unfortunately, the park system was no panacea; the State quickly found it did not have the resources to buy an adequate land base. Improvement of a deteriorating situation would come, it seemed, only if logging businesses would change their reckless cutting methods.

What could be done? While there were no clear answers, Vermonters increasingly looked toward the federal government as a means to buy and manage mountain acreage.

In 1911, Congress passed the Weeks Act which provided funds for: a) the sponsorship of cooperative state-federal fire protection programs; and b) Federal acquisition of land for the purpose of forest management. Inherent in the passage of this legislation was the relatively new concept of public control of vital resources.

In the short run, the Weeks Act gave a boost to Vermont's state forest programs. The year of its passage, the state received technical advice and two thousand dollars to enhance its innovative and fairly successful fire detection cooperative first launched in 1904.

In the following years, Federal money came in increasing allotments, paying for the construction

of access trails *on* mountain ridges, observation posts and watchmen. As part of this program, the state, in cooperation with the Forest Service, experimented with a wireless for quick detection of fires—possibly the first use of such a wireless for such a purpose in the nation.

In the long run, the Weeks Act provided the mechanism by which Vermont would gain a National Forest.

Noting the success of lobbying efforts made by the Appalachian Mountain Club and the Society for the Protection of New Hampshire Forests in establishing the White Mountain National Forest, influential Vermonters under the leadership of Senator Frank L. Greene organized and asked the Forest Service to consider establishing a forest reserve in Vermont.

In response, the Forest Service then began a review process to look for areas within the state that met Weeks Act requirements (i.e., valuable watersheds for navigable waterways), and thus cou1d be purchased for a National Forest. In 1920, federal officials comp1eted their report. Two areas were identified: the Nulhegan Unit (in the Northeast Kingdom) in Essex and Caledonia Townships with about 340,000 acres; and a Southern Unit in Bennington and Windham Townships containing 100,000 acres.

But the NFRC (the committee which recommends to the President any new National Forests) did not approve further investigation into the proposal. According to Associate Chief of the Forest Service, Edward A. Sherman, there were other parts of the country that better fit National Forest criteria and were more in need of federal attention.

Several years later, Chief of the Forest Service, William B. Greeley, voiced similar sentiments: "Why should a National Forest be established in Vermont?...forest growth in Vermont is largely thrifty, vigorous and valuable…the areas of denuded land are small and scattered…In other words, thanks to natural conditions, the common sense and conservative temper of the people, and the effective work of the State Department of Forestry, Vermont is in splendid shape in comparison with other states."

In the eyes of the Forest Service, Vermont's mountains met Weeks Act requirements and undoubtedly needed proper forest management, but from a national perspective, help was required in other sections of the country.

Lack of interest in Washington D.C. in Vermont's plea for a National Forest prompted further organization in the state. As the establishment of any National Forest requires state approval, a movement arose to create a bill that would allow federal acquisition of forest land. Under Senator Green's leadership, State Representatives H.S. Windsor and E.S. Brigham initiated an Enabling Act in the Vermont legislature which was passed in 1925.

The Enabling Act was a new invitation for the Forest Service and the NFRC to once again consider a National Forest in the Green Mountains. Several months after the passage of the Act, the Vermont Forestry Association, along with the unofficial support of Vermont Commissioner of Forestry, Robert M. Ross, urged the NFRC to again review the Forest Service findings of 1920.

But Vermont's invitation, for reasons outlined by Greeley, fell on deaf ears for several years. Not until the submission of an official state proposal—prompted, in part, by a devastating flood—did the NFRC seriously consider establishing a National Forest in the Green Mountains.

In November of 1927, heavy rains converted mountain streams into torrential rivers, wreaking havoc on timbered hills, washing away many upland communities and partially submerging basin towns like Rutland and Montpelier. The human loss was tragic. In financial terms, the state assessed the damage as close to thirty five million dollars.

A vibrant watershed and proper river and stream control may not have completely circumvented the flood, but their importance became clear, in turn adding to the movement to acquire a National Forest.

Several months after the flood, Governor John E. Weeks made the first official state commitment to attain a federal forest. The Commissioner of Forestry, Ross, then presented the NFRC with a formal proposal in May of 1928. After a favorable reaction, Ross then returned to the Commission in December of that year with "Proposed National Forest Purchase Units in Vermont."

Envisioned were two units with boundaries containing some 300,000 acres; their location similar to the Forest Service findings of 1920. But this tine, because of its proximity to major population centers, the proposed southern unit was larger than the northern unit.

The strength of this proposal as opposed to earlier efforts was its delineation of the Forest's potential benefits. Not only would a National Forest improve and preserve local watersheds, the proposal noted, but offer resources for local wood industries and provide recreation to a region with "over thirty million people within a radius of two hundred miles." Such a tack proved attractive to the NFRC as the New England area had few natural recreation areas.

Further, the heavy second growth of hardwoods and few denuded tracts within the units provided prime land for timber improvement programs, thus avoiding the high cost of reforestation. In turn, the Forest could, as the report proudly stated, "serve as a demonstrational area of proper forest management."

As many Vermonters were well aware, the establishment of the National Forest would bring other benefits: for example, the federal government would build and maintain roads within and on the periphery of the Forest.

Finally, it was hoped that a National Forest would bring a new and steady source of income to many townships. As designated by Section Thirteen of the Weeks Act, counties (or, in Vermont's case, townships) containing any National Forest property are to be compensated for lost property taxes by payment of 25% of all Forest income. This income would be derived by the sale of timber and permits for recreational use. (For years, this compensation system has remained intact.)

Because of a National Forest's numerous benefits, the 1928 proposal contained many letters of endorsement. Included in the package sent to the NFRC were letters from the Vermont State Chamber of Commerce, the Vermont Commission of Conservation, and the New England Section of the Society of American Foresters.

The NFRC found the proposal compelling; not only was it a complete study, it demonstrated Vermont's willingness to help the Forest Service reach its management objectives.

Still, other factors were involved in the Commission's final decision. New legislation, and consequently additional acquisition monies, allowed expansion of federal conservation activity. For example, the 1924 Clarke-McNary Act extended federal purchases of National Forest land beyond watershed preservation to include valuable timber land.

And thus on December 12th of 1928, the NFRC concluded that conditions warranted a National Forest in Vermont.

A four year process then began in which the NFRC and the Forest Service reviewed and modified the boundary area while working on the arduous task of acquiring land. In consultation with the state, it was originally agreed that the northern unit proposed in 1928 should be excluded, and the southern tract be enlarged and include some 370,000 acres reaching just south of Rutland to the Massachusetts border.

But it was later determined that much of the land extending from Manchester southward was owned by the International Paper Company, New England Power Company and other companies with long-term timber rights. From past experience, the Forest Service figured that such ownership made federal acquisition unlikely.

In light of these findings, the NFRC determined in 1931 that the new National Forest should contain some 102,000 Green Mountain acres located between Rutland and Manchester.

After years of examining tracts, completing title searches, assessing land values and negotiating terms for the purchase of land, the Forest Service sought formal approval for the new National Forest. On April 25th of 1932, President Hoover signed the proclamation making the Green Mountain National Forest official.

Thanks to the leadership of Senator Frank L. Green, state officials, and the Forest Service, Hapgood's vision of public ownership of mountain land had come true. The new Forest embarked on a mission to protect and manage Green Mountain land so, in the words of Hapgood, "there should be no risk run that some day they will be devastated for pulp or charcoal purposes."

Appropriately the first Forest Service purchase, completed just before Hoover signed the proclamation, was 1,842 acres from the Hapgood Estate (Hapgood died in the 1920's). Later in 1932, the remaining 7,000 acres of the estate was acquired by the Forest Service. Eventually, at the request of state officials, the National Forest would expand its borders to include mountain land extending southward from Manchester, and a new northern unit, thus creating today's 813,000 acre boundary.

A central theme in the evolution of Vermont's National Forest is its interrelationship with local and national events. The 1932 establishment of the Forest occurred in the last year of Hoover's Presidency: a time of severe unemployment, poverty and despair for a nation grown accustomed to prosperity.

1 Setting up the analysis

Purpose and Products

The purposes of this step are to:

- Identify the geographic scale or scales for the analysis,
- Develop a process plan for conducting the analysis,
- Clarify the roles of technical specialists and line officers in the team

The products of this step are:

- A statement of the objectives of the analysis,
- A list of interdisciplinary team members and participants,
- A list of information needs,
- A plan for the analysis

Objectives of the Analysis

This report analyzes all the maintenance Level Class 5, 4 & 3 roads in the analysis area, which includes classified existing Forest Service (FS) system roads, State and Township roads (see Step 2 for definitions). It describes opportunities and sets priorities for the analysis area. The next phase of the analysis will consider all Class 2, 1 and unclassified roads on the forest, however, they will not be considered in this report.

Interdisciplinary Team Members and Participants

The interdisciplinary team consisted of specialist and planners from the Green Mountain National Forest (Table 1). The team members attended meetings, contributed data for analysis and participated in the analysis, recommendation, and prioritization process.

Table 1 - Interdisciplinary Team and Support Members for the Green Mountain National Forest.

Name	Position	Role
Bruce Reid	Geographic Information System (GIS) Specialist	Team Member
Carmen Tedesco	GIS Specialist	Team Member
Pam Novitzky	Recreation Planner	Team Member
Greg Wright	Recreation Planner	Team Member
Nancy Burt	Soil Scientist	Support Member
Kathy Donna	Hydrologist	Support Member
Clay Grove	Wildlife Biologist	Support Member
Terry Gokee	Wildlife Biologist	Team Member
Dave Lacy	Archaeologist	Support Member
Steve Roy	Fisheries Biologist	Support Member
Steve Kimball	District Ranger (North)	Support Member
Dennis Roy	District Ranger (South)	Support Member
Beth LeClair	District Ranger	Support Member
Paul White	Law Enforcement Officer	Support Member
Kim Kinville	Law Enforcement Officer	Support Member
Ed Griffith	Lands Specialist	Support Member
Bob Burt	Silviculturist	Support Member
Diane Burbank	Ecologist\Botanist	Team Member
Mike Pezzetti	Civil Engineer	Team Member
Melissa Reichert	Forest Planner	Team Member
Brad Bernardy	Fire Specialist	Support Member
Kathleen Diehl	Public Affairs Officer	Team Member
Jeff LeFebvre	Civil Engineer	Transportation Planner

Information Needs

All the roads in the Green Mountain National Forest roads analysis area were mapped using a global positioning system (GPS). The data currently in the geographic information system (GIS) will be the information used for this analysis. Updates were made as new information became available. Extensive GIS maps were needed for the various resource analyses and are discussed in Step 2 and listed in Appendix A.

Analysis Plan

Green Mountain National Forest specialists completed this document. Outside specialists, Forest Service and non-Forest Service were consulted as needed. GMNF staff specialists reviewed the document and the report is available for other National Forests as well. The report is available to the public upon request and was put on the GMNF project web page http://www.fs.fed.us/r9/gmfl/nepa_planning/plan_revision/rap/rap.htm . The GMNF interdisciplinary team (IDT) conducted the analysis using data from field surveys, GIS, and public involvement. The team developed issues related to road management and reviewed all the questions in Step 4 to determine which were applicable for forest scale analysis. In Step 5, the team brought together all the resource information, made recommendations, and set priorities.

Public Involvement

The public involvement portion of the Roads Analysis Process was a critical element of the project. The IDT felt very strongly that this report should capture public sentiment and coordinate with interested parties to the maximum extent possible. Given the short time for this process (May 2002 – January 2003), a public involvement and outreach process was designed to efficiently coordinate with the public as well as Federal, State and local government.

Coordination was done through the Federal Highway Administration, the Vermont Agency of Transportation, the six regional Planning Commissions in or around the National Forest, the towns with national Forest in their boundry as well as interested parties involved in Forest Plan Revision and special interest groups with an interest in the national forest.

A Factsheet was created on the RAP and mailed to over 1500 recipients. Thirteen separate presentations on the RAP were then made to the following groups: State of Vermont Agency of Transportation, Federal Highway Administration, Bennington County Regional Commission, Windham Regional Commission, Two Rivers Ottauquechee Regional Planning Commission, Rutland County Regional Planning Commission, Addison County Regional Planning Commission and Central Vermont Regional Planning Commission as well as to the Sustainable Forestry Initiative group. The Transportation Advisory Groups (TAC's) within the Regional Planning Commissions were in attendance at RAP presentations. The TAC's have representative members from all the towns containing National Forest as well as some that do not. These towns include:

Table 2 – Vermont Towns Participating the Public Involvement Process for the RAP

Addison	Dover	Middlebury	Royalton	Vergennes
Arlington	Dummerston	Middletown Springs	Rupert	Vernon
Athens	Fair Haven	Monkton	Rutland City	Vershire
Barnard	New Haven	Mt. Holly	Rutland Town	Wallingford
Bennington	Fairlee	Mt. Tabor	Salisbury	Waltham
Benson	Ferrisburgh	Newbury	Sandgate	Wardsboro
Bethel	Glastenbury	Newfane	Searsburg	Wells
Bradford	Goshen	Orwell	Shaftsbury	West Fairlee
Braintree	Grafton	Panton	Sharon	West Haven
Brandon	Granville	Pawlet	Shoreham	West Rutland
Brattleboro	Guilford	Peru	Shrewsbury	Westminster
Bridgewater	Halifax	Pittsfield	Somerset	Weston
Bridgeport	Hancock	Pittsford	Stamford	Weybridge
Bristol	Hubbardton	Plymouth	Starksboro	Whiting
Brookfield	Ira	Pomfret	Stockbridge	Whitingham
Brookline	Jamaica	Poultney	Strafford	Wilmington
Castleton	Killington	Pownal	Stratton	Windham
Chelsea	Landgrove	Proctor	Sudbury	Winhall
Chittenden	Leicester	Putney	Sunderland	Woodford
Clarendon	Lincoln	Randolph	Thetford	Woodstock
Corinth	Londonderry	Readsboro	Tinmouth	
Cornwall	Manchester	Ripton	Topsham	
Danby	Marlboro	Rochester	Townshend	
Dorset	Mendon	Rockingham	Tunbridge	

Additionally a press release was issued in several Vermont papers and three separate open house meetings were held to gather public input for the RAP. The meeting format for all three meetings was as follows:

Welcome and Introductions
Present the Roads Analysis Process (RAP)
Participant Breakout Working Session
Breakout Groups report back to the whole group
Overall Summary
Next Steps

This proved to be very productive. Participants were empowered and involved in the process and contributed substantially to the final product.

Findings will be reported in Section 3, "Identifying Issues" of this report.

Step 2 Describing the situation

Purpose and Products

The purpose of this step is to:

- Describe the existing road system in relation to current forest plan direction

The products of this step are:

- A map or other descriptions of the existing road and access system defined by the current forest plan or transportation plan,
- Basic data needed to address roads analysis issues and questions

Existing Road and Access System Description

The roads analysis area is defined by the 2002 Proclamation boundary of the Green Mountain National Forest (Figure 1). The Green Mountain National Forest (GMNF) encompasses approximately 385,000 acres in southern and central Vermont in the Counties of Addison, Bennington, Rutland, Washington, Windham, and Windsor. This is roughly 6 percent of the total land in Vermont and 50 percent of all public lands in the State. The northern part of the forest consists of the Rochester Ranger District and the Middlebury Ranger District, while the southern portion of the forest is covered by the Manchester Ranger District.

By 1905, historic logging and agricultural practices of the 1700 and 1800's removed the majority of the original forest on what is now the GMNF. As forest regrowth occurred, the Forest Service undertook active management, following the establishment of the GMNF in 1932, to improve forest and tree quality and diversity. Total standing timber volume on the Forest has steadily increased to the current levels, which likely exceed any levels since the arrival of European settlers. About 334 wildlife species, 17 fish species, and over 400 vascular plant species inhabit the GMNF and are dependant on the habitat provided therein. No critical habitat for any federally listed threatened, endangered, or proposed species has been designated on the GMNF.

The Forest's scenic beauty stretches over nearly two-thirds the length of Vermont, and includes a diversity of landscapes ranging from the rugged, exposed heights of Mount Abraham to the quiet, secluded hollows of Lye Brook Wilderness.

Multiple Use Management

The Forest Service is charged by Congress to manage the National Forest for a variety of public benefits—"Multiple Use" is the key phrase. Since demands vary greatly, reaching a balance is a constant challenge to Green Mountain National Forest land managers. There are many management activities such as wildlife habitat projects including aspen regeneration, apple tree release, controlled burning for opening maintenance, reintroduction of the peregrine falcon, in-stream improvements for fishery habitat, deer wintering area improvement and many others. Less than one percent of the Forest is logged every year. There are regeneration cuts averaging about 15-20 acres each, selective cutting,

timber stand improvement, and areas being planted. There is an extensive winter trail networks for cross-country skiers and snowmobilers. Three downhill ski areas, Sugarbush, Bromley, and Mt. Snow, are partially located on the National Forest under special use permits.

Recreation Opportunities

Recreation opportunities include hiking, skiing, snow shoeing, camping, back-country or wilderness experiences, hunting and fishing. There are approximately 900 miles of hiking and multiple use trails criss-crossing the Forest, including the Appalachian/Long Trail which winds its way along the ridge line of the main range of the Green Mountains for 264 miles. The trail system contains a network of shelters spaced approximately one day's hike apart for the hikers' convenience and to ease the impact of overnight camping on the environment. The trails and shelters are cooperatively maintained by the Green Mountain Club and the Forest Service.

The Forest also contains six wildernesses and White Rocks National Recreation Area. All of these places offer unique recreation opportunities for back-packers to enjoy nature's solitude amid some of Vermont's most spectacular scenery. Primitive and developed camping is available throughout the Forest. There are nine developed campgrounds on the Forest with a total of 102 campsites. Each campground has its own special attraction.

There are also 9 picnic sites on the Forest for day use activities. Berry picking, birding, fishing, hunting, cross-country and downhill skiing, snow shoeing, and snowmobiling are some of the other activities available on the Forest.

Access

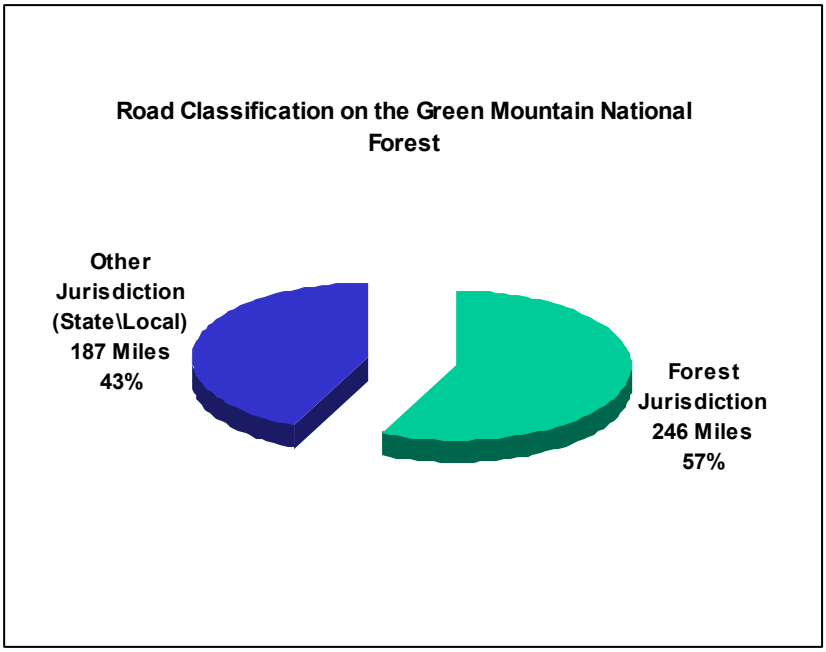
Primary access to the analysis area occurs by several major State and Federal highways including US 7, US 4, VT 116, VT 125, VT 100, VT 73, VT 140, VT 11, VT 30, VT 8 and VT 9 which border or run through the area. Most Forest Service roads are opened during hunting season. Although Forest Service roads are usually marked at the entrance with a road number, it is often difficult to determine the difference between a Forest Service road and local road. Road density within the Green Mountain National Forest ranges from 0 to 0.39 miles/square mile (Appendix A-Map 1 and 2), with the highest road densities occurring in the northern half of the forest.

A little more than half (57%) of the roads in the Green Mountain National Forest area are under Forest Service jurisdiction (Table 3, Figure 2)(Appendix A- Map 1 & 2). The remaining roads (43%) are categorized as Federal, State, town or private roads.

Table 3 - Total classified road miles in the Green Mountain National Forest.

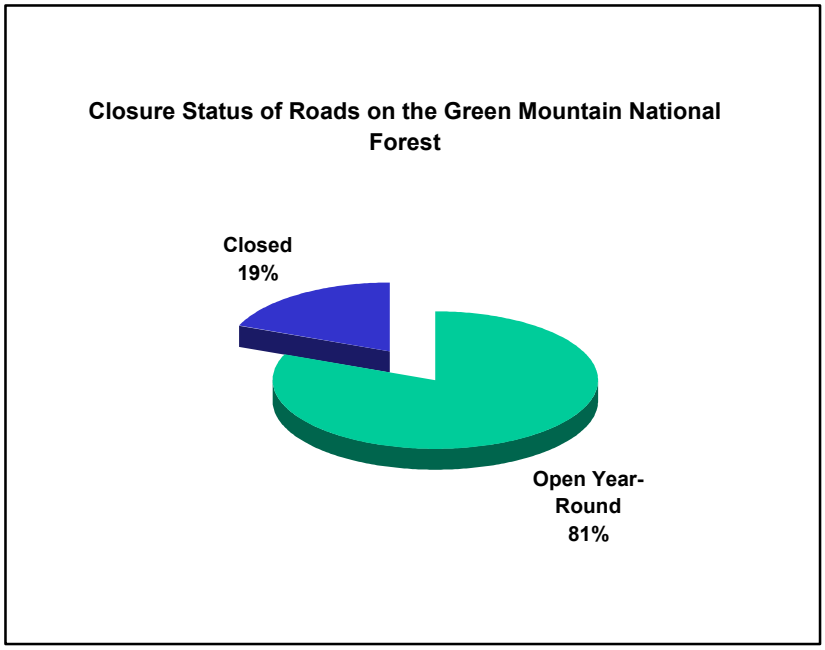
Ownership	Road Miles (%)
Forest Service	246 (57%)
Federal/State/Town/Private	187 (43%)
Total	433

Figure 2 – Road Classification on the Green Mountain National Forest



Roads in the Green Mountain National Forest are managed in the categories Open and Closed. An open road is available for the public to use whereas a closed road is not.

Figure 3 - Road management as percent (%) of all roads on the Green Mountain national Forest.

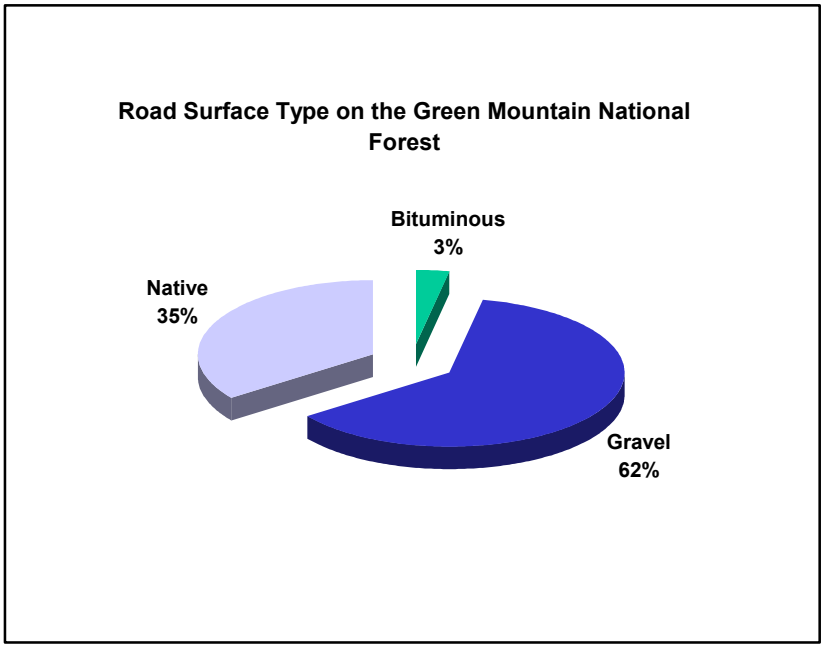


Most of the roads (62%) in the Green Mountain National Forest have Gravel surfacing (Table 4, Figure 4, Appendix A- Maps 7,8,9 & 10). The surfacing material has been shown to be an indicator of the potential for erosion and sedimentation for a road. Bituminous (paved) roads have the least potential for erosion and sedimentation while roads constructed with a native surface have the most potential for erosion and sedimentation concerns. Gravel material has typically been used in this area to mitigate the effects of road-caused erosion and sedimentation.

