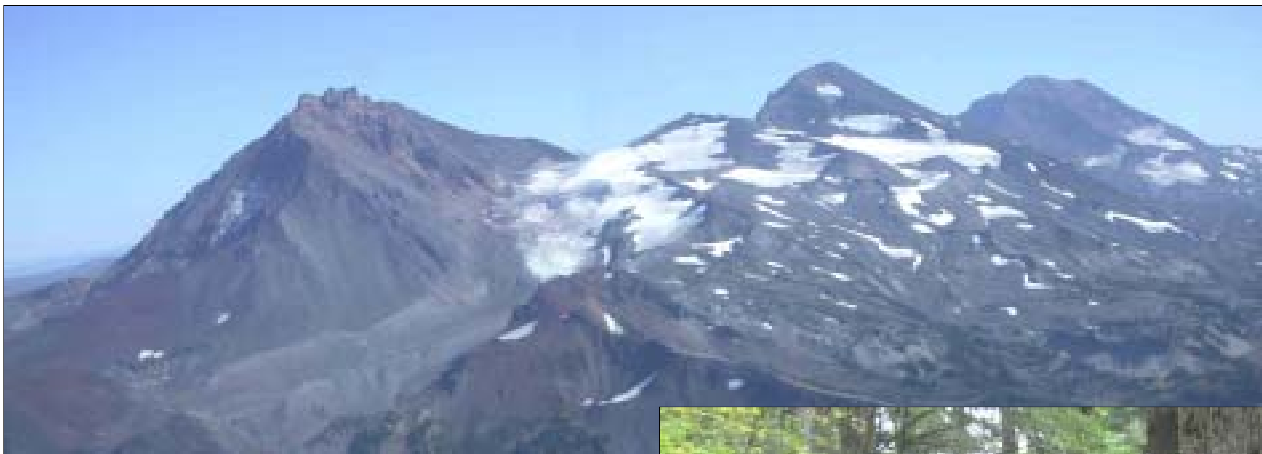
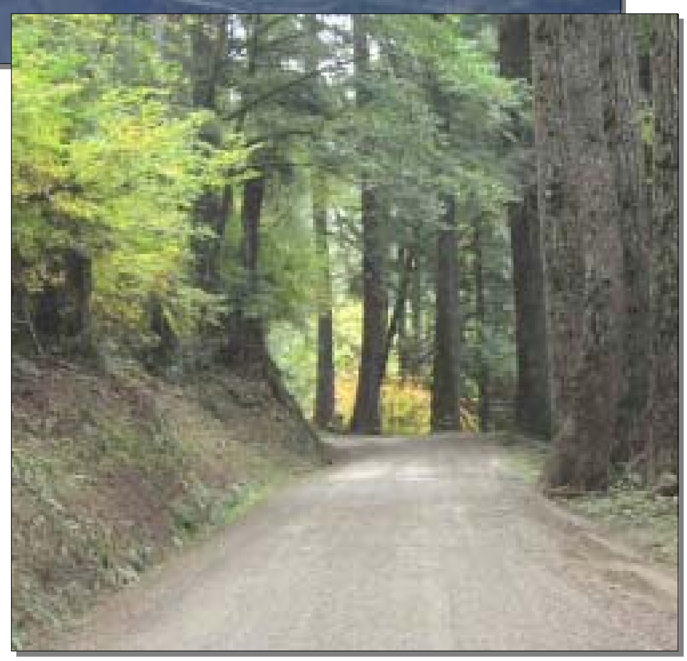
Willamette National Forest

Road Analysis Report





January 2003

FORWARD

Willamette National Forest
Forest Roads Analysis

January 2003

In July 1998 the Willamette National Forest was one of six National Forests selected to test different approaches to analyzing and documenting an analysis of Forest Service roads. The approach the Willamette tested was a forest-scale analysis following a six-step process. The Forest completed the roads analysis in October 1998. In addition to the actual roads analysis, the final document also included a critique of the six-step analysis process. The review and critique aspect of the pilot project is evident in several sections of the following document.

In August 1999 the Forest Service publication, Misc. Rep. FS-643, Roads Analysis: Informing Decisions about Managing the National Forest Transportation System was released. This document described a road analysis procedure using essentially the same six-step process used in doing the Willamette National Forest Pilot Roads Analysis.

In January 2001 the Forest Service adopted a final policy for the national forest transportation system. Included in the final policy was a requirement that all road management decisions for National Forest System roads be informed by a scientific-based roads analysis. The six-step process described in FS-643 was used as an example of the type of scientific-based analysis process envisioned by the new policy. The 2001 transportation policy also required each national forest to complete a forest-scale roads analysis by January 13, 2003.

The roads analysis/forest interdisciplinary team has reviewed the roads analysis document several times since October 1998. In 1999 when publication FS-643 was released, the IDT reviewed the six step process with the process used for the pilot analysis and verified that the two process were very similar if not identical in most regards. In August 2001, based on concerns identified during the initial analysis regarding the availability of social information relating to forest roads, the social assessment, Appendix J, was updated. Most recently in 2002, the forest transportation system of Key Travel Routes or Key Forest Roads was updated to reflect adjustments in management emphasis, land allocations, etc. since the initial analysis in 1998. This update is found in the update section of the document and on an updated map.

The intent of the Willamette NF Management Team is to continue to maintain the Forest Roads Analysis as a “living document” by periodically reviewing and updating the documentation as needed. For this reason, the loose-leaf, three-ring binder style of document is used to more easily accommodate on-going updates and changes to the document.

Update - December 2002
Key Forest Roads

I. BACKGROUND

On June 27, 1995 the Willamette Access and Travel Management (ATM) Guide was implemented under a cover letter signed by the Forest Supervisor. The letter directed the forest to identify key forest travel routes as per the guidelines and selection criteria for what was referred to as the Primary/Secondary Transportation Network in the 1995 ATM guide. During the summer of 1995, the Primary/Secondary network was identified, reviewed, and adjusted with extensive input from the districts. It was made into a GIS map and distributed.

The 1998 Willamette Pilot Roads Analysis adopted the 1995 Primary/Secondary road system as the network of Key Forest Travel Routes (Section 4.1.4). The Roads Analysis identified that these roads are needed for long-term management of the National Forest. They are the priority roads that are maintained opened for vehicular traffic. They provide the long