Table 4 - Road surfacing type for all roads and Forest Service roads in the Green Mountain National Forest, 2002.

Road Surface Type	All Roads (miles)(%)	FS Roads (miles)(%)
Bituminous	13.4 (3%)	4.0 (2%)
Gravel	267.6 (62%)	139.9 (57%)
Native	152.2 (35%)	101.9 (41%)
Total Miles	433.2	245.8

Figure 4 - Road surfacing type for all roads and Forest Service roads in the Green Mountain National Forest, 2002.



Road Definitions (36 CFR 212.1)

As mentioned above, the Federal Register published the Final Rule and Administrative Policy, January 12, 2001; this established new definitions for road management on the national forests. Listed below are the new definitions for roads.

Classified Road – Roads wholly or partially within or adjacent to National Forest System lands that are determined to be needed for long-term motor vehicle access, including State roads, county roads, privately owned roads, National Forest System roads, and other roads authorized by the Forest Service.

Temporary Roads – Roads authorized by contract, permit, lease, other written authorization, or emergency operation, and are not intended to be a part of the forest transportation system and are not necessary for long-term resource management.

Unclassified Roads – Roads on National Forest System lands that are not managed as part of the forest transportation system, such as unplanned roads, abandoned travel-ways, off-road vehicle tracks that have not been designated and managed as a trail, and those roads that were once under permit or other authorization and were not decommissioned upon the termination of the authorization.

Road Decommissioning – Activities that result in the stabilization and restoration of unneeded roads to a more natural state.

Road Reconstruction – Activities that result in improvement or realignment of an existing classified road as defined below:

Road Improvement – Activity that results in an increase of an existing road's traffic service level, expands its capacity, or changes its original design function.

Road Realignment – Activity that results in a new location of an existing road or portions of an existing road and treatment of the old roadway.

Unroaded Areas

In the roads analysis process, unroaded areas are defined as "areas that do not contain classified roads" (USDA-FS 1999, p. 11). Forest Service Road Management Policy further defined unroaded areas as "any area without the presence of a classified road, that is of a size and configuration sufficient to protect the inherent characteristics associated with its roadless condition. Unroaded areas are distinct from and do not overlap with inventoried roadless areas." (Federal Register 2001). There are no inventoried roadless areas on the Green Mountain National Forest.

Since this analysis deals exclusively with Class 5, 4 & 3 roads, the unroaded areas of the Green Mountain National Forest will not be analyzed in this study. Analysis of unroaded areas will be completed as part of Forest Plan revision.

Snowmobile Trails in the Green Mountain National Forest

There are currently 438 miles of developed snowmobile trail on the Green Mountain National Forest (Appendix A – Maps 17 & 18). On average there are 100 days during the winter season when there is sufficient snow for winter recreation activities. For snowmobile use, there are approximately 15 weekends per season when there is enough snow to groom trails and provide users with a quality trail experience. The snowmobile community has been successful in establishing many miles of snowmobile trail and connectors over the last 20 years. As a result, the snowmobile trail system on the Forest has met Forest Plan goal for trail miles.

When adequate snow cover is present, trail use is high on weekends with moderate use during the week. There is some illegal use within the forest. Some users prefer to ride right from their camp or home and not trailer to a trailhead.

The GMNF currently has grooming and maintenance agreements with the Vermont Association of Snow Travelers (VAST) for all trails on the Nation Forest. The GMNF received no special funding for these activities. Trail improvement projects are carried out by individual snowmobile clubs under contract with the State of Vermont.

Basic Data Needs

Basic data needed to adequately address the issues for the GMNF are listed below. Some of the data are included in this report, while other data used to help answer questions in Step 4 are located on file at the Forest Supervisors Office in Rutland VT.

- GIS layer of existing road network.
- Road logs and non-system road survey.
- GIS layer of wildlife cover types.
- GIS coverage and mapping of critical, unique or sensitive wildlife habitats.
- GIS map of unroaded areas (classified roads buffered ¼ mile).
- Classification of all roads by type and level of use, season of use and maintenance needs.
- Identification of illegal OHV use and garbage dumping sites within the analysis area.
- Mapping of wetlands, landforms, and ecological land types within the analysis area.
- Identification of wildlife species whose viability is a concern and are most at risk from roads.
- On-forest wildlife monitoring data.
- Identification of wildlife habitat management needs facilitated by the existing road system.
- Estimates of deer density and an assessment of road management strategies that affect hunter access.
- Identification of existing monitoring/inventory sites and the required roads necessary for access.
- An assessment of the degree of encroachment and proximity of roads to wetland areas, and the potential impacts is needed.
- The location or roads relative to riparian boundaries that influence riparian vegetative communities.
- Vegetation inventory data.
- Recreation facilities, designated trails, and areas of concentrated dispersed recreation use.

Step 3 Identifying issues

Purpose and Products

The purpose of this step is to:

- Identify the key questions and issues affecting road-related management,
- Describe the origin of the issues

The products of this step are:

- A summary of key road-related issues, including their origin and basis, presented by general categories of environmental, socio-cultural, and economic

Issue Summary

Road-related issues were captured from the public, the Vermont Agency of Transportation, the Federal Highway Administration, six Regional Planning Commissions (Bennington County Regional Commission, Windham Regional Commission, Two Rivers Ottauquechee Regional Planning Commission, Rutland County Regional Planning Commission, Addison County Regional Planning Commission and Central Vermont Regional Planning Commission), Town selectboards, Town Planning Commissions, Special interest groups (Vermont Association of Snow Travelers, Vermont Wildlife Federation, Sustainable Forestry Initiative Workgroup, as well as from Forest Service employees. Public comments were received through a variety of means. Twelve (12) public meetings were held throughout the State of VT. Newsletters were published and mailed to approximately 1500 interested parties. The forest has received numerous emails, letters, postcards, phone calls and one-on-one visits. Identified issues include:

Issue 1 – Road Management

Maintenance: During the public involvement process there was a very healthy exchange of information regarding the limited number of maintenance dollars and the comparatively high number of roads which require work. Historically, we have heard an outcry for more and more maintenance from the public with little understanding of our limited resources. The initial call for across-the-board road improvements quickly changed to prioritizing critical roads on the part of the public. Other groups (State, FHWA and Regional Planning Commissions) seem to already understand this dilemma. There was general support for the decision to not maintain roads in the winter and for reducing redundant road systems (roads which parallel or begin and end in similar areas), however there was a concern that roads be closed versus decommissioned as new construction may be difficult in the future.

Prioritization: There was strong support during the public meetings for prioritizing FS roads. This would include listing all roads and setting priorities on the allocation of maintenance and construction dollars. This would include evaluation of resources accessible from said roads (i.e. – recreation, network connection, safety, fire control, etc.), and the risks posed through its operation (i.e. – resource impact, erosion, cost to maintain, etc.).

Road Surfacing: There was concern that most of our roads are gravel or pit run material (61%), and we are creating an erosion/sedimentation problem on the forest. One alternative suggested was to pave more of our roads (where appropriate). This would reduce erosion/sedimentation, reduce gravel cost over the long-run and stabilize the road prism. Although this alternative is not a favorite of the traveling public who appreciate the atmosphere of our dirt road setting it will be discussed further.

Road Closures: Given that this phase of the analysis deals with the class 5, 4 & 3 roads (The primary road network for the Forest) there was little support for closing any roads outside our seasonal closure. There is a need to determine which roads, if any, should be closed.

Road Decommissioning: There was little support for decommissioning Class 5,4 & 3 roads on the Forest. These classes are the primary network and are needed for access to much of the Forest.
Illegal ATV Use: Some portions of the existing road system in the GMNF are being used for illegal activities. There are several garbage dumping sites being accessed using the road system. There are some ATV users that are accessing areas that are closed for motorized use. This activity create erosion and sedimentation problems into streams, mainly at stream crossings, and causes negative impacts to vegetation and wildlife.

Issue 2 – Access

Restricting Access: There is little support for restricting access on the Class 5, 4 & 3 roads as these are the primary network for the Forest. However, in Phase 2 of the process (beginning January 14, 2002) the GMNF will include Class 2 & 1 roads. There was a great deal of discussion on restricting access on certain roads on the forest. Some roads may be needed in the future and restricting access would preserve them in their current state.

Access to Cultural and Heritage Sites: There was great deal of interest in accessing cultural and heritage sites on the Forest using the road network. Virtually every historic site on the Forest was once linked directly to a transportation route of some sort; and most current routes follow in the general footprint of earlier roads. Thus, most still-active roadways, including the Class 3/4/5 Roads, have historic structures and historic archaeological sites and features within their corridors. Construction and maintenance activities have the potential to adversely affect historic sites, but Forest Plan standards and guidelines provide for the management and protection of such sites (i.e., usually through avoidance or project re-design; occasionally through data collection prior to impact).

Access to Gated Roads: Many comments were received regarding the occasional access to gated roads on the Forest. The GMNF has chosen to gate some roads that directly access larger water bodies. This was done in an effort to protect the sensitive biological/ecological systems which thrive in or near the buffers of these special areas. In so doing, this has made it difficult for those users with disabilities or difficulties hiking on rough trails to access the resource.

Access for Vegetation Management: On-going vegetative treatments exist, as well as proposed vegetation treatments. The current road system can access a large majority of the area; however, there may be a need in the future to access stands, for silvicultural treatments that currently do not have adequate access. If there were not adequate access for vegetation management then new roads would be proposed. When considering access for vegetation management the Forest Service analyzes all current roads in the area to minimize any new road construction (e.g., looks at potential for using existing Forest Service roads)

Access to private and State Game Lands: Before closing any Forest Service system roads, consideration must be given to whether or not the road will be needed for access to private or State Game Lands. The Forest Service will work in cooperation with private and other public landowners to ensure adequate access is maintained.

Access for Deer Management/Hunting (seasonal, year-round): The road system provides hunter access in the fall/winter, helping to control the deer population. Roads are used to help disperse hunters throughout more of the area than they would cover by walking; as a result roads are open for hunter access. High deer populations are a concern on the GMNF because of the effect of selective browsing on forest vegetation, particularly over an extended period of time. Deer prefer hardwood species seedlings as food, including oaks, white ash, red and sugar maples, yellow poplar, aspen, hemlock, and pin cherry. This selective browsing and elimination of seedling species affects the development and species composition of future forests. The loss or reduction of understory and shrub layer vegetation also adversely affects many wildlife species because of the removal of protective cover, food sources, and nesting sites. In order to disperse deer hunters over a larger area, roads remain open for deer hunter use.

Issue 3 – Potential Impacts to Water Quality

Potential impacts to water quality from roads occur from surface erosion, stream crossings, undersized culverts, and other culvert problems, etc. On the GMNF, limestone is often applied to roads that are within 300 feet of a stream crossing as a mitigation measure to help prevent sedimentation from the fine sandstone.

Issue 4 – Enforcement

Dumping sites, Illegal ATV use areas and poaching areas were identified in the public meetings. There was also a great deal of interest in having all Forest Service roads posted for speed. The public strongly support additional enforcement of the Forest roads and areas with high public use. The public felt the cooperative agreements with the local enforcement officials were not as effective as they could be and would like to see more Forest Service Law Enforcement Officers patrolling the Forest.

Issue 5 – Timber

In the RAP public meetings, there was a great deal of concern regarding the existing road system as a resource for future timber management. Given the current difficulties with building new roads, there was a great deal of interest in closing roads in a preservation effort for the future. There was general support for timber harvest as a management tool. Benefits include; creating open spaces for wildlife, the generation of under-story for wildlife food crop and removing ground fuel. There was not a consensus on this issue. Some feel that no timber harvesting should be done on public lands.

Issue 6 – Recreation

Hunting: Hunters are concerned that road closures force hunters to access the forest in limited areas thus creating a safety issue (i.e. – high concentration of hunters at designated access points). Hunters would like to see the maximum amount of access to the forest for this activity. Temporary or seasonal

closure of the roads after the end of hunting season is fine with this group.

Snowmobiles: The snowmobiles advocates are interested in additional trails and more cooperative agreements with the forest. Some were concerned with the addition of ATV trails but welcomed the cross-country skiers. The Vermont Association of Snow Travelers welcomes joint projects with the forest and has donated volunteer hours and cash match for projects on public lands.

ATV/Mountain Bikes: Both ATV and Mountain bike enthusiast would like to see designated trails on the forest. At this time there are no legal ATV trails and very limited mountain bike trails on the forest. Given that these two recreational activities were not highly present during the last revision of the forest plan (1982), there are very few designated areas.

Wildlife Viewing Areas: There was general support for additional wildlife viewing areas as well as request for the clearing of current viewing areas that have become overgrown.

Forest Fragmentation and Road Kills: The effects of forest fragmentation on terrestrial wildlife habitat can vary depending on the width of the road, length, level of construction (related to the ease with which a species can cross a road), the distribution of forested habitat, and the sensitivity of a particular species to roads. Dissecting a forest with roads may diminish its value as wildlife habitat, and there is evidence that roads may exacerbate the problem of forest fragmentation. One of the primary effects of forest habitat fragmentation by roads is the disturbance to wildlife by seeing traffic movement, in addition to the noise generated by passing vehicles.

Direct mortality from collisions with vehicles is well documented and few terrestrial species of animal are immune. In general, mortality increases on roads with higher traffic volume and speed (i.e., paved roads). All species are at risk and some species may be attracted to roadside vegetation, insects and dense cover established along the roadside. Some wildlife may be attracted to the road surface itself to collect seeds or gravel. Small mammals, birds and snakes aggregate on or near warm roads, increasing their risk of being hit by vehicles.

Road densities in the Green Mountain National Forest range from 0 to 0.39 miles/square mile.
Non-native Species: Roads are potential corridors for the introduction of exotic plants, animals, insects, or diseases since these groups tend to be transported by human activity corridors. Whether the road is unrestricted, restricted, closed plays a role in the probability of the introduction of the exotic. The road location can influence whether the exotic can be introduced into an acceptable habitat where it can become established. Examples are seed and insect (hemlock wooly adelgid or gypsy moth egg masses) or disease transported by vehicles. Roads also provide one of the means of dispersal for exotic species by providing suitable habitat, stressing or removing native species, and allowing easier movement by wild or human vectors

Step 4 Assessing Benefits, Problems, and Risks

Purpose and Products

The purpose of this step is to:

- Assess the various benefits, problems, and risks of the current road system and whether the objectives of Forest Service policy reform and forest plans are being met

The products of this step are:

- A synthesis of the benefits, problems, and risks of the current road system,
- An assessment of the ability of the road system to meet management objectives
-

Current Road System Benefits, Problems, and Risks

Ecosystem Functions and Processes (EF)

EF (1) What ecological attributes, particularly those unique to the region, would be affected by roading of currently unroaded areas?

Ecological attributes that are considered unique or significant are often conserved under some type of special management designation. There are several types of special management designations that would potentially be affected by roading, including Research Natural Areas (RNAs), Special Areas (SAs), roadless areas (those identified during current and past roadless area inventories), National Recreation Areas (NRAs), and Wild and Scenic Rivers (WSRs). Many of these areas prohibit the construction of new roads, although some identify road construction as allowed as a last resort. If new roads are proposed in these areas, the effects of roading on such areas will be analyzed in the Environmental Impact Statement (EIS) for the revised Forest Plan.

Currently, the Forest Plan identifies 13 designated SAs (Management Area 8.1), of which one is a RNA, and one is a NRA on the GMNF. The Forest Plan also identifies 4 of the SAs as Potential Research Natural Areas (one of the original potential RNAs was designated as a RNA in 1993); and identifies 49 Significant Streams that are considered Potential Wild & Scenic Rivers. All of these various types of special area designation were based upon protection and preservation of unique or representative ecological attributes. Some areas include classified roads while others do not. Ecological attributes protected include old growth Forest (The Cape RNA), high elevation soft-water ponds (High Elevation Ponds Special Area), a high elevation calcareous cliff (Mount Horrid Special Area), and the Forest's only alpine area (Mount Abraham Special Area). White Rocks NRA was designated to protect, in part, the ecological attributes of remote forest and a diversity of terrestrial and aquatic habitats at a large scale. Because these areas have been designated for ecological reasons (all or in part), protections for those attributes have been built into Forest Plan standards and guidelines.

Since the Forest Plan was adopted, inventories for significant ecological and biological features have

been conducted on the GMNF in cooperation with the Vermont Nongame and Natural Heritage Program (VNNHP) of the Vermont Department of Fish and Wildlife. This inventory has identified well over 50 additional sites that have significant and often unique ecological attributes, including additional small patches of old growth forest of several natural community types, many sites for rare or uncommon plants and animals, a unique heath barren and lowland bog complex, high quality examples of enriched northern hardwoods and several oak-pine natural communities, the Forest's only cedar swamp and other examples of mineral enriched peatlands (i.e. fens), additional important ponds and wetlands, and significant outcrop, cliff, and talus communities, among others. Such areas will be evaluated for appropriate management designation during Forest Plan revision. During the revision process the remaining potential RNAs will also be evaluated to determine the appropriate designation. If some of these areas are placed under management strategies that allow roads to be constructed, the EIS for Forest Plan revision will analyze the effect of that strategy on the valued attributes of the area. Potential effects of constructing roads in or through these sites depend upon the attribute of concern, and such effects are discussed further below under the "Ecological Functions and Processes", "Aquatic, Riparian, and Water Quality", and "Terrestrial Wildlife" sections.

EF (2) To what degree do the presence, type, and location of roads increase the introduction and spread of exotic plant and animal species, insects, diseases, and parasites? What are the potential effects of such introductions to plant and animal species and ecosystem function in the area?
Roads are potential corridors for the introduction of exotic organisms, since they tend to be transported along human activity corridors. The level of road access (closed, restricted, or unrestricted) can play a role in the probability of introducing a non-native organism. The road location determines whether the exotic can be introduced into an acceptable habitat where it can become established. Roads may influence the spread of exotic organisms in two fundamental ways. The presence of a travelway and sometimes a means of transport on that travelway (e.g. wheeled vehicles, clothing, fur) can serve to introduce exotic organisms to suitable habitat that was previously unavailable to them due to barriers of either access or unsuitable habitat. In addition, travelways have certain characteristics that make them in themselves suitable habitat for many of these organisms, such as sandy or gravelly open roadsides, drainage ditches, regular disturbance, and less competition from other organisms.

Non-native species can have a variety of impacts on other native organisms, their habitats, and ecosystem functions. These species tend to be invasive due to a lack of adequate natural control mechanisms within their new environments. Exotic species come from other environments where they have evolved with other organisms that either consume them or compete with them. Over time, such species find a niche in their natural environment that includes the other organisms that exert a level of control over their spread. When introduced into a new environment without the other organisms that act as controls, the exotics can spread rapidly. In these circumstances, they tend to compete well against the native flora and fauna, often replacing some of them entirely. This can lead to loss of food sources for some native species, as these new species may be unpalatable or less nutritious, or offer poor reproductive habitat for native insects. Such species can also change ecosystem processes, for example by accelerating or decelerating nutrient cycling, by changing levels of biomass accumulation, by extending the length of time it takes for sites to convert from field to forest, and by changing hydrological flow characteristics in riparian areas.

At the time the current Forest Plan was developed, it was believed that invasive species tended to be limited to areas under stress or that were open – e.g. in areas that tended to be droughty, where trees had been suffering from insect or disease pressures, or in wildlife openings, trailheads, log landings, roadsides, and abandoned agricultural lands; intact forests were thought to be fairly resistant to invasion. Most invasive plants are through of as opportunistic, and in this context they take advantage of these open and stressed environments, quickly retreating once a canopy of trees has formed. While this generally remains true, recently it has been found that some invasive species can do very well in older enriched forests that are light limited but with plenty of available nutrients (especially nitrogen and moisture) required by these species. Consequently they can still be opportunistic by crowding out the native species and exploiting the abundant resources (e.g. garlic mustard), and they can alter ecological processes that may eventually limit the growth or existence of other species (e.g. non-native earthworms). So roads that pass by or through older enriched forests can also be a concern.

The road system on the Green Mountain National Forest supports a variety of uses, including recreation and vegetation management. Many of the FS class 3-5 roads on the GMNF have been in use for decades and were roads connecting villages, hamlets, homesteads, and hill farms in the mountains prior to federal ownership. Most of the homesteads and hill farms are gone now, and so the roads are currently used to access timber, wildlife, and recreational resources. Many of the roads have the characteristics of old town roads through the forest with long stretches of close to full canopy closure and little distinction between the habitat on the road edge and into the woods. Others have a higher level of maintenance with distinct road edges and more open canopies. Most of the roads have turnouts and trail access sites along them that tend to be more open. Some are not plowed in the winter but are then open to snowmobile and cross-country ski use at that time of year. So most of these roads are accessible in one way or another to people, animals, and vehicles, all of which are vectors for exotic organisms.

Exotic Plants

For decades it has been common practice on the GMNF and across Vermont to plant various mixtures of non-native or naturalized plants to stabilize disturbed soils and road-cuts, reduce runoff and to improve wildlife habitat and aesthetics. In some areas, notably Hapgood Pond, invasive exotic honeysuckles were planted to stabilize and beautify the site. Many of the non-native wildflowers and weeds found along both paved and forest roads are now considered naturalized in Vermont. High volume, paved roads with wide, open corridors appear most susceptible to infestations of these non-native species.

Depending on the level of development during construction, forest roads can dissect the canopy allowing sunlight to reach the forest floor at greater levels, and may promote the invasion of non-native plants. These species are sometimes very aggressive in or along road corridors. The success of these plants is often to the detriment of other indigenous plants and their associated animal communities. Weeds have been known to invade wetlands and use roadside ditches to spread across the landscape. Major roads through agricultural landscapes along river corridors appear to offer the most opportunities for invasive plants, and that is where Vermont tends to have problems with these plants, such as with Japanese knotweed. Although several such roads cross through and border the GMNF, none of them are actually class 3-5 under federal jurisdiction.

The destination of a particular road can also be of concern. There are several invasive exotic aquatic plants known in the state; none are currently known from any of the lakes and ponds on the Forest. However, Grout Pond Road has as its destination Grout Pond, which is a significant site as a current and historic site for several rare plants. There are other waterbodies and wetlands that are adjacent or near to

other Class 3-5 roads. These roads could provide an easy route for exotic aquatic species to become established in the Forest. However, this has not happened yet, and so it may be that the exotic species may find the aquatic locations near these roads too cold or otherwise unsuitable at this time.

The degree to which a road system increases the introduction and spread of exotic plant species varies with the habitats involved and the ecology of the invading plant species. Generally, roadsides are the primary means of weed introduction into an area. Most weed species are adapted to open, dry, and disturbed early-succession substrates that roads provide. The movement of vehicles, humans and animals on these roads can act as major vectors of weed seeds. As noted above, the ecology of some invasive plants, such as garlic mustard, allows it to take advantage of high levels of available nutrients, even when light is at low levels. Consequently roads through such areas can also present a risk. Garlic mustard is currently very rarely found on the GMNF, which is likely due to its preference for warmer sites outside the mountains.

Surveys for invasive exotic plants over the last several years at trailheads and parking areas along some of the class 3-5 roads, have found little evidence of invasion by such plants. Species found to have established populations in or adjacent to the Forest include the various exotic honeysuckles, Japanese knotweed, and purple loosestrife. Most of the invasive plants have been found in association with the state highway system, along major river corridors, in lands abandoned from agriculture in the early 1900's, in areas where they were planted for stabilization and aesthetics, and in areas with a high density of "travelways" (e.g. ski areas). It may be that the road system on the GMNF is relatively resistant to these invasive species; alternatively the invasive plants may have better habitat elsewhere for now, and may eventually get to the Forest in the future.

Exotic Animals

The cowbird, common grackle, and European starling are considered introduced pests that can have adverse impacts on wildlife. Roads can facilitate the introduction of the cowbird into a region, especially when roads facilitate the fragmentation and isolation of forest tracts, usually through development and agricultural systems.

Exotic Insects and Diseases

The spread of insect pests can be facilitated by increased road density and traffic volume. Forest pests such as gypsy moth have been accidentally transported into and out of the forest to other parts of the state, and nation, on recreation vehicles as well as heavy vehicles used to transport forest products. Asphalt highways through the forest support Statewide and Interstate traffic that may serve as vectors of detrimental insects such as the hemlock woolly adelgid and Asian longhorn beetle. Travelways that are more open and exposed can increase the level of stress that trees along the edge experience through enhancement of drought conditions, making the trees more vulnerable to damaging insects that may travel through the corridor. Open road corridors also enhance dispersal of insects by enabling them better access to wind and increasing dispersal distance, thereby improving the likelihood of finding suitable habitat.

The construction of forest roads can have an influence on the spread of tree diseases. Road construction is performed with heavy machinery causing exposure and injury of roots of trees within and adjacent to the new corridor. As a result, construction may facilitate the spread of diseases such as armillaria root rot and sapstreak. It can also introduce stress that will make trees more vulnerable to attack by both native and exotic diseases. As with insects, more open travelway conditions can also enhance wind dispersal of spores, and so enhance the spread of these organisms.

The GMNF is not currently affected by most of the exotic organisms that have been recently introduced and causing major problems in other parts of the Northeast or Vermont (e.g. Asian longhorn beetle, hemlock woolly adelgid, and common pine shoot beetle). Gypsy moth has been well established in

parts of the Forest, although the introduction of a pathogen of the moth has appeared to keep populations of the moth low. Gypsy moth populations peak every 7-10 years and the last outbreak was in 1992. Butternut canker is known from the Forest, as are what may be resistant trees. Resistant butternut trees have been planted in an orchard along a state highway and do not appear to be negatively impacted by the proximity of this road. On the GMNF, it does not appear that the Class 3-5 road system has had any measureable effect on the spread of these exotic organisms on the Forest. The Forest is dissected by many state roads that offer more suitable habitat for spreading insects and diseases. Class 3-5 roads that do penetrate deep into the Forest do not appear to be associated with any known outbreaks of exotic pests.

EF (3) To what degree do the presence, type, and location of roads contribute to the control of insects, diseases, and parasites?

Disturbance regimes in Vermont in general and in the GMNF in particular have been found to be varied but usually not of the catastrophic variety. Most natural disturbances in the Forest are associated with the death and/or felling of single trees and small groups as a result of wind, insects and disease, breakage from ice and snow loading, lightning strikes and resulting small fires, small landslides and slumps, flooding, herbivory (deer, moose, beaver) and ice scour. Disturbance regimes that are of larger extent include regional ice storms, thunderstorm downbursts, and larger fires in limited parts of the Forest (the oak, pine and hemlock forests along the western edge of the Forest). The timing of the smaller events can also lead to larger effects, for instance when a defoliation or other stressful event is followed by a downburst or ice storm, which can broaden the effects of the disturbance. Very infrequently (at return intervals in the neighborhood of every 1000-3000 years), catastrophic events, usually from hurricanes or other larger and unusual wind events, will leave their mark on the landscape. Current disturbances related to humans include timber harvesting and trail system development.

A major historical disturbance in the Forest was the removal of most of the trees for settlement and agriculture during the 1800's and prior to federal ownership. Seventy to eighty percent of the Vermont landscape was open land in the late 1800's. This disturbance was most intensive in the valleys, and low slopes of the mountains, and less so up into the higher elevations of the mountains and the mountainous plateau in the southern Green Mountains. Most of the Forest is at a higher elevation, and so only along the Forest edges and the river corridors that enter the Forest from the valleys outside the Forest do we find a significant legacy of this disturbance. In the hills and more mountainous country, hill farms and settlements did not last long, and so while there continues to be a legacy of this disturbance, the recovering forests often appear quite similar to those that were minimally harvested.

An historical disturbance related to settlement and consequently the resulting road system was the extirpation of several species, notably passenger pigeon and beaver. The developing road system, especially where it coincided with stream corridors, was an important means for hunters to facilitate the pursuit of these species. While beaver were only extirpated in the state and were subsequently reintroduced at the turn of the century, the passenger pigeon was extirpated throughout its range. The pigeon population at the time of settlement was of such great extent that it must have had impacts on the ecology of the forests it inhabited that were significantly altered upon its demise; however there is little research to draw from to develop any hypotheses in this regard. The beaver population is still recovering and it is not clear at this point if it has reached some stable level, or if the cycle of pond and meadow establishment and abandonment has been established with any regularity.

The road system would not be expected to affect disturbances from insect and diseases, ice and snow loading, or damage from lightening strikes. Small or larger fires can be limited by the extent of the road system. However, in the GMNF the fire-prone habitats are in exposed rocky escarpments with limited road access, so the effects of the Forest road system in fire prevention may be limited, especially when considered in balance with the soil effects of constructing roads in such steep rocky areas, and the fact that most of the fires tend to spread very little. The road system can also provide more access to people who may be careless and start fires accidentally. Except during a times when trees have been stressed or killed in larger numbers than usual (e.g. during a series of drought years or after blowdown or breakage of moderate or catastrophic proportions), it is unlikely that such accidental fires will go very far, and so the road system again has a minimal effect here. It should be noted that an unusual coincidence of stressing events (e.g. the 1998 ice storm followed by a moderate hurricane in 1999 followed by moderate to serious drought in 2001 and 2002) can lead to a much greater risk of fire, and so the existing road system in those cases can be important. It is likely that such coincidence of events have happened historically, although likely rarely. Research on the Battell Preserve in Middlebury indicates that there may be periods of time where such events are more likely to occur in coincidence, and that those are the times where stand replacing fires have occurred.

The road system would not affect winds from tornados or severe straight-line winds, but blowdown from straight-line winds could have some concentrated localized effects, particularly when adjacent to new road corridors cut through standing trees. Trees along these new corridors may have received damage to root systems during construction causing them to be susceptible to blowdown. Trees develop wind firmness from surrounding trees as they grow, and after new road construction, will have some compensating root development over time to increase wind firmness. In addition, given the north-south alignment of the Green Mountains and the major river valleys on the Forest (which hold many of the major state roads as well), winds from nor'easters and hurricanes can be funneled down these corridors, and would be enhanced by the enlarging of the existing natural corridor due to roads. It is not likely that any of the roads on the Forest under federal jurisdiction would contribute to this effect, as most are not within these north-south natural corridors.

Soil slumping and landslides range from gentle washing of nutrients and organic material downhill to landslides that completely remove all the vegetation and soil. Such dramatic slides are far less common on the Forest than smaller slides that result from heavy rains that loosen the soil and send a few trees and some soil downslope a bit. Soil slumping and landslides can be affected by the road system, which can enhance the instability of naturally unstable slopes. Many of these naturally unstable slopes are found in river valleys; consequently this is more of a problem along state roads rather than along Forest roads, again as most of the state roads are in the major river valleys and the valleys of their major tributaries, both within and outside the Forest. Soil slumping and landslides have detrimental effects on water quality, and so while such disturbance can be entirely natural, they can be further enhanced to unacceptable levels by the road system. Further discussion of the effects of the road system on erosion and water quality can be found in the Aquatic, Riparian Zone, and Water Quality section.

Flooding and ice scour can also be affected by the road system for similar reasons as landslides: many roads are placed in stream corridors and so significantly affect the natural dynamics and flows of those streams. Changes to these regimes can be important to organisms that inhabit both the stream and the riparian corridor, and so depend upon a particular set of dynamics for their survival. Further discussion of the effects of the road system on hydrology can be found in the Aquatic, Riparian Zone, and Water Quality section.

Beaver herbivory, dam construction, and pond and meadow creation is a major ecological disturbance

factor on the GMNF. Vegetative composition and structure in stream valleys have been greatly altered by beaver "management" over the last several decades since their reintroduction. Because many roads have been constructed in stream valleys, including roads on the Forest, roads and beaver have often come into conflict, usually due to beaver constructing dams that flood roads. This has happened on FR10 for example, and led to the construction of a device that prevents beaver from damming the culvert. Beaver are a natural part of the disturbance dynamics of forests in these riparian corridors and lowlands, and so the presence of roads in those corridors will often lead to displacing the beaver if they continue to flood roads. This in turn will affect the beaver cycle of pond to meadow to pond and allow forests to grow in such areas, perhaps to the point where there is no longer a food source for the beaver. However, there appear to be many areas of suitable habitat for beaver where there is adequate room for the dynamics of this type of disturbance to operate without the constraint of roads. Ecologically important complexes of beaver meadows and ponds have not been identified near roads, and so it is unlikely that the current road system will have major impacts on this disturbance regime on the Forest. Deer and moose herbivory currently appear to be of limited effect and consequence on the GMNF. Deer have become more limited on the GMNF over the last 50 years due to the maturation of most of its forests, although they are abundant in the agricultural/woodland landscapes still found in the valleys and low slopes of Vermont. Moose are however becoming more prevalent, and have been returning to Vermont from the north, making their way into the southern reaches of the Forest. Because the populations of both species appear to be in transition on the GMNF, it is difficult to determine the extent of the disturbance regime that these species are likely to exert at this time on the Forest. Deer and moose herbivory tends to limit reproduction of trees, especially oak, and given their preference for orchids can have impacts on the flora. When other natural disturbances occur to existing overstory canopies, the future vegetative composition has been predetermined by the conditions present in the understory which can be significantly altered by deer and moose herbivory. Road management has a significant influence on deer herd management. Road density allows easier entrance for hunters whether walking or by vehicle if the road is opened. Most roads in the restricted management category are opened for deer hunting season. Thus, the road system is a tool in controlling deer herbivory on the GMNF.

EF (4) How does the road system affect ecological disturbance regimes in the area?

Roads facilitate the recognition, sampling, monitoring, and ground-based treatment of insect and disease problems. In areas where there is no access, there would likely be a delay in outbreak recognition, sampling or monitoring for insect and disease infestation unless aerial detection is used. Ground based treatment methods would be limited by road access; however, aerial detection and treatment would not be affected by road access. Roads generally are not enough of a barrier to affect the spread of insect and disease outbreaks. As noted under EF(2), roads that are wide and open are more likely to facilitate the spread of insects and disease that depend on wind dispersal for some part of their life cycle, as well as those that "hitchhike" on creatures or vehicles that use such corridors.

EF (5) What are the adverse effects of noise caused by developing, using, and maintaining roads?

The effects of forest management practices can be either quantitative or qualitative. Qualitative effects, such as noise produced by an activity, are subjective, non-priced outputs, and are often monitored by public opinion. The effects of noise can only be valued by the importance each individual attaches to them.

Road construction can have a significant effect on the environment, while later, the maintenance of roads is relatively insignificant. The use of forest roads depends on many factors, specifically: on the original purpose and need for the road, the ever-changing public need for access on any given day or

season, current interest in an activity or destination, and condition of the road including the running surface and restrictions placed on access, meaning FS administrative decisions to restrict with signs or gates. Consequently, the level of noise expected from a particular road is dependent on its use at any given period of time.

Roads, as part of developed recreation areas, tend to concentrate people, vehicles, and activities that increase noise levels near sites and may displace some wildlife species if the use levels are high enough for an extended period of time. Roads provide access to dispersed recreation areas such as trailheads , overlooks, visitor information services, and parking areas for activities such as hunting and fishing. Road construction typically involves the clearing of trees and soil disturbance with heavy equipment. Noise from jackhammers, chain saws, log skidders, bulldozers, graders and heavy truck traffic occurs in the initial stages of any project. This noise is generally of short duration, usually one construction season or less. Wildlife desiring a quiet environment may be displaced during this period. After construction, if the road is open to traffic, noise is generated by vehicular use on the road. Roads that remain open (and the traffic noise generated) may negatively affect wildlife and some recreational opportunities. Road maintenance with heavy equipment occurs periodically throughout the summer as roads receive heavy equipment use and are brought up to standard. Noise levels may vary slightly by the size of equipment used and the number of machines running at any one time. Whether road construction or maintenance, the noise is very localized and of short duration.

Road construction during the breeding season is particularly disturbing to avian species. Nest abandonment during incubation or when young are in the nest occurs when construction activities and associated noise are near the nest. Noise associated with road construction, maintenance, and use may modify an animal's behavior, causing altered movement patterns. Adverse effects on wildlife varies with the intensity and duration of the disturbance and can range from short term avoidance of the area during construction and maintenance activities, to long term impacts such as shifts in home range and altered reproductive success. Long-term impacts are more likely to be associated with new road construction in relatively unroaded areas or along highways with heavy traffic. Noise produced by road improvement work, maintenance activities, or increases in traffic volume may have an adverse effect on wildlife on roads that are normally closed or gated. Many wildlife species have or are able to adapt and tolerate noise along open forest roads and major highways.

Road decommissioning, gating, and signs restricting access temporarily or permanently will have a long-term effect by reducing road-related noise.

Aquatic, Riparian Zone, and Water Quality (AQ)

AQ (1) How and where does the road system modify the surface and subsurface hydrology of the area?

The overall hydrology in a watershed, particularly the quantity and timing of flow, is affected by roads:

- expanding the channel network
- converting subsurface flow to surface flow
- reducing infiltration on impervious road surfaces.

The channel network is expanded by road ditches creating stream channels in portions of the hillside that were previously unchannelized. Road ditches also intercept subsurface flow and convert it to surface flow. Peak flows are increased with an expanded channel network because concentrated surface flow reaches the channel faster than subsurface flow. Surface flow is also increased due to the

reduced infiltration on impervious road surfaces, resulting in a smaller storage of water in the soil profile and an increase in run off as overland or surface flow. Baseflows are regulated and sustained from the storage and movement of subsurface water through the soil profile. Roads disrupt these processes, and result in higher peak flows and less water available to sustain baseflows.

The road density of an area is an indicator of the road system's relative potential for modifying surface and subsurface hydrology. The higher the road density, the greater the potential for the road system to affect the hydrology. Though the total miles of Class 3, 4, and 5 roads on the Forest are small in percentage compared to the total acreage of Forest land, some watersheds, such as the Middlebury River, Otter Creek, and the West River, have a more concentrated density of the road system than other watersheds. These particular watersheds may have a greater potential for the road system to affect their hydrology.

AQ (2) How and where does the road system generate surface erosion?

Surface erosion is highly dependant on soils, slope steepness, road surfacing, road grade, age of the road, traffic volumes, and the effectiveness and spacing of drainage structures. Proper drainage structure, function, and spacing are key to minimizing the amount of surface flow, which directly affects surface erosion. For example, surface erosion below culvert outlets can move sediment directly into streams. Road-stream crossings also have the potential to directly affect surface run off and sediment delivery to the stream channel.

Poorly designed road-stream crossings directly affect hydrologic function and increase erosion when they constrict the channel, when they are misaligned relative to the natural stream channel, or when improperly sized culverts are installed. Road-stream crossings can also act as connected disturbed areas where water and sediment are delivered directly to the stream channel. Connected disturbed areas are defined as "high runoff areas", like roads, where vegetated buffers and lead off ditch construction (for intercepting and dissipating runoff) are limited, and where the discharge surface runoff flows into a stream or pond. Proper culvert size is also critical in preventing road wash outs, which result in increased sedimentation and degraded water quality in streams.

Opportunities to improve stream crossings, culverts, and drainage structures include:

- Design crossing to pass fish, sediment and bed load, large woody debris, not just water. This could mean removing existing pipes and designing alternatives such as armored crossings.
- Realign crossings that are not consistent with the channel pattern.
- Change the type of crossing to better fit the situation; for example, consider bridges or hardened crossing on streams with floodplains and consider bottomless arch culverts in place of round pipe culverts.
- Add cross-drains near road stream crossings to reduce the potential for direct discharge of sediment into streams.
- Increasing the effectiveness of drainage structures, especially on maximum grade roads.
- Design the drainage structures to discharge surface runoff onto vegetated buffers, and not directly into streams or ponds.

AQ (4) How and where do road-stream crossings influence local stream channels and water quality?

Approximately 100 Forest Service stream crossings were surveyed between 1995 and 2001 to determine if they would pass resident and anadromous fish. Culverts can create fish migration barriers so proper size and placement are critical to maintain physical features (maintain channel slope and an invert elevations approximating the grade of the existing channel, resting pools above and below pipes, etc) that facilitate fish passage. Proper culvert size is also critical in preventing road wash outs, which result in increased sedimentation and degraded water quality in streams. Increased sedimentation of streams can lead to severe morphological impacts to stream channels and aquatic organisms inhabiting these streams.

Preliminary results indicate approximately 60% of the culverts surveyed were impassable to resident or anadromous fish species present in GMNF streams. Several other culverts have not yet been evaluated to determine if they are passable or not.

Road-stream crossings also have the potential to directly and indirectly affect local stream channels and water quality. Poorly designed crossings directly affect hydrologic function when they constrict the channel, when they are misaligned relative to the natural stream channel, or when improperly sized culverts are installed. Road-stream crossings also act as connected disturbed areas where water and sediment are delivered directly to the stream channel. Connected disturbed areas are defined as "high runoff areas" like roads where vegetated buffers and lead off ditch construction to intercept and dissipate runoff are limited, and that the discharge surface runoff flows into a stream or pond.

Opportunities to improve stream crossings and culverts include:

- Design crossing to pass fish, sediment and bed load, large woody debris, not just water. This could mean removing existing pipes and designing alternatives such are armored crossings.
- Realign crossing that are not consistent with the channel pattern.
- Remove and replace existing fish barrier culverts that cannot be improved or structurally modified to provide fish passage.
- Change the type of crossing to better fit the situation; for example, consider bridges or hardened crossing on streams with floodplains and consider bottomless arch culverts in place of round pipe culverts.
- Add cross-drains near road stream crossing to reduce the potential for direct discharge of sediment into streams.

AQ (5) How and where does the road system create potential for pollutants, such as chemical spills, oils, de-icing salts, or herbicides to enter surface waters?

Wherever roads are adjacent to or cross streams, floodplains, or wetlands, there is some potential for spilled pollutants, such as salts, oils, and herbicides, to access the stream channel. Log haulers and other heavy equipment associated with harvest and road activities carry sufficient fuel and oil to cause localized water quality problems, if an accident occurred. This situation can be minimized by stipulations in timber sale or road maintenance contracts that specify haul speeds, fueling practices, weather or road moisture limitations, and other aspects of the operations.

AQ (6) How and where is the road system 'hydrologically connected' to the stream system? How do the connections affect water quality and quantity (such as delivery of sediments, thermal increases, elevated peak flows)?

The road system is hydrologically connected to the stream system where there are direct connections to disturbed areas. This includes stream crossings, as well as areas where roads are adjacent to stream courses and there is an insufficient buffer strip between the road or road drainage structures and the stream system. Also, an extended channel network (e.g. roads and ditches) can increase peak flows. Increasing peak flows through this extended channel network increases the energy available for in-channel erosion, which affects stream stability and increases sedimentation. The biggest water quality concern associated with the road system is the delivery of sediment to the stream. Since many of the roads on the Forest parallel streams or are adjacent to the stream corridors, there are inherent risks that could affect water quality and quantity.

Drainage structures include stream crossings, road ditch lines, culverts, as well as areas where roads are adjacent to stream courses and there is an insufficient buffer strip between the road or road drainage structures and the stream system.

Road-stream crossings have the potential to directly affect surface run off and sediment delivery to the stream channel. Poorly designed road-stream crossings directly affect hydrologic function and increase erosion when they constrict the channel, when they are misaligned relative to the natural stream channel, or when improperly sized culverts are installed. Proper culvert size is also critical in preventing road wash outs, which result in increased sedimentation and degraded water quality in streams.

The channel network is expanded by road ditches creating stream channels in portions of the hillside that were previously unchannelized. Road ditches also intercept subsurface flow and convert it to surface flow. Proper drainage structure, function, and spacing are key to minimizing the amount of surface flow, which directly affects surface erosion.

Peak flows are increased with an expanded channel network because concentrated surface flow reaches the channel faster than subsurface flow. Surface flow is also increased due to the reduced infiltration on impervious road surfaces, resulting in a smaller storage of water in the soil profile and an increase in run off as overland or surface flow.

The road system directly affects riparian communities where it impinges on riparian areas. Roads can indirectly affect riparian communities by intercepting surface and subsurface flows and routing these flows so that riparian areas dry up and the riparian vegetation is replaced with upland vegetation. There are very few areas, if any, in this condition on the Forest. In a small number of areas, though, the road is immediately adjacent to the stream, preventing any vegetation from growing in the riparian area.

Riparian communities, also, play a vital role in providing shade. Removal or degradation of these communities can affect stream stability and water temperatures, which in turn, affects aquatic habitat and water quality. The lack of shade problem is considered to be very limited along Forest roads and is generally confined to private lands in valley bottoms where agricultural practices and development often results in loss of degradation of riparian vegetation.

AQ (7) What downstream beneficial uses of water exist in the area? What changes in uses and demand are expected over time? How are they affected or put at risk by road-derived pollutants?

Downstream beneficial uses of water in the Forest include the protection and propagation of fish and wildlife species and their habitats. All streams on the Forest are designated as cold-water fisheries. Of the 50 or so streams currently inventoried for fish resources, all support some level of natural reproduction for resident trout species. Atlantic salmon fry (newly hatched fish) are stocked annually in the White River and West River watersheds. Three age classes of juvenile salmon can be found in most of these streams. Emigration of young salmon smolts (ocean migrates) during spring snow melt and freshets is critical to the success of the restoration program.

Forest ponds also include cold and warm water game species and non-game fish with resource protection and propagation as designated uses. Recreational fishing is also a very desirable downstream use of the water and fisheries resources on the Forest.

These designated uses are detrimentally affected if sediment from forest roads surpasses the tolerance of the fish and other aquatic organisms (e.g. macro-invertebrates) or if roads cause channel instability, which degrades aquatic habitat. In addition, heavy vehicle use on forest roads can increase the amount of fine sedimentation on road surfaces that can run off into stream courses during a rain event. Forest-wide monitoring of fine sediment levels in fish spawning and rearing habitat indicates the highest quantities and most potentially adverse conditions exist in lower gradient, valley bottom streams. Although, forest and non-forest gravel roads likely contribute sediment to these stream reaches, it is believed most of the sediment comes from unstable stream banks and poor land use practice such as agriculture and development along streams and riparian areas. The exception to this would be road failures and washouts from severe, but relatively infrequent, flood events.

Demands by the public for water-based uses are expected to increase over time. This includes such uses as fish and wildlife resource protection and enhancement, fishing, canoeing/kayaking, improved water quality for aesthetics/scenic values, and possibly increased demands for domestic water supplies and commercial needs such as snow making at alpine skiing resorts.

AQ (8) How and where does the road system affect wetlands?

Roads can directly affect wetlands by encroachment, and indirectly by altering hydrologic surface and subsurface flow paths (see AQ1). Wetlands help dissipate excess energy during high floods and recharge soil moisture and groundwater. The wetlands function is compromised when roads encroach on or isolate wetlands, which can increase peak flows. When peak flows increase, more water is available as overland or surface flow erosion run off.

A road adjacent to, or within 200 feet of a wetland is a good indicator of where the road system could potentially be affecting the hydrology of the wetland. Although the exact percent of forest road miles within 200 feet of existing wetlands is unknown, the figure is estimated to be less than 15%. Concerns are greatest in areas where the roads have affected surface and subsurface flow patterns.

AQ (9) How does the road system alter physical channel dynamics, including isolation of floodplains; constraints on channel migration; and the movement of large wood, fine organic matter, and sediment?

Roads can directly affect physical channel dynamics when they encroach on floodplains or restrict channel migration. Floodplains help dissipate excess energy during high floods and recharge soil moisture and groundwater. Floodplain function is compromised when roads encroach on or isolate floodplains. This can increase peak flows. When peak flows increase, more water is available for in-channel erosion, which in turn, affects channel stability. Restricting channel migration can cause channel straightening which increases the stream energy available for channel erosion. This can also result in channel instability from increased bed load quantities, channel down cutting and increases in the size of substrate being moved downstream. Altering channel pattern affects a stream's ability to transport materials, including fine organic matter, large woody debris and sediment.

Although the exact number of miles of forest road within a couple hundred feet of existing streams is unknown, the figure is likely quite large forest-wide. A road within 200 feet or so of a stream is a good indicator of where the road system could potentially be affecting physical channel dynamics. Many of the forest roads were built in riparian areas along streams where existing trials/old roads could be developed and the nature of the topography was conducive to road building. Concerns are greatest on reaches with floodplains where channels naturally meander, typically lower gradient streams. However, there are also concerns on upland, step:pool streams where channel down (head) cutting from increased run-off and peak flows near roads can affect channel dynamics and structural integrity of the road. This situation generally occurs where roads are directly adjacent to the stream and no buffer exists. These sites are often need road maintenance after heavy precipitation events. Road culverts (see A4, A7) also affect a stream's ability to transport organic material and sediment and often results in plugged pipes where erosion can cause damage to water resources and road infrastructure.

AQ (10) How and where does the road system restrict the migration and movement of aquatic organisms? What aquatic species are affected and to what extent?

Migration and movement of aquatic organisms are primarily restricted at road crossings with culverts. Generally, the restriction is on upstream migration although downstream migration can also be affected. This results from hanging culverts; high flow velocities in pipes, inadequate water depths, and lack of resting pools for fish migration, etc. In some locations, migration barriers are desirable to protect native species. While culverts can affect the migration of amphibian species, the greatest concern appears to be the effect on fish species.

Brook trout are the most widely distributed native fish species on the GMNF. Anadromous (sea-run) Atlantic salmon occurs in watersheds draining into the Connecticut River Basin. Several non-game native fish species such as Slimy sculpin and Blacknose dace are also common in forest streams. Other non-native species include rainbow and brown trout. Information contained in A4 describes some of the current migration barriers on Forest and non-forest roads. Additional fish passage evaluations are currently underway in the White River watershed. Watershed with native fish species would be considered high priority for site-specific analysis at the watershed and project scales. Opportunities to address problem crossing are also discussed in A4.

AQ (11) How does the road system affect shading, litter fall, and riparian plant communities?

The road system directly affects riparian plant communities where it travels through such areas, essentially removing this habitat and replacing it with a relatively impervious ground cover and altered drainage system that can change the hydrology of the communities affected. Indirectly, a road within a riparian corridor, by intercepting surface and subsurface flows and altering their route, can shift plant community composition in the corridor. When flows are directed out of the corridor, an ordinarily moist or wet corridor can dry up and be replaced with upland vegetation; when flows are concentrated in an area of the corridor rather than dispersed throughout, that part of the corridor can become wetter and harbor more wetland vegetation. In addition to altering flows, the loss of vegetation within the riparian corridor in association with a road can reduce shading and also lead to drier and brighter conditions in the corridor, shifting plant composition toward upland communities and those more tolerant of light. Changes in composition and structure of riparian plant communities, as well as the loss of vegetation in the road area, can contribute to reductions in stream stability and increases in stream temperature, both of which can have affects on aquatic biota. Such changes can also affect the viability of populations of rare species that occupy the riparian corridors.

Road maintenance and reconstruction of the system can have some of the same effects as the original construction, including shifting hydrology and vegetation composition related to the introduction of updated drainage systems, altered road placement, and loss of vegetation that was stabilizing the previously disrupted corridor. In areas that have become wetlands in the corridor due to drainage systems associated with the road, maintenance and reconstruction can disrupt both the hydrology and species composition of the small wetlands, and in some cases can have negative consequences for rare species that had inhabited the newly created habitat.

On the GMNF, an example of this is along the Natural Turnpike (FR 54) which travels at it's northern end through a narrow riparian area associated with the Blue Banks Brook drainage, along which the globally rare and Appalachian Jacob's Ladder can be found. It is also associated with parts of the Sparks Road (FR 233), which is partly within the riparian area associated with Sparks Brook. Road maintenance and reconstruction along these stretches of the road has in the past destroyed some plants and disturbed habitat. However, the species has recolonized habitat that was disrupted in the past, although it is not clear whether this is a response to soil disturbance, reduction in competition, suitable hydrology, or some combination of these or other factors. A Conservation and Research Plan for Appalachian Jacob's Ladder (Deller 2002) has been prepared that identifies the need for more formal monitoring and improved management along this road. While closure of these roads could recreate more natural habitat, it appears that the species is also exploiting some patches of habitat created by the road, including persistant partially open canopy closure. It is likely that more careful management and monitoring in these areas will help these populations persist in these corridors.

AQ (12) How and where does the road system contribute to fishing, poaching, or direct habitat loss for at-risk aquatic species?

High traffic roads adjacent to streams with sport fish are the most likely to contribute to fishing and poaching. This is not generally considered a serious issue on the GMNF and does not significantly affect aquatic populations and at-risk species.

The road system contributes to direct habitat loss where road failures or mass movements of road material directly impact stream channels through delivery of sediment and habitat loss, and where the road system is restricting channel migration and/or isolating floodplains. Also, impassable culverts can limit upstream migration of spawning fish that could result in reduced natural reproduction or fragmentation of fish populations.

AQ (13) How and where does the road system facilitate the introduction of non-native aquatic species?

Road systems that terminate at waterbodies, or facilitate getting close enough to access a waterbody, or that follow streams closely with pull-outs for parking or fishing, can facilitate the introduction of non-native invasive plants and animals into these water sources. Invasive plants often associated with aquatic systems in Vermont include Japanese knotweed, purple loosestrife, water chestnut, flowering rush, frog-bit, yellow flag iris, Eurasian water milfoil, yellow-floating heart, phragmites, and curly-leaved pondweed. All of these species can be distributed to other waterbodies through seeds or plant parts carried by vehicles, people and animals in vehicles, and watercraft. The closer one can get to a waterbody, and the more recreationists along Forest Roads that use waterbodies on the Forest as well as waterbodies lower in elevation and closer to populated areas, the more likely it is that the Forest waterbodies will become infested with some of these species. Although zebra mussels are established in Lake Champlain, their requirement for hard water limits their likely infestation on the Forest as many of our most sensitive waterbodies are high elevation soft-water ponds. Ponds associated with the Vermont Valley and lower elevations in more calcareous substrates may be more at risk.

Non-native invasive species of most concern on the GMNF include Japanese knotweed along the New Haven and White Rivers, small parts of which are managed by the GMNF, and purple loosestrife, phragmites, and Eurasian water milfoil. Purple loosestrife and phragmites are known sporadically but infrequently from places on the Forest, and they cover a very small area. Although the origins of these small populations are not necessarily known, it is clear that the road system can facilitate their spread. However, most of our ponds, even those with Class 3-5 roads ending right at the site, are not infested with these weeds. Currently Eurasian water milfoil is not known to be a problem on the GMNF, although there have been concerns expressed regarding Chittenden Reservoir and potential future introductions via motorboats. It is possible that the lack of large waterbodies and associated use of larger motorboats might be doing more to limit the spread of these species onto the Forest, when compared to the access of recreationists to these sites. It is also possible that our waterbodies and streams are less accessible at this time than other water sources, and so see generally less use. It is likely that increasing the road network to improve access to these sites will increase the risk of infestation. Japanese knotweed is a significant problem along major rivers and tributaries. However, it is not found in association with Class 3-5 roads within federal jurisdiction but rather in association with the major state road corridors within the floodplains of these larger rivers.

AQ (14) To what extent does the road system overlap with areas of exceptionally high aquatic diversity or productivity, or areas containing rare or unique aquatic species or species of interest?

There are six roads in the Class 3-5 part of the road system that lie within, adjacent to, cross, or end at areas of aquatic biological significance, either for rare species or unique or exemplary ecosystems. The roads and species or communities of concern are:

- Natural Turnpike (FR 54) and Sparks Road (FR 233); FR 54 runs along and within the riparian zone of Blue Banks Brook, which has several populations of the globally rare Appalachian Jacob's ladder; FR 233 crosses the riparian zone of Spark's Brook which includes a seep where an experimental population of jacob's ladder was introduced in 1990.

- Ripton-Goshen Road (FR 32) and Dutton Brook Road (FR 104); these two roads form the east and north boundaries respectively of Dutton Brook Swamp, a white cedar-red maple swamp considered significant by the State of Vermont due to it being the highest elevation occurrence of this swamp type, and it being a recorded site for the uncommon yellow and showy ladyslippers.

- Leffert's Pond Road (FR 412); this road runs along and adjacent to Leffert's Pond and its associated wetlands (a complex of hardwood and evergreen forested swamp, shrub swamp, emergent wetland, and some sedge mat), which is considered a significant natural community by the State of Vermont.

- Grout Pond Road (FR 262); this road provides direct access to Grout Pond (MA 8.1C), which has been a rare plant hotspot for close to 100 years, including records for such plants as Snail-seed pondweed, Water bur-reed, Low water-milfoil, Tuckerman's pondweed, Water-thread pondweed, Tuckerman's quillwort, and Northeastern bladderwort. This pond is also noted for its diversity of aquatic plants, and is considered a significant high elevation softwater pond by the State of Vermont.

There are an additional four roads in the system that end at points that provide access to an additional 4 significant ponds:

- Silver Lake Road (FR 27); this road ends at a parking lot that provides trail access to Silver Lake and Leicester Hollow, both areas being known for a variety of terrestrial and aquatic rare species. The species of interest here is Hairy woodmint, a very rare species in Vermont that grows in wet seeps and is associated with Leicester Hollow Brook.

- Wallingford Pond Road (FR 20); this road ends at a point that provides access through a jeep trail to Wallingford and Fifield Ponds (MA 8.1B), another significant high elevation softwater pond and wetland complex well renowned for its rare aquatic flora, including American shore-grass, Tuckerman's quillwort, Olive spikerush, Ovate spikerush, Pod-grass, Water bur-reed, Alternate-flowered water-milfoil, Matted spikerush, Water sedge, and Michaux sedge. Access to the pond via the jeep trail has been a known problem for illegal vehicle use of the access road and resulting sedimentation in the pond. Access has also facilitated the placement of illegal structures at the pond.

- Old Job Road (FR 30); this road ends at a trailhead that provides access to Big Mud Pond (in Peru Peak Wilderness) and Lost Pond (in Big Branch Wilderness). Big Mud Pond is considered a significant high elevation softwater pond to the State of Vermont, and is known for rare and uncommon aquatic plants, including Water bur-reed, Long sedge, and Shore sedge. Lost Pond is considered a significant site by the state of Vermont due to the quality of the heath bog and black spruce swamp surrounding the pond.

- Moses Pond Road (FR 29); this road ends at a trailhead that provides access to Moses Pond; it also runs adjacent to Jenny Coolidge Brook Wetland. Moses Pond is considered by the State

of Vermont to be a significant feature, in particular for its vigorous population of the rare Tuckerman's pondweed. Jenny Coolodge Brook Wetland is considered significant by the State of Vermont due to the presence there of a rare dwarf shrub bog natural community of fair quality. Improvements to FR 29 in the vicinity of the bog are cited as potential threats to the bog.

Terrestrial Wildlife (TW)

TW (1) What are the direct effects of the road system on terrestrial species habitat?

General

The following discussion provides an overview of the potential effects that roads can have on terrestrial wildlife and wildlife habitat. Most of these potential effects depend on the road density, level of construction, the type and amount of use on the roads, and the response of a particular species. The GMNF is characterized as a large primarily forested area with a relatively low road density even when other jurisdiction roads are considered (Table 5). Therefore, in general, the effects of roads on wildlife on the GMNF is expected to be minimal.

The road system directly affects terrestrial species habitat by: 1) replacing forested habitat; 2) changing the movement of animals; 3) creating edge habitat, and; 4) causing habitat fragmentation. Roads built to higher standards and open to the public have a greater potential to produce these effects than roads built to lesser standards, and closed or restricted to the public.

Eight physical characteristics of the environment are altered by roads; soil density, temperature, soil moisture, light, dust, surface water flow, pattern of runoff, and sedimentation. Long-term road use leads to soil compaction that can persist for decades even after use is discontinued. With water vapor transport reduced on a road with a hard surface, compared to bare soil, temperature increases occur. Heat stored on the road surface is released at night, creating heat islands around roads. Moisture content of soils under roads declines in response to changes in soil porosity. Roads increase the amount of light reaching the forest floor. The amount of light depends on how much of the original canopy and lower strata remain as well as the road width. Early-succession, disturbance adapted, higher light level preferring species may take advantage of these conditions (Trombulak and Frissell 2000, pg. 21).

Replacement of habitat

Roads directly affect terrestrial species habitat by replacing the existing physical habitat with a linear, non-forest condition. Road construction kills any sessile or slow-moving organism in the path and often immediate to the path of the road (Trombulak and Frissell 2000, pg. 19). New construction removes wooded habitat and native ground vegetation, creates a linear opening in the forest canopy, and creates edge habitat. Lost forested habitat can contain mast producing trees, conifer cover, brood habitat, den trees and snags. Some species benefit from the edge habitat created by roads while others may be harmed. The amount of habitat affected by a road may extend beyond the road corridor depending on the clearing width , and the amount and speed of traffic.

On the Green Mountain NF there are 181 miles of level 3-5 roads. If we assume a clearing width of 25 feet for these roads than the direct habitat effects are about 550 acres. This represents 0.14 % of the forested habitat on the GMNF.

Table 5 - Selected road measurements for the Green Mountain National Forest.

Road measure	GMNF
Miles of FS level 3, 4, 5 roads	181
Road density of FS level 3, 4, 5 roads	0.39 miles/sq mile
Area affected by roads, FS level 3, 4, 5 roads	550 acres

In general, the level 3, 4, and 5 roads on the Forest have low clearing widths, are primarily gravel surface, and receive relatively little traffic at slower speeds. All of these factors probably limit most of the direct habitat effects to little beyond the clearing width of the road.

Effects of roads on the movement of animals

Organisms move at many different scales including; home range movements (within one area), seasonal migration back and forth between two areas, dispersal, meaning the movement of young organisms out of their natal area, and geographic range shifts are long-term population responses to environmental change (Kohm and Franklin 1997, pg. 59). Movement may be the one-time passage of a young garter snake dispersing from its birthplace or it may be the daily to-and-fro of a gray fox or blue jay patrolling its territory (Hunter 1990, pg. 129). The viability of organisms depends on whether they can move freely over a large enough area to find needed resources, whether they can migrate freely between seasonal ranges, whether organisms can disperse among subpopulations and habitat patches, and whether organisms are free to shift their geographic ranges as needed (Kohm and Franklin 1997, pg. 59-60). Establishment of a road in a forest environment may affect wildlife habitat by creating a linear feature that constitutes a barrier to movement. Barriers may occur at different levels. The following factors will determine the degree to which a road can form a barrier:

- The particular species involved, large animals are generally affected less than small animals.
- The level of construction and level and season of use, wide, paved roads with high use will present a greater barrier.
- Road density, a higher density will have a greater affect.
- The quality of the habitat that the road traverses.

If a road has dense herbaceous roadside vegetation, it may form an absolute physical barrier stopping the movement of less mobile animals such as amphibians. Roads may constitute a psychological barrier to small animals and insects in that even though they are physically capable of crossing the road in a few seconds, they are unwilling to do so. In Kohm and Franklin (1997) studies found that a forest road inhibited the movement of small mammals even though the road was only three meters wide and closed to traffic. While roads can form a barrier to some species, they also expedite the travels of other species (Hunter 1990, pg. 129). Roads may facilitate movement of species by providing clear corridors for travel. Roads have been shown to increase and focus movement of deer, coyote, and turkey.

Depending on the amount that roads create barriers or form corridors, they can lead to shifts in home range, altered movement patterns and altered reproductive success. Again, the effects will vary depending on road density, the road location, the level and season of use, the types of habitats

traversed, the species involved and the status of populations in the surrounding area. Effects will be greatest from roads that traverse or isolate critical or specialized habitats, where the level of activity is high enough to displace species sensitive to disturbance, and from roads that alter an animal's behavior to the extent that reproductive success is affected. Roads can also contribute toward isolation of populations where modification of behavior makes the animals less likely to cross roads.These animals might experience some consequences of isolation (Hunter 1990, pg. 131). In Australia even an overgrown, unused road inhibited small mammal movement (Hunter 1990, pg. 132). At times, linear features constitute a filter, not an absolute barrier. Some members of a species will cross a road while other individuals will not. Human hunters and trappers who use roads to access remote areas can also exert a filtering effect on animals attempting to cross a road (Kohm and Franklin 1997, pg. 62-63).

Spatial relationships of species movement may be altered by the presence of roads. Acting as barriers and corridors, they can change predator prey relationships, browse pressure, and other species interactions.

When evaluating behavior related effects to wildlife, the size and type of road, as well as the level and season of use are considerations. These effects can also be evaluated by looking at behavior of landscape level species, such as large predators like the black bear.. For example, in a telemetry study of black bear movements, bears almost never crossed interstate highways, and they crossed roads with little traffic more frequently than those with high traffic volume (Brody and Pelton 1989 in Roads: Science Synthesis 2000).

On the GMNF and surrounding area, a study of black bears found that paved roads with heavy automobile traffic, mesh fences, open land, steel guardrails, or clustered houses are barriers to bear movement. Roads without these features are semi-permeable barriers, with some bears crossing and others not depending on sex and age, and the proximity of the road to food sources (Hammond, 2002).

Road density has been used as an indicator for habitat suitability for large predators. Wolves in Wisconsin were shown to be limited to areas where the road density was 0.45 km/km^2 or less (Mladenoff and others 1995). The road density on the GMNF is 0.2 km/km2. Due to their limited width(s), low level of use, and low density, the level 3, 4, and 5 roads on the GMNF are expected to have a limited effect on the behavior of large mammals.

Effects of roads fragmenting forested habitat

If roads form a sufficient barrier to species and the road density is high enough this can cause habitat fragmentation for some species. The amount that a habitat is fragmented by roads depends on several factors:

- the width of the road and with of corridor cleared, and level of construction (related to the ease with which a species can cross a road),
- length, amount, season, and type of use,
- the distribution of forested habitat,
- associated changes along roads such as hedge rows, and development (e.g. houses),
- sensitivity of a particular species to roads.

The effects of fragmentation by roads are thought to be greatest when a road cuts through an intact habitat patch where there is little existing edge habitat, when available interior habitat is significantly reduced, or when populations or critical habitat of less mobile species becomes isolated due to roads.

Declining interior songbirds are a group of species considered at risk from fragmentation directly associated with roads. For the GMNF based on species diversity and abundance data, in addition to comparing available habitat, there is no evidence that the present road system significantly affects breeding bird habitat. This is due primarily to the predominantly forested nature of the forest, which helps reduce edge related effects and allows for the continued availability of interior bird habitat.

Wildlife structures provided by roads

In addition to the above effects, roads provide some habitat features that benefit some species. Bridges and other structures provide roosting cover and nesting habitat for bats and swallows. Culvert pipes provide escape routes for mammals like the woodchuck and raccoon. Beaver frequently create wetland habitat by plugging road drainage structures.

TW (2) How does the road system facilitate human activities that affect habitat?

Increased human use, facilitated by roads, may result in diverse and persistent ecological effects. New roads increase the ease of human access into formerly remote areas. As a result, roads increase the opportunity for natural resource management activities such as timber harvesting, habitat management, fire suppression, prescribed fire, mineral development, and recreation development. Roads can also increase the development of in-holdings. The changes to habitat from these activities can be wide spread, and long lasting or permanent.

On the GMNF, there has been relatively low levels of management and use of roads, therefore the effects of human activities are minimal.

TW (3) How does the road system affect legal and illegal human activities (including trapping, hunting, poaching, harassment, road kill, or illegal kill levels)? What are the effects on wildlife species? General Perspective

Roads of all kinds affect terrestrial wildlife by increasing mortality from road construction, increasing mortality from collisions with vehicles, and increasing the use of habitat by humans.

Vehicle Collisions

Direct mortality from collisions with vehicles is well documented and few terrestrial species of animal are immune. Road kill is often non-specific with respect to age, sex and condition of the individual animal (Trombulak and Frissell, 2000, pg.20). In general, mortality increases on roads with higher traffic volume and speed (i.e., paved roads). This is particularly noticeable when roadsides offer spring herbaceous vegetation that is yet unavailable in interior forest environments and during the reproductive period of some species (e.g. white-tailed deer rut). All species are at risk and some species may be attracted to roadside vegetation, insects and dense cover established along the roadside. Some wildlife may be attracted to the road surface itself to collect seeds or gravel (Trombulak and Frissell, 2000, pg.20). In addition, animals often respond to the heat islands produced by roads. Small mammals, birds and snakes aggregate on or near warm roads, increasing their risk of being hit by vehicles (Trombulak and Frissell 2000, pg.21). Amphibians may be especially vulnerable to road kill because their life histories often involve migration between wetland and upland habitats and because individuals are inconspicuous and slow moving(Trombulak and Frissell 2000, pg.20).

Mortality from collisions can have effects on a population's demography. The incidence of road kill relative to species abundance is greater on high traffic roads. Wildlife populations can become fragmented or depressed from cumulative road mortality and continue to suffer higher proportionate

rates of mortality in high traffic areas.

Mortality from collisions may increase when a road traverses a species' home range or isolates critical or specialized habitat used by a species. The increased disturbance from traffic may be enough to displace a species or alter an animal's behavior. Many species on the GMNF have small to average home ranges (smaller than 20-acres) and have little need to cross roads unless their territory includes or borders a road. Other species traverse large ranges and the size and type of road as well as the season of the year can affect animal behavior and ultimately the risk of collision.

Certain species may be more attracted to roads and highways because of their warmer temperature, water retained in ditches, or because of road side vegetation. Other small or somewhat slow-moving mammals that are often victims of passing vehicles on forest roads include porcupine, opossum (*Didelphis marsupialis*), skunks, raccoon, chipmunk (*Tamias striatus*), and red squirrel. In addition, ruffed grouse occasionally collide with vehicles. Direct mortality (road kills) can have a filtering effect on wildlife populations. The presence of roads or the disturbance produced by vehicle use will turn back some individuals while others may die trying to cross.

Because of the low road density and low traffic levels, road kill is probably minimal on the GMNF.

Hunting, trapping, poaching, and collecting

Road systems can facilitate activities such as hunting, trapping, poaching, illegal taking, and collecting of species that result in direct mortality to wildlife. Roads open to the public may facilitate over-hunting and disturbance in general (Hunter 1990, pg. 258). Human hunters and trappers (legal and illegal) who use roads to access remote areas can also exert a filtering effect on animals attempting to cross roads (Kohm and Franklin 1997, pg. 63).

On the GMNF, some black bears have been shown to avoid roads (e.g. FR71) possibly due to the road being used as a route by hunters utilizing hounds to track bear (Hammond, 2002). On the GMNF, legal hunting and trapping are the primary uses of Forest Service roads during their seasons.

Harassment and disturbance

Roads that remain open can negatively affect wildlife due to the easy access provided to the public. Human activity can negatively impact wildlife during the breeding, nesting, young rearing season, and during adverse winter weather periods. Nest abandonment by wild turkey, ruffed grouse, raptors, waterfowl, and the displacement of wild turkey from brood habitat can occur. Certain roads on the GMNF may experience high levels of dispersed camping for short periods which may reduce the habitat suitability along these roads for some species because of disturbance (e.g. FR 42). However, this effect is limited to summer weekends.

TW (4) How does the road system directly affect unique communities or special features in the area?

Roads may have both direct and indirect effects on rare communities and special habitat features. Direct impacts can include the loss of unique features during the process of road construction, vehicle-caused death of wildlife species that use unique habitats near a road, and death or damage to rare plants that find roadsides with certain characteristics desirable habitat. Direct impacts to plants and animals can occur both through the initial construction and use of the road, as well as during any road maintenance and reconstruction. Indirect impacts are varied, and can include weed invasion or pond

sedimentation facilitated by vehicle traffic on a nearby road, changes in hydrology resulting from drainage structures that affect the composition, structure, or function of these communities, and changes in other environmental characteristics (e.g. exposure to sunlight and increased temperature) that make the feature or habitat less unique or valuable.

Special features may include rock outcrops, caves, vernal pools, spring seeps raptor nest sites, and maternity roosts. These features may be unique in themselves, or they may provide habitat for rare, threatened or endangered species. A unique community or special feature on the landscape can be as small as a patch of woodland orchids or a single breeding pond for a local population of salamanders, or as large as several hundred acres of an exemplary natural community of unique value due to its large size and high quality habitat for a variety of species.

Some sites are so sensitive to disturbance that one needs to carefully consider the appropriateness of road construction, as well as maintenance, including levels, equipment used, and timing. In areas characterized by wet soils, riparian zones and other fragile features, road building can cause severe damage to a site. Sometimes the damage can degrade an ecosystem's productivity for decades or centuries.

Although lands with special features or rare communities often make up only a small portion of an area, these sites and habitats can receive a disproportionate amount of wildlife use or high concentrations of rare species. Many times these areas are tied to a species' specialized requirements. Consequently, protecting rare communities or special habitat features is essential in maintaining the viability of local populations.

The Forest Plan and its amendments recognized the importance of unique natural communities and special features such as wetlands, ponds, cliffs, and riparian zones. These resources are protected in a variety of ways, for example through preferential standards and guidelines for riparian areas (Forest Plan 1987, pp. 1-19 – 4-20), or through special management area designations for some exemplary natural communities, ponds, wetlands and cliffs (Forest Plan 1987, pp. 4.144 – 4.172). Threatened, Endangered, Proposed, and Sensitive species and their unique habitats are recognized and protected wherever they occur (Forest Plan 1987, 4.34-4.37, Appendix E). Management Area Guidelines call for additional measures protecting wintering areas for deer (Forest Plan 1987, p. 4.107-4.116). Given this direction in the Forest Plan, features and habitats recognized in the Plan are generally protected from direct or indirect effects of new road construction. However, there are occasionally conflicts between road system maintenance and reconstruction that can lead to effects to these features and often to the species dependent on these features. There can also be continuing effects of the existing road system on these habitats that exist simply due to the presence of the road and its associated drainage structures.

Effects

In section AQ(14), a number of unique or exemplary features, communities and rare plants of aquatic ecosystems were identified that have some relationship to the road system (Class 3-5). In addition to those sites, there is another area of terrestrial communities that comes in contact with the road system. The following road provides access to these features:

- White Rocks Spur (FR 52A); this road has as it's destination a trailhead that leads to White Rocks Cliffs and Ice Beds (MA 8.1B), considered a significant biological feature by the state of Vermont for it's exemplary open talus slope, large acidic/circumneutral cliff, and mature spruce forest. The site is home to the uncommon Wild millet and Spikemoss, and is an historic site for peregrine falcon nesting.

Following Forest Plan guidelines, there tend to be limited direct effects of the maintenance and reconstruction of existing system roads on unique communities or special features. Road maintenance

and reconstruction along the portion of FR 54 that has Appalachian jacob's ladder growing nearby requires aggressive monitoring; there have been examples of plants being mowed during annual maintenance before they were able to set seed, and plants being destroyed during the replacement of a culvert. In both cases, the plants did not appear to be negatively impacted. In the first case better communication ensured that mowing schedules were learned in advanced and that areas with Appalachian jacob's ladder were staked to prevent mowing. Maintenance now appears to have limited effects, so long as communication is maintained. In the latter case, the plants were able to recolonize the disturbed soil and so were not displaced from the site. In both cases, while the presence of the road does force the species' habitat into ditches, banks, and culverts along the riparian corridor, the habitat appears suitable and viable and so long as communication is maintained, direct effects appear to be mitigated.

The presence of road corridors within riparian zones has disrupted the original hydrology of these riparian zones. FR 233 and FR 104 are two examples of where this is likely to have happened. The portion of the Spark's Brook drainage where FR 233 crosses the stream and where Appalachian jacob's ladder was introduced is very seepy with lots of surface and subsurface water movement. It is likely that this habitat has changed since the road was constructed, although it is unclear if species have been lost as a result. Consequently, we cannot determine if there were any historic losses of this species as a result of this road. The success of the introduction of the species at its current location suggests that the hydrology is still suitable to maintain the species in this area. FR 104 cuts through the top end of an ecologically significant cedar swamp. While the swamp continues on the other side of the road on private land, it is drier than the swamp below the road. It is likely that the road altered the hydrology of this swamp such that the swamp below the road continues to be suitable for uncommon species of cedar swamps, while the area above the road shifted in composition and structure and became less suitable. Indirectly, the system roads associated with the unique features identified above can have a number of effects. By providing access to hikers, boaters, pets, and vehicles, they expose these sites to increased recreational use, leading to increased risk of trampling or disrupting rare plants and unique features; introduction of non-native invasive species into riparian zones and ponds (see also EF(2)); and reduced water quality through sedimentation and introduction of toxins. For example, FR 262 and FR 20 both provide access to significant ponds, both of which are protected in the Forest Plan. However, the access to Grout Pond provides for a developed recreation experience on the pond, which allows watercraft to easily put into the pond that may have come from other ponds infested with an invasive aquatic species. The access to Wallingford Pond via FR 20, while not direct, facilitates illegal vehicle use of the jeep trail to the pond, which has resulted in sedimentation problems, as well as other uses of and structures at the pond that are not allowed and can affect water quality.

System roads may also be affecting the potential expansion of these communities or the wildlife that inhabit these unique communities. Wetlands that are expanding due to increased beaver activity may be limited or reduced if those wetlands begin to threaten a road. Often beaver dams are pulled or controlled at culverts to stabilize water levels or eliminate a pond that has flooded a road (e.g. along FR 10). Wetlands can also be prevented from expanding by the presence of a road, which alters hydrology by drying out an area and leads to changes in vegetation composition and therefore habitat suitability for some species (e.g. FR 104).

COMMODITY PRODUCTION

Timber management (TM)

TM (1) How does road spacing and location affect logging system feasibility?

Efficient and economical road spacing for ground based logging systems on terrain similar to that of the Green Mountain National Forest utilize an average 1300 to 5000 feet skid distance to the farthest harvest unit in order to balance economical yarding cost with road density.

In addition, unroaded areas or areas with access constraints due to stream crossings may require other forms of non-conventional harvest plans such as helicopter, forwarder, and/or temporary skidder bridge. In the case of helicopter logging, road spacing should be based on a 0.5 to 1.0 mile yarding distance from back harvest unit to landings. In 2001, helicopter logging occurred in the town of Warren, VT. Helicopter or non-conventional forwarder/temporary bridge crossing systems should be evaluated economically and environmentally in the unroaded areas.

In mast areas where conventional skidder systems would be utilized, the opportunities for decommissioning system roads or obliteration of unclassified roads may be evaluated based a logging plans for efficient and economical road spacing. Future access needs for the following road segments may be evaluated in light of these considerations:

We don't perceive needing additional roads, but this will need to be determined during Forest Plan Revision (FPR) for newly acquired lands.

Most sales on the Green Mountain National Forest are logged with ground-based equipment. The trees are either felled by hand with chain saws or cut mechanically with a feller buncher and then yarded to the landing with rubber tired cable skidders. In general, a road spacing of 2,000-3,000 feet would be economical for ground-based skidding.

The cut-to-length logging system has been tried on a limited basis on the GMFL and within Region 9. This system uses a mechanical processor that cuts, limbs, and bucks the logs to length, at the stump. The logs are then brought to the landing on a forwarder. It is possible to yard logs longer distances with a forwarder and thus the road spacing can be a little wider. However, due to high purchase price and relatively low cut volumes per acre, the cut-to-length system has not proven to be more economical than conventional rubber tired systems in Region 9. If cut-to-length systems are required to increase road spacing, stumpage values will be reduced and there will be a greater chance of no-bid timber sales.

Another reason the cut-to-length system has not been utilized much on this Forest is that it is a short log (less than 25 feet) system. Most of the log trucks and sawmills in this area are designed and equipped to haul and handle long logs.

In general, close road spacing results in quick turn times and higher production that reduces yarding cost and increases stumpage value. Although closer road spacing can increase the total road cost due to more roads, this total cost can be reduced with the use of temporary roads.

Cable logging systems are not common within Region 9 and experimental use occurred in the early 1980's. The road location is particularly important for cable logging. Most cable logging systems employ uphill yarding and roads located above the unit and along the "break" (where the slope changes from gentle to steep) provide better cable deflection that usually increases production and reduces ground disturbance. Long cable yarding distances (greater than 1,600 feet) require larger size equipment and wider roads. The amount of steep slope cable yarding opportunities will be analyzed during the suitable timberland analysis for the Forest plan revision.

Helicopter logging has recently been used in this Region, on a limited base. This logging system is extremely expensive. Helicopter logging is becoming more feasible as stumpage prices increase. Helicopter logging feasibility is improved by locating roads and landing to provide downhill yarding and short yarding distances (less than ½ mile).

Generally, road construction is only allowed where it is determined to be economically and technically necessary to achieve resource management objectives. The most efficient road spacing that would maximize timber stumpage values is not acceptable because it usually conflicts with other resource management objectives.

TM (2-3) How does the road system affect managing the suitable timber base and other lands? How does the road system affect access to timber stands needing silvicultural treatment?

Lands suitable for timber management in the Forest Plan were determined by:

1. Identifying all forested land from nonforested land.

2. Subtracting forested land not available including: wilderness areas, research natural areas, wild and scenic river corridors, powerline corridors, and administrative sites such as campgrounds.

3. Subtracting forested land where irreversible damage is likely to occur if managed for timber production.

4. Subtracting forested land where restocking cannot be assured within five years.

5. Subtracting forested land where adequate response information is not available. These are areas where there wasn't enough information to predict response to timber management. These areas cannot be considered part of the suitable land base until further inventory is collected.

The result of the above steps was the land identified as tentatively suitable for timber management.

6. The last step in the suitability analysis was to determine the suitable land from the tentatively suitable land base. This step excluded the lands identified as not appropriate for timber production because they were assigned to other resource uses to meet forest plan objectives.

When the Forest Plan was signed in 1987, 179,976 acres were identified as land suitable for timber management. The Allowable Sale Quantity was calculated from growth and yield projections based on these areas only. During the last 15 years of forest plan implementation, as the Forest conducted project level planning, ID teams have further refined the suitable timber base. Project-level ID teams have concluded that some stands in the suitable base are incompatible with management area prescriptions (they are too rocky, too wet, have unstable soils, etc.) and those acres have been removed

from the suitable land. Another larger scale effort identified forested riparian areas as not suitable for timber management and those acres were removed from the suitable land base. Now, as the Green Mountain National Forest prepares the forest plan revision, the suitable timberland will be reanalyzed and what we learned from project level analysis in the last 15 years will be used in the Forest Plan Revision Suitability Analysis.

Timber management on the suitable timberland and on other tentatively suitable timberland where timber management may be needed to meet desired future condition is economically feasible only if road access is present. Without an adequate road system, the 1987 Forest Plan management objectives and prescription for the suitable timber base and other commodity resources cannot be accomplished. At the scale of this roads analysis, we will only consider the arterial and collector road systems.

Minerals management (MM)

MM (1) How does the road system affect access to locatable, leasable, and salable minerals?
Mineral resources on National Forest System Lands are separated into three categories: locatable, leasable, and saleable.

Locatable Minerals = Ore deposits or precious mineral resources subject to location and development under the General Mining Law of 1872 and managed by the Secretary of Interior.

Leasable Minerals = Federally owned fossil fuels (oil, gas, coal, oil shale, etc.), geothermal resources, sulfur, phosphates, and uranium. These minerals are subject to exploration and development under leases, permits, or licenses issued by the Secretary of Interior.

Saleable Minerals = Mineral materials, otherwise known as "common varieties" which generally include deposits of sand, gravel, clay, rock or stone. The disposal of these materials is by a Mineral Materials Permit issued at the discretion of the Forest Service.

At this time there are no locatable or leasable mineral activities occurring on the forest.
There are several open gravel pits in existence on the forest, which are used by the Forest Service for federal road construction and maintenance. Where sufficient reserves exist, the Forest Service will issue term permits to local towns on an as-needed basis. The number of permits vary annually and the total number at any one time is usually less than five.

Access roads are in place and sufficient to meet the current and anticipated future needs for sand, stone, and gravel.

Water production (WP)

WP (2) How does road development and use affect the water quality in municipal watersheds?
The road system is hydrologically connected to the stream system where there are stream crossings, and where roads are adjacent to stream courses with an insufficient buffer strip between the road or road drainage structures and the stream system. Also, an extended channel network (e.g. roads and ditches) can increase peak flows, which increases the energy available for in-channel erosion, which affects stream stability and increases sedimentation. The biggest water quality concern associated with the road system is the delivery of sediment to the stream. Heavy vehicle use on forest roads can increase the amount of fine sedimentation on road surfaces that can run off into stream courses during

a rain event. Since many of the roads on the Forest parallel streams or are adjacent to the stream corridors, there are inherent risks that could affect water quality and quantity.

The municipal watersheds (Water Source Protection Areas) that potentially may be affected by the Forests' management and recreational activities are listed in Table 1. In some cases, sediment added from roads can enter municipal water reservoirs or ground water sources, degrading water quality.

Table 6 - The Water Source Protection Areas within the Proclamation Boundary

NORTH HALF	Watershed Name	Town Name
	Mad River	Warren
	Furnace Brook	Chittenden
		Rutland
	Otter Creek	Mendon
	Middlebury River	Ripton
	Neshobe River	Goshen
	Tweed River	Chittenden
		Pittsfield
SOUTH HALF		
	Otter Creek	Wallingford
		Mt. Tabor
	Walloomsac River	Woodford
	Deerfield River	Readsboro
		Searsburg
		Somerset
		Dover
	Batten Kill	Dorset
		Manchester
	Winhall River	Peru
		Winhall
	Roaring Branch	Sunderland

Special forest products (SP)

SP (1) How does the road system affect access for collecting special forest products?

The current Class 3, 4 and 5 road system was established both prior to public ownership of the land for access to hill farms, mountain villages, and homesteads, and during public ownership to provide access to timber and recreational opportunities. This road system currently provides access to a range of special products across the Forest, while leaving parts of the Forest inaccessible by roads of this maintenance level. Currently the level of special forest product gathering is small but diverse, with most gathering focused on personal use. There are well over 30 types of products that have been gathered either currently or in the recent past from the Forest, ranging from decorative products like boughs, burls, Christmas trees, ferns, mosses and vines, to wood products like furniture made of striped maple, walking sticks, and firewood, to edible products like berries of all types, apples, fiddleheads, maple sap, leeks, ginseng, and sweet grass.

It is unlikely that minor changes in the road system will have a major effect on these collection opportunities. New roads will make more of the Forest accessible for this use, which, given the limited law enforcement and permit monitoring staff on the Forest, could lead to permittees operating outside

their permit specifications. Closure of roads may limit the ability of some to enjoy a gathering opportunity that they engaged in either for enjoyment or for economic reasons. However, there have been no studies undertaken at this point to determine the relative significance of gathering in general on the Forest and the various purposes of such gathering (e.g. economic, recreational). Currently most permits are issued for firewood, Christmas trees, and maple sap, with an occasional permit provided for collections of wood for products that will be sold, and for products that are for biological or medical research. Permit holders are issued maps of areas where their product of interest is available and that are accessible by road. These maps will usually either focus on areas designated for the particular use (e.g. firewood units, Christmas tree units) or will identify areas where collecting is not allowed (e.g. biomedical research); usually permits will include a maximum amount allowed. Because staff time is limited, permits are generally limited in number to those that can be monitored, and so there are likely more opportunities for gathering via road access on the Forest than are currently provided through permit. Consequently, if some roads are closed, there may be others with similar opportunities that had not been made available in the past and which could be opened to such uses. Issues of proximity and quality of the site to the gatherer will play into the value of these trade-offs.

Special - Use Permits (SU)

SU (1) How does the road system affect managing special-use permit sites (concessionaires, communications sites, utility corridors, and so on)?

The existing road system is sufficient to deal with almost all current special uses. Safe and efficient access to areas under Special Use Authorizations has a direct effect on the economics of an operation, either through volume of customers, or operations and maintenance costs. Most recreation special use proposals/authorization are designed around the existing road system, however specific proposals may be needed for adjustments in operations. This is especially true for the larger permittees, such as the alpine or nordic resorts.

Access and Forest Service responsibility under ANILCA are important considerations when dealing with road management decisions. The basic obligation to provide reasonable access to private inholdings may require that some existing roads be kept open even if not needed for other management activities. The Green Mountain National Forest has 150 +/- non-recreation Special Use Authorizations. Most of these uses rely on the existing road access or utility corridors to accommodate construction, operation and maintenance. Requests for new authorizations are regularly received and analyzed using established processes for NEPA and special uses.

General Public Transportation (GT)

GT (1) How does the road system connect to public roads and provide primary access to communities?

The Green Mountain National Forest road system does not have any roads that function as primary access routes directly to or between communities. However, there are a few Forest roads, FR's 10, 54 and 71, that connect to Town and/or State Highways that serve as secondary through-routes for communities during the spring to fall seasons. State and Town Highways provide the primary access into and through the National Forest. The majorities of National Forest roads, which are primarily dead end roads, connect to Town Highways and provide safe and greater access into National Forest lands for recreation, administration, timber management and private in holding access.

GT (2) How does the road system connect large blocks of land in other ownership to public roads (ad hoc communities, subdivisions, inholdings, and so on)?

The Green Mountain National Forest road system does not connect any large blocks of land in other ownership. State and/or Town highways provide primary access to all large blocks of land in other ownership within the National Forest proclamation boundary, with a few of these large blocks of land having secondary access via National Forest roads. The majority of these large blocks of land are composed of multiple ownerships.

There are numerous scattered other ownership in holdings of small to medium size blocks of land, less than 1,000 acres, within the National Forest that are accessed about equally by National Forest roads or Town highways.

Those other ownership in holdings requiring access via National Forest roads are addressed on an individual basis as requests are received. National Forest policy is that access will be provided to a level that is reasonable and suitable for the anticipated uses that will occur on the land. When landowners desire access, they are asked to apply for a special use or road permit. The application will then be analyzed through the NEPA process to determine possible environmental effects and the level of reasonable access required.

GT (3) How does the road system affect managing roads with shared ownership or with limited jurisdiction? (RS 2477, cost-share, prescriptive rights, FLPMA easements, FRTA easements, DOT easements)?

The Green Mountain National Forest road system is comprised of 433 miles of road with 245 miles under Forest Service jurisdiction and 187 miles under private, State or Town jurisdiction. The roads under other jurisdiction are scattered throughout the forest and are essential links in the road system that provides access into the National Forest lands.

Cooperative agreements are established between the Green Mountain NF and Towns to share road improvement and maintenance responsibilities when it is desirable and beneficial to both parties. Presently the Green Mountain NF has entered into Road Cooperative Agreements with twenty-three (23) Vermont Towns. This high number of agreements is a result of the high percentage, almost 50 percent, of Town Highways on the Green Mountain NF road system. While it is recognized by both parties that mutual cooperation maximizes benefits to the public, it has not always been possible for the Green Mountain NF to cooperate with the Towns when needs arise due to availability of funds and/or timing. Due to the Green Mountain NF inadequate road funding level, which is not adequate to perform the minimum annual maintenance on our roads, we will continue to only be able to cooperate on road improvement or maintenance projects on a very limited basis. Regrettably this has and will probably continue to result in the Towns disappointment and displeasure with our inability to cooperate in future needed and worthwhile projects.

Also, the Forest Service, Federal Highway Administration (FHWA) and the Vermont Agency of Transportation (VTRANS) have entered into a Memorandum of Understanding (MOU). This document sets forth general procedures for planning, programming, environmental studies, design, construction and maintenance of designated Forest Highways. Presently there are fifty (50) miles of Forest Highway.

There are no cost-share agreements with private or other public landowners on the Forest. The diversity of ownership and lack of any sizeable in-holdings does not present the opportunity nor need

to pursue agreements of this type.

Rights of access by law, reciprocal rights, or easements are recorded in Forest files and Town records. The Forest Service recognizes these rights and works with the owners to preserve access while protecting the natural resources and facilities on adjacent National Forest lands. Also, there is an understanding by the Forest Service that individuals or entities may have established valid rights, unknown to the Forest Service presently, to occupy and use National forest lands and roads. The courts have established that such valid outstanding rights may be subject to some federal regulations. See Sierra Club v. Hodel, 848 F 2d (10th Circuit, 1988). This analysis recognizes that such valid outstanding rights may exist and the Forest Service will certainly honor such rights when it is subsequently determined that the specific facts surrounding any claim to such rights meet the criteria set forth in any respective statute granting such occupancy and use (see Washington County v.The United States, 903 F. Supp. 40 [D. Utah. 1955]).

Cost-share = An agreement between the Forest Service and town whereby both parties agree to share costs for road construction/maintenance.

Prescriptive Rights = Rights created when a person uses property without the permission of the owner for a period of time. (15 years in VT) – Note: Prescriptive rights do not accrue over lands of the U.S.

FRTA Easements = Easements the Forest Service grants to landowners who join the Forest Service in providing a permanent road system that serves lands administered by the Forest Service and lands and resources of the landowner. These easements may be granted to public road agencies for public roads that are not part of the Federal-aid system. (There are currently no FRTA easements within the GMNF.)

DOT Easements = Easements granted by the FHA to States for highways that are part of the Federal-aid system. (We estimate that 11 DOT easements have been issued within the GMNF)

FLPMA Easements = Easements for rights-of-ways not issued under other authorities. e.g. easements to private landowners seeking access across national forest lands. Currently there are 2 FLPMA easements within the GMNF.

State & Federal Highways:

There are roads within the GMNF which are under the jurisdiction of the State of Vermont and/or Federal Highway Administration. The maintenance of these highways is the responsibility of the State.

Town Highways:

Several Class 1, 2, and 3 Town Highways exist throughout the forest and where beneficial to both parties, the Forest Service will enter into cooperative agreements with the respective towns to share road improvement and maintenance responsibilities.

Class 4 Town Highways and Town Trails are those roads where the town does not perform maintenance; these roads are user-maintained. If the U.S. elects to utilize one of these roads, it will enter into a cooperative agreement with the town. This agreement is to confirm the town's

concurrence with our use of the public right-of-way and rarely obligates them for any contribution of funding or maintenance of the project.

Rights In Common:

There are roads where the U.S. has a right-of-way in common with others. In this situation, the intent is for those who use the road to perform their pro-rata share of maintenance. This rarely happens except where there is a formal maintenance agreement among the various landowners; i.e. a subdivision where each lot owner contributes to the maintenance of the access road. The U.S. cannot enter into an agreement of this nature because of the long term obligation to guarantee funding for this purpose – the U.S. cannot obligate funds in advance of appropriation, which in our case, occurs annually.

If the U.S. elects to use a road where we have a right-of-way in common, we will fund and perform whatever construction, reconstruction, or maintenance is necessary to meet our needs. Our action will be performed in a manner which will not interfere with the use of others who have access rights over the road. The bottom line is, we can utilize our right of access, but have little or no control over use by others.

(The total number of R/W's held in common is unknown – it is expected to be approximately 30)

Exclusive Access Rights:

Within the forest boundary there are several areas of private ownership. The U.S. has secured right-of-way easements over some of these parcels. The easements provide the U.S. with exclusive jurisdiction of any road or trail constructed on the land. The easement will often include the right of the U.S. to allow/control the public's use of the road. (Records indicate 114 easements have been acquired for the GMNF)

There are rare situations where the landowner granting the right-of-way to the U.S., has retained a right of access within our easement corridor. When this occurs, the deed reflects the obligation of that landowner to perform a pro rata share of maintenance costs, based on his use of the road. (Two of these exist on the GMNF)

Licenses:

A license is a temporary permit to cross private land. It is to be used where the need is for a minor road for a short term not to exceed 5 years. The GMNF has secured licenses for skid roads associated with timber harvesting activities. Currently we have two licenses in effect which will expire in 2005.

<u>GT (4) How does the road system address the safety of road users?</u>

The Forest Service and the Federal Highway Administration entered into a Memorandum of Understanding in 1975 that required the Forest Service to apply the requirements of the national highway safety program, established by the Highway Safety Act, to all roads open to public travel. This agreement was modified in 1982 to define "open to public travel" as "those roads passable by four-wheeled standard passenger car and open to general public use without restrictive gates, prohibitive signs…". Most of the Green Mountain NF and all of the Finger Lakes high standard roads

maintained at maintenance level 3, 4 and 5 meet this definition. Design, maintenance and traffic control on these roads emphasize user safety and economic efficiency.

Roads on the Green Mountain and Finger Lakes National Forest are managed and signed in accordance with their maintenance and traffic service design levels and are considered adequate for a prudent driver under normal operating conditions. Any management activity that increases use or considerably alters normal traffic patterns would be mitigated with appropriate warning and precautionary signs. Additional road maintenance or reconstruction to restore or improve standards and insure safety may be required to safely accommodate increased traffic volumes and/or traffic composition.

The largest proportion of road maintenance and improvement funds allocated to the Green Mountain and Finger Lakes NF is spent on these higher standard roads. Safety work such as surface maintenance, roadside clearing and mowing and installation and maintenance of regulatory and warning signs are performed on an annual basis. During the winter, these roads are not plowed open and some are subject to seasonal restrictions to prevent road damage during the early spring mud season. Traffic control signing follows the standards set forth in the Manual on Uniform Traffic Control Devices (MUTCD).

Administrative Uses (AU)

AU (1) How does the road system affect access needed for research, inventory, and monitoring?
The current Class 3, 4 and 5 road system does provide access to opportunities on the Forest for research, inventory, and monitoring. Research tends to be the opportunity most limited by access on the GMNF. Most access to research sites, such as existing and potential RNA's, is via trails or Class 1 or 2 roads that branch off of higher maintenance roads. For example, Wallingford Pond Road (FR 20) provides access to the Wallingford Pond area (High Elevation Pond potential RNA) via a 0.8 mile high clearance jeep trail, and Furnace Brook Road (FR 57) provides access to The Cape RNA via the Baker Brook road, which is a 1.6-mile stretch of high clearance road that heads north to the site from FR 57. While researchers have on occasion been frustrated by the poor access to some of these unique research areas, they understand that what makes them unique in many respects is their remoteness, and that their relative inaccessibility has limited the impacts that humans have had at these sites. Consequently, some researchers have sought research opportunities in other parts of the Forest that are not specifically designated for research, and where there is useful road access. Forest Health Monitoring plots are examples of this kind of research, as is the Beaver Meadows Whole Tree Harvesting Research Project in Ripton. Various studies of regeneration, planting techniques and other silvicultural questions have been undertaken over the years successfully within the current road system.

All of the system roads are used to access the landbase to conduct silvicultural inventories. The limits to the extent of the road system often mean less inventory can be accomplished in a day due to slow driving on jeep trails and long hikes into sites, and often can require a four-wheel drive vehicle. However, our inventories appear to be keeping pace with the need to accomplish resource improvement projects, as such projects themselves can also be limited by access.

Forest system roads play a vital role in facilitating Forest Plan monitoring for wildlife and plant resources. For example, in the North half of the Forest, portions of Forest Roads 67, 54, 59, 229, and 42 are used every year to conduct monitoring surveys for Management Indicator Species such as barred owl, American woodcock, and ruffed grouse. Forest Roads 100 and 5, among other lower maintenance class roads, have been used recently to access skid trails and woods roads (e.g. high clearance roads) for woodland bat monitoring. Because this type of monitoring requires a great deal of

bulky and heavy equipment, access via the road system has been critical. While some rare species monitoring is facilitated by the road system (e.g. woodland bats, Appalachian jacob's ladder in roadside ditches), most is not as the species we know of tend to be found away from roads. Access via system roads has also facilitated deer population surveys (pellet-group counts) that provide information for making project planning decisions and forest-wide population estimates.

Forest system roads have also been a useful target for monitoring of invasion by noxious weeds and other pests, as these roads often have roadside, trailhead, and destination parking that serve as new entry or establishment points for some invasive species. These sites are easy to monitor and may provide the Forest with an opportunity to catch an invasion before it gets out of control.

AU (2) How does the road system affect investigative or enforcement activities?

The road system on the Green Mountain National Forest plays a major role in both investigative and enforcement activities. Law Enforcement Officers (LEO's) regularly patrol Forest Service roads to access trailheads, recreation areas, concentrated use area, and other remote areas within the forest.

The primary purpose of patrols is the detection and response to violations that occur on National Forest Lands. Most roads within the Forest are well maintained and easy to travel. However, there are several roads that are frequented by users that are not maintained and often hard to negotiate while on regular patrol. Violations often occur in these areas as law enforcement has a limited presence in these remote areas.

The Forest also has numerous roads/trails that are not otherwise defined (road or trail?). This makes enforcement difficult as the permissible use is not clear.

The road system is also utilized by other state and local enforcement officers. Their use of National Forest roads may be tied to their own investigations or are otherwise responding to reports of accidents or other crimes that occur within the National Forest. Since these other agencies don't regularly patrol within the National Forest, it's important that the Forest do a good job in maintaining and signing roads so state and local agencies can easily find their way around.

Protection (PT)

PT (1) How does the road system affect fuels management?

50% of the GMNF wildfires occur within road corridors. Shaded fuel breaks are being constructed and maintained along major travelways. Routine road debrushing projects where chipping of debris is not required add to the fuel accumulation. All future contracts should including chipping of all debris. Some prescribed burning is done for wildlife habitat improvement or site preparation for oak regeneration. The current road system allows access to most of the analysis area for any fuels management. There are several "large" un-roaded areas within the analysis area where access is more limited but no fuels management is expected to occur in these areas.

PT (2) How does the road system affect the capacity of the Forest Service and cooperators to suppress wildfires?

The GMNF has a low occurrence of wildfire primarily due to high annual precipitation and hardwood forest types present on the forest. Most of the wildfires that occur on the GMNF are caused by human activities. The current road system is sufficient to meet the needs of the Forest Service and cooperators to suppress wildfires within the analysis area.

PT (3) How does the road system affect risk to firefighters and to public safety?
The current road system provides very good access to the analysis area with numerous exit routes if necessary. Due to low occurrence of wildfires on the GMNF and the road system within the analysis area, risk to firefighters and public safety is low.

PT (4) How does the road system contribute to airborne dust emissions resulting in reduced visibility and human health concerns?

Airborne dust emissions due to vehicle traffic on roads are rarely a problem on the GMNF. In a normal year, rainfall is sufficient in timing and quantity to prevent airborne dust, except in the driest few weeks of the summer. The airborne dust is not regarded as a health or visibility problem.

Of greater concern in Vermont are the health and environmental effects of motor vehicle emissions, as they are a major contributor to air pollution in the state. However, the emissions contribution of people driving motor vehicles on Forest Service roads is small (in the state-wide context), so the effects of these emissions will not be considered in this analysis

Recreation - Unroaded Recreation (UR)

UR (1) Is there now or will there be in the future excess supply or excess demand for unroaded recreation opportunities?

Nationally there appears to be an excess demand and a limited supply of unroaded recreation opportunities. Whether this holds true for the Green Mountain National Forest can only be determined through statistically valid surveys. Given limited time and resources, we can only make some general assumptions about supply and demand for this type of recreation.
There is a relatively small amount of public land available in the State of Vermont. Therefore, it would be only natural for the public to look to the Green Mountain National Forest, the largest landowner of relatively undeveloped land to provide unroaded recreation. This is consistent with the decisions in the 1987 LRMP for the Forest. There was a strong demand for unroaded recreation at that time that appears to have carried through the 15 years of plan implementation.
From preliminary comments received for the plan revision and for project planning, it can be determined that a significant number of people still desire non-motorized recreation and unroaded activities. Since many parts of Vermont are becoming more developed, one can assume that this will translate into increased future demand for unroaded recreation on the Green Mountain National Forest.

Complicating this situation is the fact we are also faced with the increasing demand for motorized recreation and recreation that needs roads. The balance of these demands is at the core of the challenges we face in Plan Revision.

UR (2) Is developing new roads into unroaded areas, decommissioning of existing roads, or changing the maintenance of existing roads causing substantial changes in the quantity, quality, or type of unroaded recreation opportunities?
Following the direction in the LRMP, there has been relatively little new road construction in the 15 years of plan implementation. The LRMP emphasized the reconstruction and maintenance of the existing transportation system, so there has been very little new road development into undisturbed areas. Since most work has occurred in areas previously roaded, the effect on unroaded recreation is

almost insignificant. Maintenance of existing roads is an on-going activity on the existing transportation system, so this would have little negative effect on unroaded recreation.
Most unroaded recreation on the Green Mountain National Forest needs some level of access to trailheads where the actual participation in the recreational activity occurs. The Level 3, 4 and 5 roads provide a large part of the access needed to these trailheads. A positive effect of the road reconstruction and maintenance is that we were able to maintain or improve access to trailheads needed by recreationists. Decommissioning of roads leading to critical trailheads could be detrimental to unroaded recreation in certain places.

UR (3) What are the effects of noise and other disturbances caused by developing, using, and maintaining roads on the quantity, quality, and type of unroaded recreation opportunities?

The noise from constructing new roads would carry into the forest and could affect a recreationist's sense of remoteness. However, construction activities are short in duration. The sound from road maintenance activities could carry into the forest, but are also of short duration. Road use from standard vehicles does not carry far into the forest because of the low speeds involved, whereas off-road vehicle use does carry far across the landscape and could affect a sense of remoteness.
The significance of this noise depends primarily on the location of the road and the management emphasis of surrounding lands. The Recreation Opportunity Spectrum is one tool the USFS uses to define objectives for an area. This system provides a means to categorize lands according to the type of recreational opportunity a person could expect to achieve within a given area. Ranked from Primitive to Urban, this system defines the level of development, noise, crowding etc that one should expect in the area. Roads adjacent to land that should be managed as primitive or semi-primitive would have a greater negative effect than if adjacent to lands managed as roaded natural, rural or urban. In the more developed areas, there should be a higher expectation of noise than in the more primitive end of the spectrum.
Because of the low level of road work on the GMNF, there is very little negative effect on unroaded recreation from road management activities on Level 3, 4 and 5 roads. Work on lower level roads, especially in more remote areas may have greater negative effect since the areas are more likely to have ROS objectives that are closer to the Primitive end of the spectrum.

UR (4) Who participates in unroaded recreation in the areas affected by constructing, maintaining, and decommissioning roads?

The primary recreation users of unroaded areas are hikers, skiers and other non-motorized recreationists. At particular times of year there may also be use by hunters, anglers, berry pickers, birdwatchers and numerous other activities. Many uses, such as equestrian use, are limited by trail restrictions that would restrict riding to roads, unless there is specific approval for individual trails.

UR (5) What are these participants' attachments to the area, how strong are their feelings, and are alternative opportunities and locations available?

In calendar year 2000, the Green Mountain and Finger Lakes National Forests participated in the National Visitor Use Monitoring effort that was the first attempt to obtain a statistically valid sample of recreation use on the National Forests. A report, published in August 2001 provides some very useful data to assist in answering this question. Like any survey the data must be interpreted and used correctly so some assumptions and clarifications need to be made.
Unfortunately the survey didn't provide a detailed breakout of data for unroaded recreation. Much of

the data is only statistically valid when one considers the forest as a whole. Despite these limitations we can see many trends that lead us to logical conclusions. One thing we can assume from the data is that most of the use comes from Vermont and that much of the use is of relatively short duration, which suggests that day hikes or very short visits are common. From this one can assume that a large portion of our users are locals that probably use the area regularly. From comments on projects and the Forest Plan, we know that they have very strong feelings about their particular activities and the areas they use for recreation.

Depending on location, some of the recreationists may have access to state land or other larger ownerships. Some may travel to adjacent states and recreate in the Adirondacks or the White Mountains. For most people the Green Mountain National Forest provides the only real opportunity to recreate on large blocks of undeveloped land.

Road-related Recreation (RR)

RR (1) Is there now or will there be in the future excess supply or excess demand for roaded recreation opportunities?

The Green Mountain National Forest has experienced very little change in the number of roads either built or closed over the past ten to fifteen years. However, in that time the total number of roads under Forest Service jurisdiction has increased, due to an active and ongoing land acquisition program. In some cases the lands purchased came with existing road systems.

Current users of the Green Mountain National Forest participated in many road-based activities as shown on Table 1. The overwhelming majority of visitors were local residents of Vermont (Table 3). As there has been no evidence presented of over-use of the existing road system one can assume this forest fills its role in satisfying the surrounding communities demand for these activities. With the few exceptions found at some concentrated (undeveloped) roadside camping areas, there appears to be adequate parking and lack of congestion at day use areas, campgrounds, reservoirs and other road-based recreation facilities. There are no studies of future visitor-use demand for Green Mountain National Forest.

Public meetings held in a variety of local communities for this RAP process did not produce comments showing forest users requesting further development of a road system for recreational purposes, with a few site-specific exceptions. Some area residents requested a re-opening of a road on a recently purchased parcel in order to access a small reservoir. There was both support and opposition, for allowing off-road vehicles to use existing roads and/or create a new motorized trail system.

Historically, it's clear that this forest has seen roads built over much of its terrain in earlier years. As part of its legacy of previous historical settlement patterns, roads were a prevalent part of early farming and logging on the land now managed as the Green Mountain National Forest. Of course many of these roads are no longer in use and may not any longer clearly exist as features on the land. Those areas are now available for non-road based recreation.

An earlier visitor survey shown below contains useful information specific to the Green Mountain National Forest. However it was not designed to adequately answer the question "what is demand for roaded-based recreation". For example, trail hiking is a very different activity compared to going for a walk along a forest road. However in this sample the statistical question is lumped into one category, showing that 47% of visitors reported participating in "hiking or walking" during their visit to the Green Mountain National Forest. It is not possible to discern if these were road-based activities or not.

The only recreation group that this particular study would let us clearly state were not road-based would be the 8% who participated in "backpacking, camping in unroaded areas".

The last ROS inventory of the Green Mountain National Forest was accomplished for the 1987 Land and Resource Management Plan (or Forest Plan). This inventory roughly showed the percent of the Green Mountain National Forest acres available to provide road-based recreation.

A factor when trying to evaluate current road based recreation opportunities is the large percent of acres on this forest that are too newly acquired have any assigned ROS class. The current Plan Revision of the Green Mountain National Forest Plan will include the inventory of these newly acquired acres.

Table 7 - Activity Participation and Primary Activity for Green Mountain & Finger Lakes National Forests.

Activity	% Participation	Percent Stating it was their Primary Activity	Road Based Activities?
Camping in developed sites (family or group)	2	*	Yes
Primitive camping (motorized)	1	*	Yes
Backpacking, camping in unroaded areas	8	2	No
Resorts, cabins and other accommodations on FS managed lands (private or FS run)	1	0	Yes
Picnicking and family day gatherings in developed sites (family or group)	5	*	Yes
**Viewing wildlife, birds, fish, etc on NFS lands	12	*	Yes or No
**Viewing natural features such as scenery, flowers, etc on NFS lands	50	10	Yes or No
Visiting historic and prehistoric sites/area	2	*	Yes or No
Visiting a nature center, nature trail or VIS	2	0	Yes
Nature Study	3	0	Yes or No
General/other- relaxing, hanging out, escaping noise and heat, etc,	22	5	Yes or No
Fishing- all types	5	5	Yes or No
Hunting- all types	5	5	Yes or No
Off-highway vehicle travel (4-wheelers, dirt bikes, etc)	0	0	Yes
Driving for pleasure on roads	4	*	Yes
Snowmobile travel	1	1	Yes or No
Motorized water travel (boats, ski sleds, etc)	0	0	Yes
Other motorized land/air activities (plane, other)	0	0	Yes or No
Hiking or walking	47	32	Yes or No
Horseback riding	*	*	Yes or No
Bicycling, including mountain bikes	2	*	Yes or No
Non-motorized water travel (canoe, raft, etc.)	*	*	Yes or No
Downhill skiing or snowboarding	25	25	Yes
Cross-country skiing, snow shoeing	14	11	Yes or No
Other non-motorized activities (swimming, games and sports)	5	1	Yes or No
Gathering mushrooms, berries, firewood, or other natural products	16	3	Yes or No

* less than 1 percent participation

** first version of survey form used October through March had these two viewing categories combined as viewing scenery

Definitions:

Roaded recreation opportunities are classified under an inventory system used by National Forests called the Recreation Opportunity Spectrum, or ROS. The concept is that all forestland maybe categorized- based on social, physical and managerial criteria- by the variety of settings available. In turn, these settings provide different opportunities for public recreation use- from the most primitive, to road-based. "Roaded Natural", "Rural" and "Urban" are three of the six categories that combined would be described as roaded recreation. These categories have *activities* that may vary depending upon the local forest situations. Viewing scenery, driving for pleasure, bicycling, boating, horseback riding, RV or car-camping (in developed sites or undeveloped areas adjacent to roads), picnicking, swimming, berry-picking, hunting, fishing, x-country skiing and snow play are all examples.

The roaded recreation characteristics are typically described this way, according to the R9 or Eastern forest guides: Roaded Natural- "This forest is a mosaic of different age classes and groupings appearing as a predominately natural environment. Openings are noticeable throughout the forest and are the result of natural and human-caused occurrences. Forest is accessible by foot, horseback, and motorized vehicles. Visitor interaction is low to moderate. Evidence of other users is prevalent. A system of roads and trails permits entry for a variety of management purposes and may be opened or closed to specific vehicles or types of uses. Resource modification takes place but is harmonized with environment. Recreation experiences allow affiliation with groups, or isolation from sights and sounds of humans at different times and places. There would be few opportunities for challenge or risk."

The Rural and Urban ROS classes are also likely to be road-based recreation. According to the R9/Eastern forest guides: "This forest exhibits a forested, farmed, and/or developed landscape. Human cultural practices have substantial modified the natural environment. Forest is accessible by same means described under Roaded Natural above. Visitor interaction is moderate to high. Other users are readily evident. Resource modification and utilization takes place and is conspicuous because of its contrast with less modified environments. Challenge and risk opportunities are unimportant. All activities listed under Roaded Natural would still occur, but also include activities such as resorts, commercial public lodging, and competitive sport fields."

RR (2) Is developing new roads into unroaded areas, decommissioning existing roads, or changing maintenance of existing roads causing significant changes in the quantity, quality, or type of roaded recreation opportunities?

No. There has been very little new road construction activity on the Green Mountain National Forest within the past ten years. Neither have maintenance levels changed over this period of time, and no roads in Levels 3,4 or 5 have been decommissioned on the forest.

RR (3) What are the adverse effects of noise and other disturbances caused by constructing, using, and maintaining roads on the quantity, quality, or type of roaded recreation opportunities?

There are no adverse effects created by construction activities, as this activity is not occurring.

Potential adverse effects of maintenance would include displacement/detours, inconvenience, travel delays, and limited opportunities to view wildlife which would be displaced by road activities. The maintenance of roads would displace some recreationists while that road activity is occurring. This

disturbance would be temporary and users would return when the road activity was completed. The degree of inconvenience would vary by circumstance. If a visitor was on their only trip to the Green Mountain National Forest, perhaps at a picnic site and encountered constant noise or other construction disturbances during their one visit, which would likely have a highly negative impact. Contract clauses may be placed to limit the roadwork to specified times or weekdays during which operations would be allowed, thus limiting the impact on visitors.

RR (4) Who participates in roaded recreation in the areas affected by road constructing, maintaining, or decommissioning?

Basic descriptors of the forest visitors were developed based upon those visitors interviewed then expanded to the forest visitor population. This description does not separate roaded recreation users vs wilderness or off-road users. However it gives the overall picture of visitors to the Green Mountain National Forest. It should be noted that use statistics were mixed with samples taken on the Finger Lakes NF located in New York state, however Seventy-one percent of visitors were male and 29 percent were female. Fewer than 16 percent of visitors were under age 16 and not interviewed. Fewer than three percent of visitors were over 70 years old and the 41 to 50 year old age group accounted for 28 percent of visitors.

The National Visitor Use Monitoring (NVUM) project was implemented as a response to the need to better understand the use of, importance of and satisfaction with national forest system recreation opportunities. The Green Mountain and Finger Lakes National Forests participated in the NVUM project from January 1 through December 31, 2000. Results were published in August 2001. This study identified the primary activities of visitors. Included were activities that were both road-based and those that required a more primitive, un-roaded setting. Wilderness users, day hikers, campers, skiers, casual forest users passing through the Green Mountain forest were all interviewed. The following discussion uses total visitor activities, whether road-based recreation or not.

The average Green Mountain National Forest visitor went to 1.1 sites during their national forest visit. The average length of stay on Green Mountain National Forest for a national forest visit was 6.5 hours. Eight percent of visitors stayed overnight on the forest. Forest visitors sometimes go to just one national forest site or area during their visit. For example, downhill skiers may just go the ski area and nowhere else. Ninety-six percent of visitors went only to the site at which they were interviewed. During their visit to Green Mountain National Forest the top five recreation activities of the visitors were viewing wildlife and natural features, hiking and walking, downhill skiing or snowboarding, and general relaxation. Each visitor also picked one of these activities as their primary activity for their current recreation visit to this forest. The top primary activities were hiking and walking, downhill skiing or snowboarding, and cross-country skiing. The results of the NVUM activity analysis do not identify the types of activities visitors would like to have offered on the national forests. It also does not tell us about displaced forest visitors, those who no longer visit the forest because the activities they desire are not offered.

Table 8. Age distribution of Green Mountain & Finger Lakes National Forests visitors.

Age group	Percent in group
Under 16	15.7
16-20	3.5
21-30	13.9
31-40	18.2
41-50	28.2
51-60	12.5
61-70	5.3
Over 70	2.7

Table 9 - Race/ethnicity of Green Mountain & Finger Lakes National Forests visitors.

Category	Total percent national forest visits
Black/African American	0
Asian	0.9
WHITE	98.5
American Indian/Alaska Native	0.1
Native Hawaiian or Other Pacific Islander	0
Spanish, Hispanic, or Latino	0
Other	0.4

There was an average of two people per vehicle on this forest with an average of two axles per vehicle. This information in conjunction with traffic counts was used to expand observations from individual interviews to the full forest population of recreation visitors.

About one percent of the forest visitors were from another country. The survey did not collect country affiliation. Visitor's most frequently reported zip codes are shown in Table 3. The forest can determine what percent local visitor use they have by comparing the local forest zip codes to those listed. There were 338 different zip codes reported.

Table 10 - Zip Codes of Green Mountain & Finger Lakes National Forests recreation visitors.

Zip Code	Towns	Frequency	Percent
All Vermont 05733	Brandon, Goshen, Leisester, Sudbury	16	3.2
05701	Rutland, Mendon	15	3.0
05753	Middlebury, Cornwall	14	2.8
05443	Bristol, Lincoln	12	2.4
05767	Rochester	12	2.4
05748	Hancock	9	1.8
05763	Pittsford, Chittenden	9	1.8
05673	Waitsfield, Fayston	7	1.4
05674	Warren	7	1.4
05250	Arlington, Sunderland	5	1.0
05737	Chittenden	5	1.0
05401	Burlington	4	0.8
05491	Vergennes, Addison	4	0.8
05602	Montpelier, Berlin	4	0.8
05766	Ripton	4	0.8
01701, 02118, 03755,05255, 05355, 05495 05745, 05769,	**VT-**Manchester Wardsboro, Williston Forest Dale, Salisbury **MA-**Framingham & Boston. **NH-**Hanover.	3 each	0.6 each

RR (5) What are these participants' attachments to the area, how strong are their feelings, and are alternative opportunities and locations available?

Since at this time the Green Mountain National Forest is not constructing or decommissioning any class 3-5 roads, people's attachments to and desired use of these areas will not be effected. Maintenance would typically only have a temporary effect on the use of an area.

Passive-Use Value (PV)

PV (1) Do areas planned for road entry, closure, or decommissioning have unique physical or biological characteristics, such as unique natural features and threatened or endangered species?

As noted in the EF, AQ, and TW sections above, there are several unique or significant features or communities, and rare and uncommon species, associated with roads in the maintenance level 3-5 system. For example, woodland bats, including the Indiana bat, use road corridors at night for foraging; the globally rare Appalachian jacob's-ladder grows in roadside ditches and swales; several roads in the maintenance level 3-5 system either travel along, through, or end at significant aquatic ecosystems, including wetlands and high elevation softwater ponds.

There are currently no roads planned for new construction, closure, or decommissioning on the GMNF. Any of the activities, when proposed, would need to be evaluated in the context of the species that may occur there and the habitats and ecosystems that support them. All three activities could have both negative and positive consequences, depending upon how they were accomplished. New roads can create artificial pockets of habitat for rare plants, and can provide foraging corridors for bats and other animals. On the other hand, new roads can disrupt aquatic and wetland systems, and funnel additional human use and invasive exotic species to areas that had been relatively protected from such disturbances. Decommissioning of roads can remove these corridors and consequently limit disturbances that are not a natural component of the affected ecosystems. However, if not done well, it can also eliminate habitat for rare and uncommon species that had been created or enhanced over the years through the construction and maintenance of the road. Closure of roads may have the least negative effects and the most positive, as it can maintain the existing habitat for species while limiting the introduction of uses and species that can disrupt these natural communities. Weighing the relative benefits and costs of these actions will be an important component of the analysis of any changes that could be proposed in the road system at this maintenance level in the future.

PV (2) Do areas planned for road construction, closure, or decommissioning have unique cultural, traditional, symbolic, sacred, spiritual, or religious significance?

The historic context for most Class 3/4/5 roads is significant: directly related historic structures and archaeological sites frequently occur within most road corridors; and precontact Native American sites are occasionally present. Forest Plan standards and guidelines provide for the identification, protection and management of such sites.
Native American spiritual values could be incidentally affected by road construction, but to date no such

areas have been specifically identified in association with Class 3/4/5 Roads. Closure or decommissioning is unlikely to have an adverse affect.

PV (3) What, if any, groups of people (ethnic groups, subcultures, and so on) hold cultural, symbolic, spiritual, sacred, traditional, or religious values for unroaded areas planned for road entry or road closure?

To date, such values have not been specifically identified. However, it is known that both the Abenaki and Mahican tribes have a cultural legacy on these lands and they should therefore be consulted if road entry or road closure actions pertaining to unroaded areas are proposed.

Social Issues (SI)

SI (1) What are people's perceived needs and values for *roads*? How does road management affect people's dependence on, need for, and desire for *roads*?

The perceived need and value of roads on the GMNF is personal, socio-economic and environmental. Class 3,4, and 5 roads provide access to the GMNF from neighboring communities and the local transportation system. Forest system roads provide access into and through the Forest for many forms of recreation, special uses, and FS management activities. Some FS system roads are also part of the local transportation system providing residents access to local roads for daily travel to and from work and their communities. Most people seem satisfied with the present Class 3-5 road system. Some people believe more roads are needed to provide greater access for recreation and timber harvest. Some people believe that roads cause environmental problems and disturb wildlife.
Road management decisions can affect road use – higher level maintenance roads are more pleasurable and comfortable but can also invite increased use of the road. Year round maintenance of roads provides access for winter activities but may also invite development on non-FS lands located on the road.

SI (2) What are people's perceived needs and values for *access*? How does road management affect people's dependence on, need for, and desire for *access*?

Perceived Need and value of access to the GMNF encompasses many areas. Many believe that they are entitled to access to the entire National Forest. Others believe that access should be restricted in some areas to protect resources and prevent high use. People access the Forest for many reasons – recreation including hiking, skiing, horseback riding, snowmobiling, camping, mountain biking, swimming, boating, hunting, fishing, wildlife viewing and photography; quiet and solitude; economic including gravel extraction, timber harvest, plant gathering, and other special uses and FS management activities including habitat restoration, monitoring, and maintenance of facilities. Access for ATV use is not allowed on the GMNF. ATV users have expressed a desire for access. Access for a number of uses is restricted and some of these users have expressed an interest in increased access.

Road management affects people's ability to access the GMNF by making access to some areas quite easy and making access to other areas more difficult. The existence of high maintenance level roads makes an areas accessible to anyone with a car, the existence of lower level maintenance roads makes areas accessible to those with high clearance vehicles and some recreational users, the absence of roads makes areas accessible only to those who area able to use trails or bushwhack. Where access has historically been provided, people become used to that access and depend on its continued availability.

In areas where there historically has not been road access, people may desire that access or may actually appreciate the lack of access.

SI (3) How does the road system affect access to paleontological, archaeological, and historical sites?

Virtually every historic site on the Forest was once linked directly to a transportation route of some sort; and most current routes follow in the general footprint of earlier roads. Thus, most still-active roadways, including the Class 3/4/5 Roads, have historic structures and historic archaeological sites and features within their corridors. Construction and maintenance activities have the potential to adversely affect historic sites, but Forest Plan standards and guidelines provide for the management and protection of such sites (i.e., usually through avoidance or project re-design; occasionally through data collection prior to impact). A high percentage of these historic period sites have been identified on the Forest, thus facilitating their inclusion in the planning project process.
Precontact Native American archaeological sites are not likely to be dramatically more common along current travelways than elsewhere on the landscape (except to the extent that the road system parallels waterways). They, too, are subject to Plan-level protection, but their occurrence and distribution across the landscape is less well documented and needs to be addressed on a project-by-project basis.

SI (4) How does the road system affect cultural and traditional uses (such as plant gathering, and access to traditional and cultural sites) and American Indian treaty rights?

Presently it is unknown what affect roads have on cultural and traditional uses. There are no officially designated collecting or gathering areas under Permit or otherwise designated at this time. On the other hand, it is known that numerous kinds of resources are indeed gathered on the Forest by Native people (as well as others), and these cultural/traditional use activities may be facilitated by the existence of the road system. Therefore, scoping for any proposed changes to the road system should include the Native American community.

There are no American Indian Treaty rights applicable to the GMNF.

SI (5) How are roads that are historic sites affected by road management?

By and large, Class 3/4/5 Roads are not likely to retain any of the original "fabric" of their original/historic condition given their use-and-maintenance histories, and the need to meet modern transportation standards. But they may still be considered "historic" based on the length of time the route has been in-place, and its association with other sites and events.

Therefore, re-construction and maintenance of the existing "footprint" of an historic Class 3/4/5 road will be unlikely to be an adverse affect. However, road re-alignment, widening, and/or straightening may well have an adverse affect on the historic character of the road (as well as any associated historic sites within the road corridor). The significance of this adverse affect to the road itself would need to be evaluated, particularly in light of the cumulative effect of any changes that have already occurred.

Table 11 – Census 2000 Data

Geographic area	Population	Housing units	Total area in square miles	Density per square mile of land area	
				Population	Housing units
USA	281,421,906	15,904,641	3,794,083	79.6	32.8
Vermont	608,827	294,382	9,614.26	65.8	31.8
COUNTY					
Addison County	35,974	15,312	808.30	46.7	19.9
Bennington County	36,994	19,403	677.67	54.7	28.7
Rutland County	63,400	32,311	944.77	68.0	34.6
Washington County	58,039	27,644	695.43	84.2	40.1
Windham County	44,216	27,039	798.12	56.1	34.3
Windsor County	57,418	31,621	975.74	59.1	32.6

Source: U.S. Census Bureau, Census 2000 Summary File 1

Road management decisions affect the communities' access to the GMNF. As previously discussed, roads managed at higher levels are more accessible to passenger vehicles and use for tourism. Some areas near the GMNF are quite economically dependent on tourism and recreation. Often there is a social clash, even in these communities, between the use by local people and use by people from "away." Heavy tourism and recreational use on roads can impact their ability to be used for timber harvesting, horseback riding, hunting access and other traditional rural uses. Roads with a lower degree of maintenance may not have the same pressures for tourist-oriented uses. Roads provide opportunities for FS management of facilities, vegetation and wildlife habitats.

Unroaded areas are defined as "any area without the presence of a classified road, of a size and configuration sufficient to protect the inherent characteristics associated with its roadless condition. Unroaded areas do not overlap with inventoried roadless areas." Unroaded areas provide much of the GMNF's backcountry recreational opportunities. These areas contain numerous trails and contribute to the social and economic fabric by providing opportunities for backcountry recreation – hiking, snowmobiling, skiing, hunting, fishing, wildlife watching and photography. Unroaded areas do not, however, provide the same opportunities for FS management. Access for trail and shelter maintenance is much more difficult in unroaded areas. Timber harvesting and wildlife management are also more difficult without the presence of roads.

SI (7) What is the perceived social and economic dependency of a community on an unroaded area versus the value of that unroaded area for its intrinsic existence and symbolic values?

Many people believe that unroaded areas are important in our hectic and motorized environment. These areas provide places to get away from technology and noise. Many believe that unroaded areas provide opportunities for spiritual rejuvenation. Most people believe that these areas are important at least for providing opportunities to experience and enjoy the natural environment. Many areas in the GMNF are frequently used by local residents for relaxation. According to the National Visitor Use Monitoring results approximately 90% of those using the GMNF gave Vermont as their address.

Some people believe that unroaded areas are predominantly used by the young, athletic tourists not by most other users. They believe vehicular access is important to the use of the GMNF by the general public and to the economic vitality of neighboring towns. They also believe that unroaded areas do not provide the goods and services such as timber harvest and special uses provided in roaded areas.

SI (8) How does road management affect wilderness attributes, including natural integrity, natural appearance, opportunities for solitude, and opportunities for primitive recreation?

The Wilderness areas on the Green Mountain National Forest are located near State arterial highways. Wilderness areas are also surrounded by Forest Service and local roads. These roads provide easy access to Wilderness areas. Consequently Wilderness areas are used for day hiking as well as distance hiking. Access to primitive recreation opportunities is quite easy due to this road network. Wilderness areas with sections of the Appellation Trail and the Long Trail experience high levels of use on those trails decreasing opportunities for solitude. The sound of traffic is also noticeable in many Wilderness areas. This detracts from the natural experience and feeling of remoteness.

Step 5 Describing Opportunities And Setting Priorities

Purpose and Products

The purpose of this step is to:

- Compare the current road system with what is desirable or acceptable
- Describe options for modifying the road system that would achieve desirable or acceptable conditions

The products of this step are:

- A list of opportunities for addressing important problems and risks

Roads Analysis Conclusions And Opportunities

The description of opportunities and priorities is based on information available at the Forest scale. In this assessment, only the maintenance level 3,4 & 5 road system are analyzed.
The following six questions from Miscellaneous Report FS-643 titled Roads Analysis: Informing Decisions about Managing the National Forest Transportation System (USDA-FS 1999) were used as a guide to summarize the conclusions from the Green Mountain national Forest Roads Analysis.

1) Does the existing system of roads create an unacceptable risk to ecosystem sustainability?

Evaluation of the classified road system at this Forest-wide scale suggests that the current road system overall does not pose a serious risk to ecosystem sustainability. However, the Green Mountain National Forest recognizes that in some areas, numerous road segments create a significant enough effect on ecosystem processes and/or habitat to warrant modification to reduce impacts. This assessment provides information regarding the type and degree of risk from roads to various resources. In most cases, these risks will vary across the landscape due to the natural sensitivity of the land, the intensity of the road network, and geographic range of terrestrial or aquatic species habitats.

Roads that may cause risk to ecosystem sustainability on the Green Mountain National Forest are primarily roads with gravel or soil surface material. Road characteristics and uses that cause unacceptable risks to ecosystem sustainability include:

- Entrenchment of the travel way occurring due to location, use, erosion, and surface blading. When there are no drainage structures to remove water and sediment from the road surface, sediment and gravel may eventually be delivered to a stream at a crossing.
- Roads with ditches that empty directly into a stream.
- Roads with ditches that do not have the proper number and/or placement of relief culverts and/or lead out ditches.
- Roads that are located adjacent to the stream with no buffer or with a narrow buffer.
- Unmaintained roads that are used just enough by four-wheel-drive traffic during wet periods to cause ruts that channel water, eroded soil, and gravel to either deposit soil and gravel materials further somewhere else on the roadway or deliver sediment to a stream

- Low maintenance or no maintenance roads that have plugged or washed out culverts that causes bank erosion or additional sediment in the stream..
- The existing road system on the Green Mountain National Forest does not create an unacceptable risk to ecosystem sustainability. The relatively low road density and mitigation measures taken during construction and maintenance efforts have reduced environmental impacts. Forest specialists review plans and suggest construction techniques to reduce impacts to the environment.
- Whenever maintenance or redesign is done we should install proper drainage structures including ditches and ditch lead out structures.
- In some cases, relocate segments of roads that do not have adequate buffer strips or that are constantly washing out.
- Encourage towns not to use ditch clean out material or other inappropriate materials to protect road fills that share a bank with an adjacent stream.
- Encourage towns to blacktop roads that cannot be economically relocated and that are consistently delivering sediment and gravel to streams.
- With the emphasis to improve water quality, one of the logical methods would be for road management agencies to pave gravel roads and harden ditches in critical watersheds. This in turn would drive down long-term maintenance costs.
- Enforce forest-wide guidance and do not allow gravel removal from streams administered by the Green Mountain National Forest.
- Ensure that removal of streambed materials from streams that eventually flow into a stream administered by the national forest are in compliance with dredge and fill activities regulated by Section 404 of the Clean Water Act, Section 10 of the Rivers and Harbors Act as administered by the United States Army Corps of Engineers.

2) Can the maintenance requirements of the existing system be met with current and projected budgets?

Forest Service roads:

Historically, the maintenance budgets have not been adequate to maintain the road system to an adequate level. Some roads have been closed or their use restricted to reduce the level of maintenance needed. Additionally, some maintenance has been "deferred" until it could be included in future years or as part of a timber sale.

Township roads:

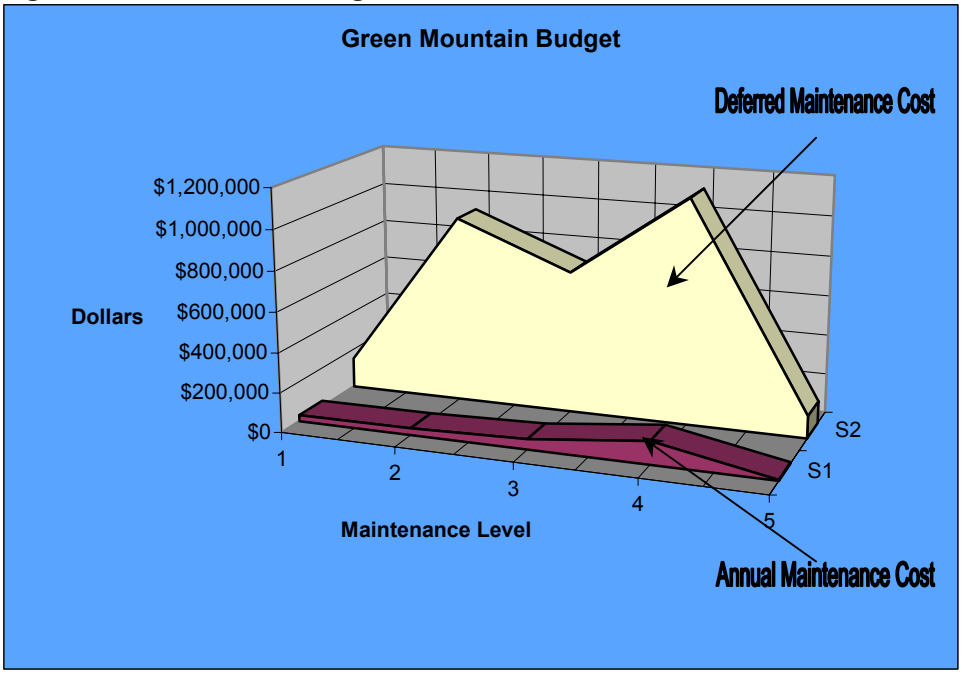
Local townships do not have adequate funding to maintain the current road system. Towns continue to seek assistance through cooperative agreements with the Forest Service to maintain town roads included on the FS System and located within or leading to the National Forest.

Over the last decade, maintenance budgets have remained static or risen slightly, but not enough to offset the effects of inflation and deferred maintenance needs. It is unlikely that future budgets will rise sufficiently to allow full maintenance of the existing transportation system. If this trend continues, the Forest will fall further behind on its maintenance program each year. Opportunities to minimize costs and road-related risks are discussed below (Table 12, Figure 5).

Table 12 -Summary of funds for Road Maintenance and Operations

Maintenance Level	Total	Annual Maintenance		Deferred Maintenance	
	Miles	$/Mile	Total $	$/Mile	Total $
1	65.4	$483	$31,616	$2,304	$150,828
2	102.6	$324	$33,334	$9,400	$940,000
3	35.4	$1,465	$51,733	$20,201	$714,359
4	41.3	$2,900	$114,816	$27,279	$1,127,477
5	2.5	$2,148	$5,370	$45,117	$112,792
Total	**247.2**	**$7,320**	**$236,869**	**$104,301**	**$3,045,456**

Figure 5 – Green Mountain Budget Data 2002



We need to be more aggressive in obtaining funds to assist towns in road maintenance and reconstruction of the town roads that primarily serve customers of the Green Mountain National Forest. For the first time since FY 1995, the agency is returning to field based budget proposals. The FS is adopting a new system for formulation and execution of its budget, Budget Formulation and Execution System (BFES). The Green Mountain National Forest entered field-based information about capabilities (dollars and outputs) and management priorities. We hope that under this new approach, we can obtain more road dollars to maintain our road system. However, the forest is under a constrained budget system. So, if road maintenance dollars increase, funds for other functions would have to decrease. Other FS funding sources include the capital improvement process (CIP) for projects over $250,000 and the Road and Trail Deposit Fund. Both of these funding sources could help reduce our deferred maintenance backlog, thus helping to free up funds for annual road maintenance and would not have an effect on the constrained budget.

3) Are some existing roads not needed to meet projected access needs?

This forest scale analysis looks at our public road system including township roads. A public road under FS jurisdiction assigned to maintenance level category 3, 4, or 5 (FSH 7709.58 section 12.3). That is a road maintained for travel in a standard passenger car. Level 3 roads are low speed, single lane with turnouts and spot surfacing. Level 4 roads are mostly double lane and aggregate surfaced. Level 5 roads are normally double lane, paved facilities.

The Maintenance Level 3, 4 & 5 roads identified in this document are considered to be adequate for current and foreseeable future access needs. Potentially, the lower-scale transportation analyses will identify some maintenance level 1 and 2 roads and some un-classified roads as surplus to Forest needs.

No new road access is proposed or evaluated in this Forest-scale assessment. However, should future new access be required, road construction will need to be evaluated at the watershed and/or project scale. In general, future roads will be constructed with modern design and layout techniques that will minimize adverse ecological risks while providing safe and efficient transportation. Existing roads may also be added to the Forest transportation system through land acquisition or cooperative agreement. Roads acquired through land acquisition are generally acquired as part of a larger project whose goals are not road-related. Cooperative agreements for cost-share roads confer rights to the Forest Service for road management activities. Benefits of acquiring these roads are tied to the purpose of the acquisition, which is subject to NEPA but is not expected to be part of a larger scale roads assessment. Any decision to add road mileage to the system should consider the constrained road maintenance budget, and the potential conflicts that additional maintenance needs will create.

This analysis does not include proposals for road building, closure, or decommissioning of local roads (Level 1(closed to motorized traffic) and Level 2 (intermittent travel by high clearance pick-up or 4x4) roads. The closing of unneeded local roads is an important subject. The closing of some of these local roads may create desired visual conditions, reduce sediment delivery into streams, eliminate sights and sounds of motor vehicles, and improve the experience for forest visitors seeking solitude. However, we need to do a site-specific analysis or smaller scale analysis to identify specific roads that need management action. It is inappropriate to address this subject in this forest-wide road analysis of public roads.

4) If new access is proposed, what are the expected benefits and risks?

Any proposed additions to the transportation system will be analyzed during the NEPA process (National Environmental Policy Act). Any road considered for construction or reconstruction will be studied to determine the purpose and the need for the project. Once completed, the proper NEPA analysis will be done. Benefits and risks will be evaluated on a case by case and project by project basis.

5) What opportunities exist to change the road system to reduce the problems and risks or to be more consistent with forest plan direction and strategic intent of the roads system?

There are a number of options available to reduce costs and minimize road-related risks on the Forest road system. Operational or administrative actions may include changing the service/maintenance level, traffic routing or restricting access to the road only to address resource protection or health and safety concerns. In other cases, resource protection or health and safety may require capital

investments in the form of road improvements, new construction or decommissioning to be effectively addressed. In either case, contrasting the benefits, duration and magnitude of access need with the resource costs is needed to inform decision making in order to realize a safe, efficient, and effective transportation system with minimal resource consequences. These options should be considered during lower scale analyses. Some specific examples are provided here:

Reducing Maintenance Levels: Reducing a Maintenance Level 2 to a Maintenance Level 1 road can reduce maintenance requirements as well as address water quality risks. Since Level 1 roads are not maintained for access, it is important they are in a condition where they can be essentially self-maintaining. They should not have ditches and cross drains that require maintenance, nor should they have drainage structures that require regular maintenance. When considering reductions in maintenance levels from Level 2 to Level 1, consideration must be given to the work needed to place the road in such a condition that it can be self-maintaining. Work required may include reshaping to an outsloped configuration, removing culverts and fills, or replacing culverts with rock-armored dips or rock fills. All of the considerations discussed above require site-specific and detailed analysis on a road-by-road basis.

Reconstruction: Annual maintenance costs may be reduced by reconstructing roads that are currently maintained in an inslope-ditch-crossdrain configuration to an outsloped template where road surface drainage is dispersed over the full length of the road prism, rather than being concentrated into ditches and discharged via crossdrains. An outsloped template not only reduces maintenance needs, it also typically minimizes the adverse impacts often associated with the concentration of surface runoff. The costs associated with reconstruction to outslope a road are substantial and often cannot be justified on an economic basis alone. It should be noted that not all insloped roads are candidates for reconstruction to outslope. On roads where public use during adverse weather conditions is routinely expected or encouraged, safety issues may recommend against an outsloped configuration. In almost all other cases, however, an outsloped road template is the least-cost and least-impact design alternative.

Decommissioning: Maintenance costs may be reduced through the elimination of unneeded roads. The identification of unneeded roads is best accomplished on a road-by-road basis at the project or watershed scale of analysis. When evaluating candidate roads for decommissioning, careful consideration must be given to public and administrative needs. These needs must be weighed against the savings to be realized through the elimination of future maintenance costs and the benefits to be realized through the reduction in impacts to other forest resources. In addition, the specific work needed and the costs associated with decommissioning need to be assessed, as well as the likelihood of obtaining funding to accomplish the needed work.

Managers will need to utilize site-specific information for each road in order to weigh access needs against resource risks in identifying opportunities for road projects.

The following is a list of opportunities for road management activities that can address conflicts. Definitions are included in the Glossary at the end of this document.

- New Road Construction
- Travel Restrictions
- Traffic Management
- Change in Maintenance Level

- Road Decommissioning
- Road Maintenance
- Road Reconstruction:
    a. Road Improvement – Methods include:
        1. reestablishing former drainage patterns, removing inboard ditches, outsloping road surface, minimizing hydrologic influence of road;
        2. minimizing mass wasting hazards, reducing or stabilizing road fills, armoring or reconstruction of fills with large composition materials;
        3. minimizing road width;
        4. surfacing road bed with erosion resistant material;
        5. upgrading crossings to pass 100 year flows and associated debris, restoring fish passage
    b. Road Realignment

Implementing the standard mitigation measures of the forest plan and/or the deferred maintenance identified in the deferred maintenance surveys will bring the road system in line with the forest plan direction and strategic intent of the road system.
The *Forest Plan* provides overall guidance for the road system on the Green Mountain National Forest as well as area specific direction.

Road Management and the Forest Plan

Major Areas of Concern include:

- Construction of new roads
- Road Maintenance
- Recreational use of roads

FOREST PLAN DIRECTION:

The present Forest Plan outlines a number of goals set forth to determine the transportation system needs for the Forest. Analyses were done for each Opportunity Area during subsequent planning efforts after the plan was published. The analysis covered some of the following subjects (Forest Plan 4.76 - 4.78):

- Road management objectives and design criteria
- Cost efficiencies
- Road obliteration after use
- Maintenance
- Access issues
- Gate locations

Recreational standards and guidelines for roads also were included in the Plan. Standards and guidelines covered such areas as (Forest Plan 4.39 - 4.58):

- Visual concerns
- Surfacing materials
- Road/trail density
- Motorized vs. non-motorized.

CURRENT INFORMATION & MONITORING:

New road construction has decreased in the years since the current Forest Plan was adopted (1987). This is due in part to a decrease in the number of timber sales overall and the amount of road access most of the forest has in place. Also, Management Area designations have limited the amount of road-building that could be done overall. Many current timber sales use existing roads and/ or create temporary winter log truck roads that need very little surface preparation due to frozen ground conditions during their use.

In 1999, a new Forest Service road policy was enacted. This policy was intended to prevent road development in inventoried roadless areas and required National Forests to complete a thorough road analysis process. This process is to determine the minimum road system needed, establish transportation management objectives and priorities and identify any unneeded roads.

Road maintenance is an important component of retaining safe access to the Forest. Some roads have been closed or access reduced due to lack of road maintenance funds or management decisions to limit motorized access. Some roads are more expensive and difficult to maintain than others. These factors as well as resource impacts and level of use play a part in the road system planning process. Recreationists are the main users of the Forest road system although when timber sales take place, monies are also allocated for road maintenance.

6) Are additional roads or improved roads needed to improve access for forest use or protection, or to improve the efficiency of forest use or administration?

Construction or acquisition of new roads is expected to be minor and principally in areas of: (1) providing access to private inholdings; (2) realignment of existing roads; (3) construction of temporary roads under special use permit or to support resource projects; (4) classifying existing unclassified roads and moving them onto the Forest Transportation System; and (5) acquisition of cooperatively managed roads. No new construction is necessary for the proposed Maintenance Level 3, 4 & 5 road system; however, road improvements may be warranted if service level are increased. With regard to the secondary roads (ie., level 1-2), the principal focus of the agency will be to determine if they are essential for public or agency use. If so, emphasis may be placed on upgrading them for forest use, efficiency and resource protection. If they are determined to be unneeded, they should be removed from the system and decommissioned. Areas with high road density frequently correspond with multiple ownerships and cooperatively managed road networks. These areas have the potential for significant road improvement and warrant completion of watershed level roads analyses.

Access for Research, Inventory and Monitoring:
The current Class 3, 4 and 5 road system does provide adequate access to opportunities on the Forest for research, inventory, and monitoring. Research tends to be the opportunity most limited by access on the GMNF. Most access to research sites, such as existing and potential RNA's, is via trails or Class 1 or 2 roads that branch off of higher maintenance roads. While researchers have on occasion been frustrated by the poor access to some of these unique research areas, they understand that what makes them unique in many respects is their remoteness, and that their relative inaccessibility has limited the impacts that humans have had at these sites. Consequently, some researchers have sought research opportunities in other parts of the Forest that are not specifically designated for research, and where there is useful road access. Forest Health Monitoring plots are examples of this kind of research, as is the Beaver Meadows Whole Tree Harvesting Research Project in Ripton. Various studies of

regeneration, planting techniques and other silvicultural questions have been undertaken over the years successfully within the current road system.

All of the system roads are used to access the landbase to conduct silvicultural inventories. The limits to the extent of the road system often mean less inventory can be accomplished in a day due to slow driving on jeep trails and long hikes into sites, and often can require a four-wheel drive vehicle. However, our inventories appear to be keeping pace with the need to accomplish resource improvement projects, as such projects themselves can also be limited by access.

Forest system roads play a vital role in facilitating Forest Plan monitoring for wildlife and plant resources. For example, in the North half of the Forest, portions of Forest Roads 67, 54, 59, 229, and 42 are used every year to conduct monitoring surveys for Management Indicator Species such as barred owl, American woodcock, and ruffed grouse. Forest Roads 100 and 5, among other lower maintenance class roads, have been used recently to access skid trails and woods roads (e.g. high clearance roads) for woodland bat monitoring. Because this type of monitoring requires a great deal of bulky and heavy equipment, access via the road system has been critical. While some rare species monitoring is facilitated by the road system (e.g. woodland bats, Appalachian jacob's ladder in roadside ditches), most is not as the species we know of tend to be found away from roads. Access via system roads has also facilitated deer population surveys (pellet-group counts) that provide information for making project planning decisions and forest-wide population estimates.

Forest system roads have also been a useful target for monitoring of invasion by noxious weeds and other pests, as these roads often have roadside, trailhead, and destination parking that serve as new entry or establishment points for some invasive species. These sites are easy to monitor and may provide the Forest with an opportunity to catch an invasion before it gets out of control.

Fire and Law Enforcement:

The current road system on the Green Mountain National Forest provides adequate coverage for fire suppression and law enforcement efforts. Additional or improved roads are not needed to improve efforts now or in the foreseeable future.

Step 6 Reporting

Purpose and Products

The purpose of this step is to:

- Report the key findings of the analysis

The products of this step are:

- A report including maps, analyses, and text documentation of the roads analysis
- Maps that show the data and information used in the analysis, and the opportunities identified during the analysis

Report

This report will be reviewed by the personnel from Green Mountain NF and shared with other offices in the Forest Service that are also working on roads analysis. This report will be available to the public upon request and posted on the Green Mountain and Finger Lakes National Forest web page.

Maps

All maps used for this report are included in Appendix A.

Map 1	Class 3, 4 or 5 North Jurisdiction
Map 2	Class 3, 4, or 5 South Jurisdiction
Map 3	Stream Crossings North
Map 4	Stream Crossings South
Map 5	Roads Near Streams North (300 feet)
Map 6	Roads Near Streams South (300 feet)
Map 7	Road Surface Type (3,4,5) North
Map 8	Road Surface Type (3,4,5) South
Map 9	Road Surface Type (All Roads) North
Map 10	Road Surface Type (All Roads) North
Map 11	Wetlands North
Map 12	Wetlands South
Map 13	Rare Threatened and Endangered Species North
Map 14	Rare Threatened and Endangered Species South
Map 15	Recreation Sites North
Map 16	Recreation Sites South
Map 17	Snowmobile Trails North

Map 18 Snowmobile Trails South
Map 19 Trails North
Map 20 Trail South
Map 21 Class 3, 4 or 5 and Deeryards North
Map 22 Class 3, 4 or 5 and Deeryards South
Map 23 In Holding North
Map 24 In Holding South
Map 25 Management Units North
Map 26 Management Units South
Map 27 Gravel Pits North
Map 28 Gravel Pits South
Map 29 Suitable Stands North
Map 30 Suitable Stands South

Glossary

Access and Travel Management (ATM) - A design and implementation of objectives, strategies, prescriptions, and operation plans for providing access and travel opportunities in the forest. It is not a new idea or process. ATM considers and coordinates all resource needs, user groups, modes of travel, economic and legal issues, traffic and safety requirements, and agrees with both National and Regional policy using the Forest's ATM Guide in conjunction with the Forest Land & Resource Management Plan as a guiding document. ATM is dynamic, for it constantly responds to changing public, economic, land and resource management needs.

All-Terrain Vehicle (ATV) - A vehicle able to negotiate most kinds of terrain through traction devices such as wide tracts, large low-pressure rubber tires, and/or four-wheel drive *(see ORV).*

Anthropogenic - factors related to human influences or effects

Archaeological sites - typically the material remains of ancient native inhabitants, but can also be historic sites.

Arterial Roads - Primary travel routes that provide service to a large land area. They usually connect with public highways, or other Forest Service arterial roads.

Benefit/cost ratio - A measure of economic efficiency computed by dividing total discounted primary benefits by total discounted economic costs

Closed Travelway (Road) - A road on which all vehicle traffic has been excluded by natural blockage, barricade, regulation, or by obscuring the entrance. A closed travelway is still an operating facility on which traffic has been removed (year-long or seasonal) and remains on the Forest Development transportation system. Closed travelways have two general categories: regulated use and restricted use.

Regulated Use (Gated Roads)

"Seasonally Open" : These roads are closed part of the year to publics with a gate, sign or other device for purposes of wildlife management, recreation use or other resource management reasons. While some may be maintained for passenger cars, most of these roads are maintained for high-clearance vehicle use. In those cases where resource management or access and travel plans have identified an administrative need, such as user conflicts, safety hazards, fire control or special use access, the road will still be maintained, but closed with a gate or other removable device. Prohibited use signs will be posted on these devices.

Restricted Use

"Closing Naturally": These roads serve no identified access need, and are not causing resource damage. Therefore, they do not require immediate closure with some sort of

device. Closure will occur gradually. The road will first be stabilized; however, brush will not be cut or slumps and rockfall removed unless resource damage is occurring. The lack of maintenance will eventually result in the road becoming impassible to motor vehicles.

"Closed With A Device": These roads are closed to all designated traffic year-round, but will remain on the road system for potential use in the future. Access is controlled by permanent devices or a natural barricade. Prohibited and allowed uses are signed. These roads will also be stabilized.

Code of Federal Regulations (CFR) - Contains traffic management and traffic engineering requirements that the Forest Service must follow in the management and operation of national forest roads

Collector Roads - Roads that serve small land areas and usually connect with National Forest arterial roads or public highways. They collect traffic from local roads and terminal facilities.

Cooperative Work Forest Service (CWFS) Funds – The acceptance of contributions for deposit in the US treasury, available for expenditure by the Forest Service for road maintenance.

Cultural properties - locations of traditional cultural activities of indigenous people and their descendants.

Decommissioned Road - To remove those elements of a road that reroute hill slope drainage and present slope stability hazards. The road is stabilized to reduce potential for storm damage and the need for maintenance. The road's travelway is no longer suitable for travel. Decommissioning includes putting a road in storage (storm proofing with dips, berms, waterbars etc) for later use, or in some cases the road is obliterated (restoring the hydrologic function of the ground by decompacting the road surface, removing fills and culverts, revegetating etc) to never be used again.

Developed Recreation - Recreation that requires facilities, resulting in concentrated use of an area. An example of a developed recreation site is a campground. Facilities might include roads, parking lots, picnic tables, toilets, drinking water, and buildings.

Drainage - In this document, drainage refers to a culvert, which is a conduit or passageway under a road, trail or other facility.

Dispersed Recreation - A general term referring to recreation use outside developed recreation sites. This includes activities such as scenic driving, hiking, bicycling, backpacking, hunting, fishing, snowmobiling, horseback riding, cross-country skiing, and recreation in primitive environments.

District - (Ranger District). A geographic administrative subunit of the Forest.

Ecosystem - A complete, interacting system of organisms considered together with their environment--*e.g.*, a marsh, a segment of a stream, or a lake.

Ecosystem Management - Using an ecological approach to achieve the multiple-use management of National Forests and Grasslands by blending the needs of people and environmental values in such a way that National Forests and Grasslands represent diverse, healthy,

productive, and sustainable ecosystems.

Environmental Assessment (EA) - A systematic analysis of site-specific activities used to determine whether such activities have a significant effect on the quality of the human environment and whether a formal environmental impact statement is required; and to aid an agency's compliance with the National Environmental Policy Act when no environmental impact statement is necessary.

Emergency Relief for Federally Owned Roads (ERFO) – ERFO funds to repair catastrophic failure of federally owned roads. This does not include failures resulting from structural deficiencies or normal physical deterioration.

> **ERFO Funds** – Emergency relief funds available for expenditure under the authority of 23 U.S.C. 125(a) and (c).
>
> **ERFO Projects** – Projects funded partially or entirely with ERFO funds.

External Benefits - a positive impact caused by the agency benefiting some other party without requesting payment, such as enhanced property values.

External Costs - cost is one caused by the agency and imposed on some other party without compensation, such as polluting water, or degrading scenic beauty. In this same token external benefits such as enhanced property values were also not investigated.

Federal Highway Administration (FHWA) **-** The federal public road authority responsible for federal highways to be open to pubic travel and commerce.

Financial Efficiency - The usefulness of costs to produce outputs. In measuring financial efficiency, costs are limited to those that can be valued in an open market.

Forage - All browse and non-woody plants harvested for feed or available to livestock or wildlife for grazing.

Forest Plan - The Green Mountain National Forest Land and Resource Management Plan which "...provide(s) 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."

Forest Roads - As defined in Title 23, Section 101 of the United States Code (23 U.S.C. 101), any road wholly or partly within, or adjacent to, and serving the National Forest System and which is necessary for the protection, administration, and utilization of the National Forest System and the use and development of its resources.

Forest Service Manual (FSM) - A manual that provides a unified system for issuing, storing, and retrieving all continuing direction that governs Forest Service programs and activities. The manual sets forth legal authorities, management objectives, policies, responsibilities, delegations, standards, procedures and other instructions that are continuing and that apply to or are needed by more than one unit.

Forest Transportation Facility - A classified road, designated trail, or designated airfield, including bridges, culverts, parking lots, log transfer facilities, safety devices and other transportation network appurtenances under Forest Service jurisdiction that is wholly or partially within or adjacent to National Forest System lands (36 CFR 212.1).

Guideline - A policy statement that is not a mandatory requirement (as opposed to a standard, which is mandatory).

Heritage Resource - Any definite location of past human activity identifiable through field survey, historical documentation or oral evidence. This includes archaeological and architectural sites or structures, and places of traditional cultural or religious importance to specified groups whether or not represented by physical remains.

Highway Safety Act of 1966 (P.L. 89-564) - Directs states and participating agencies to identify and survey accident locations; to design, construct, and maintain roads in accordance with safety standards; to apply sound traffic control principles and standards; and promote pedestrian safety. This Act applies to forest roads that have operation and maintenance levels of "3" to "5" (roads suitable for passenger cars).

Hydrologic - Describing quantity, quality and timing of water yield.

Inholding - Land belonging to one landowner that exists within a block of land belonging to another. For example, small parcels of private land exist within national forest boundaries.

Interdisciplinary Team (IDT) - A group of individuals with varying areas of specialty assembled to solve a problem or perform a task. The team is assembled out of recognition that no one discipline is sufficiently broad enough to adequately analyze the problem and propose action.

Key Watershed - A term in the President's Forest Plan for a watershed containing (1) habitat for potentially threatened species or stocks of anadromous salmonids or other potentially threatened fish, or (2) greater than six square miles with high-quality water and fish habitat.

Landing - Any place on or adjacent to a logging site where logs are assembled for further transport.

Long Term - In the context of these guidelines, 10 years and beyond.

Monitoring - The process of collecting information to evaluate if objectives and anticipated or assumed results of a management plan are being realized or if implementation is proceeding as planned.

Maintenance Levels - Defines the level of service provided by, and maintenance required for, a specific road, consistent with road management objectives and maintenance criteria:

> *Maintenance Level 1* - Assigned to intermittent service roads during the time they are closed to vehicular traffic. The closure period is one year or longer. Basic custodial maintenance is performed.

Maintenance Level 2 - Assigned to roads open for use by high clearance vehicles. Passenger car traffic is not a consideration.

Maintenance Level 3 - Assigned to roads open and maintained for travel by a prudent driver in a standard passenger car. User comfort and convenience are not considered priorities.

Maintenance Level 4 - Assigned to roads that provide a moderate degree of user comfort and convenience at moderate travel speeds.

Maintenance Level 5 - Assigned to roads that provide a high degree of user comfort and convenience. Normally, roads are double-lane and paved, or aggregate surfaced with dust abatement.

Management Area - For purposes of this guide, geographic areas designated or described by certain resource and land allocations contained in current Forest Plan and subsequent area or landscape plans.

National Environmental Policy Act (NEPA) of 1969 - An Act to declare a National policy which will encourage productive and enjoyable harmony between humans and the environment, to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of humanity, to enrich the understanding of the ecological systems and natural resources important to the nation, and to establish a Council on Environmental Quality. (The Principal Laws Relating to Forest Service Activities, Agriculture Handbook No. 453, USD, Forest Service, 359 pp.)

National Forest Management Act (NFMA) - A law passed in 1976 as an amendment to the Forest and Rangeland Renewable Resources Planning Act, requiring the preparation of forest plans and the preparation of regulations to guide that development.

The National Fire Management Analysis System (NFMAS) - A formal process that provides a consistent and objective method for estimating the efficiency and effectiveness of alternative fire protection programs using an economic efficiency criterion.

Net Public Benefit - An expression used to signify 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 rather than a single measure or index.

Obliteration- Restoring the hydrologic function of the ground by decompacting the road surface, removing fills and culverts, re-vegetating, or other actions with the intent that the road will not be used again.

Off-Road Vehicle (ORV) - Any motorized track or wheeled vehicle designed for crosscountry travel over natural terrain (*e.g.*, motorcycles, all-terrain vehicles, four-wheeled drive vehicles, and snowmobiles *(see also ATV)*).

Partnership - In the context of these guidelines, partnerships are those alliances between

individuals, groups and/or the Forest that enable road and trail maintenance or monitoring activities beyond those required for resource management access. Partnerships: 1) Foster good stewardship within the land management plan; 2) Are not exclusive but serve publics at large; 3) Benefit all parties involved.

President's Forest Plan (4/94) - Option 9 of FEMAT. Alternative 9 and the preferred alternative of the DSEIS. Sometimes referred to as the Forest Plan, (not to be confused with the National Forest Management Act of 1976 (NFMA) definition of a Forest Plan).

Project - An organized effort to achieve an objective, identified by location, activities, outputs, effects, and time period and responsibilities for execution.

Public Involvement - A Forest Service process designed to broaden the information base upon which agency decisions are made by (1) informing the public about Forest Service activities, plans and decisions, and (2) encouraging public understanding about and participation in the planning processes leading to final decision making.

Recreation Opportunity Spectrum (ROS) - Land delineations that identify a variety of recreation experience opportunities. They are categorized into six classes: Primitive, Semiprimitive Nonmotorized, Semi-primitive Motorized, Roaded Natural, Rural, and Urban.

Restricted Use - Restricted use is a passive form of facility management relying on (1) voluntary user compliance with signs provided at or on the facility, or (2) commercial user compliance with contractual requirements outlined therein.

Riparian Area - A geographic area containing an aquatic ecosystem and adjacent upland areas that directly affect it. This includes floodplains, woodlands, and all areas within a specified distance from the normal line of high water of a stream channel or from the shoreline of a standing body of water.

Road - A general term denoting a facility for purposes of travel by vehicles greater than 50 inches in width. Includes only the area occupied by the road surface and cut and fill slopes (FSM 2355.05). Types of roads include:

> *Classified Road*: Roads wholly or partially within or adjacent to National Forest System lands that are determined to be needed for long-term motor vehicle access, including State roads, county roads, privately owned roads, National Forest System roads, and other roads authorized by the Forest Service (36 CFR 212.1).
>
> *Unclassified Road:* Roads on National Forest System lands that are not managed as part of the forest transportation system, such as unplanned roads, abandoned travelways, and off-road vehicle tracks that have not been designated and managed as a trail; and those roads that were once under permit or other authorization and were not decommissioned upon the termination of the authorization (36 CFR 212.1).
>
> *Forest Highway*: A forest road open to public travel, and under the jurisdiction and maintenance of a public road authority. The Forest Service is not a public road

authority (23 USC 660.105).

Primary Road: High standard through-routes, arterial linkages, Scenic Byways. These will handle the majority of Forest visitor and other travel needs. They will be maintained at levels that safely accommodate low-clearance vehicles (typically a passenger car).

Secondary Road: Key inter-forest connections to interior recreation, forest management and fire response. These connect trailheads, project sites, special use areas, research areas, development sites, or private lands to the primary road network.

Temporary Road: Roads authorized by contract, permit, lease, other written authorization, or emergency operation not intended to be a part of the forest transportation system and not necessary for long-term resource management (36 CFR 212.1).

Non-System Travelway (Ghost Road): A road within the National Forest System that is not necessary to protect, administer, or use the national forest system or its resources. (An example might be a permanent road to access private inholdings.) This can also include trails.

Road Decommissioning: Activities that result in the stabilization and restoration of unneeded roads to a more natural state (36 CFR 212.1), (FSM 7703).

Road Improvement: Activity that results in an increase of an existing road's traffic service level, expands its capacity, or changes its original design function.

Road Realignment: Activity that results in a new location of an existing road or portions of an existing road and treatment of the old roadway (36 CFR 212.1).

Traffic Service level: Describes the significant characteristics and operating conditions of a road (FSH 7709.56, ch.4).

Bridge: A road or trail structure, including supports, erected over a depression or an obstruction, such as water, a road, a trail, or railway, and having a deck for carrying traffic or other loads.

Roadless Area - Areas identified during the Roadless Area Review and Evaluation process (RARE II) which have no roads and are at least 5,000 acres in size.

Roadsheds - Large blocks of land separated by major highways (in this case they are all state highways).

Road Management Objective (RMO) - Defines purpose, use, operational and maintenance level of road based on resource management and access and travel management objectives.

Road Upgrading - Includes erosion controls, road surface treatment to prevent dust and erosion, installing larger culverts and stabilizing fill slopes.

Short Term - In context of these guidelines, less than 10 years.

Stabilization - A process to slope, dip and waterbar travelways thereby reducing run-off concentrations and alleviating the risk of erosion and landslides if designed drainage structures fail to carry storm runoff. This also includes grass seeding slopes. Unstable fill embankments that exceed the required travelway may be partially or fully removed.

Stormproofing - *See "Stabilization."*

Threatened Species - A plant or animal identified and defined in accordance with the 1973 Endangered Species Act and published in the Federal Register.

Travelway - A way for passage of vehicles, conveyances, persons, or domestic livestock (stock driveways & horse trails), developed by construction or use.

Transportation System - Roads, trails, waterways, and airways used to access forest.

TSPIRS - An accounting process developed jointly by the General Accounting Office and the Forest Service at the direction of Congress. The TSPIRS accounting system and the resulting report are intended to provide the Forest Service, Congress, and the public with an accurate statement of the cost and benefits of managing the national forest timber.

Viewshed - The landscape that can be directly seen from a viewpoint along a transportation corridor.

Watershed - The drainage basin contributing water, organic matter, dissolved nutrients and sediments to a stream, lake or river.

Watershed Analysis (WA) - Identifies key processes, functions and conditions within a watershed and describes past and current conditions and trends. This is an analytical process, which creates a tool to help identify and prioritize actions that implement Forest plans. Watershed analysis is ecosystem analysis at the watershed scale.

Water Barring - Berm or ditch-and-berm combination cutting across roads (and trails) at an angle such that all surface water running on the road and in the road ditch is intercepted and deposited over the outside edge of the road. These normally allow high clearance vehicles to pass.

Watershed Restoration - Improving current conditions of watersheds to restore degraded fish habitat and provide long-term protection for aquatic and riparian resources.

References

Federal Register. 2001. FSM 1920-Land & Resource Management Planning, Chapter 1920, Section 1920.5. Department of Agriculture, Forest Service, Forest Transportation System. Federal Register, Vol 66, No. 9, January 12, 2001.

USDA-FS(U. S. Department of Agriculture-Forest Service). 1999. Roads Analysis: Informing decisions about managing the National Forest Transportation System. Misc. Rep. FS-643. Washington, D.C.: U.S. Dept. of Agriculture Forest Service. 222 p.

Deller, MaryBeth. 2002. Polemonium van-bruntiae Britton (Appalachian Jacob's ladder) New England Plant Conservation Program Conservation and Research Plan for U. S. Forest Service Region 9. New England Wild Flower Society, Framingham, Massachusetts, USA.

Thompson, E.H. and E.R. Sorenson. 2000. Wetland, woodland, wildland: a guide to the natural communities of Vermont. The Nature Conservancy & the Vermont Department of Fish & Wildlife, University Press of New England, Hanover, NH.

Cogbill, C.V. 2000. Vegetation of the presettlement forests of northern New England and New York. Rhodora 102: 250-276.

Cogbill, C.V. 2002. Presentation on Forest History and Current Conditions, Vermont Wildlife Habitat Forum, October 4, 2002, Montpelier, VT.

Bennett, A.F. 1991. Roads, roadsides and wildlife conservation: a review. PP. 99-118 in: Saunders, D.A.; Hobbs, R.J. (eds). Nature conservation 2: The Role of corridors. Surrey, Beatty and Sons, Victoria, Australia.

Bowles, A.E. 1995. Response of wildlife to noise. Pages 109-156 in Knight, R.L.; Gutzwiller, K.J. (eds). Wildlife recreationists. Washington, DC: Island Press

Forman, R.T.T.; Hersperger. A.M. 1996. Road ecology and road density in different landscapes, with international planning and mitigation solutions. PP. 1-23 in Evink, G.; Garrett, P.; Berry, J. (eds). Proceeding, Transportation and wildlife: reducing wildlife mortality and improving wildlife passageways across transportation corridors, Florida Dept. of Transportation/Federal Highway Administration transportation-related wildlife mortality seminar, April 3- May 2, 1996, Orlando, Florida.

Gucinski, H.; Furniss, M.J.; Ziemer, R.R.; Brookes, M.H. (eds.). 2000. Forest Roads: A synthesis of scientific information. USDA, Forest Service.

Hammond, F.M. 2002. The effects of resort and residential development on black bears in Vermont. Vermont Agency of Natural Resources, Department of Fish and Wildlife.

Hodgman, T.P.; Harrison, D.J.; Katnik, D.D.; Elowe, K.D. 1994 Survivial in an intensively trapped marten population in Maine. Journal of Wildlife Management 58(4): 593-600.

Hunter, Malcolm L., Jr. 1990.
WILDLIFE, FORESTS, AND FORESTRY. PRINCIPLES OF MANAGING FORESTS FOR BIOLOGICAL DIVERSITY. ***Prentice Hall***, 370p.

Kohm K.A.and Franklin J.F. 1997. Creating a forestry for the 21st Century. The science of ecosystem management. Island Press, Washington.

Mader, H.J. 1984. Animal habitat isolation by roads and agricultural fields. Biological Conservation 29:81-96.

Mladenoff, D.J.; Sickley, T.A.; Haight, R.G.; Wydevens, A.P. 1995. A regional landscape analysis and prediction of favorable gray wolf habitat in the northern Great Lakes Region Conservation Biology 9(2):279-294.

Murcia, C. 1995. Edge effects in fragmented forests: implications for conservation. Trends in Ecology and evolution 10:58-62.

Trombulak, S.C., Frissell, C.A. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. Conservation Biology 14:18-30.

Appendix A

Maps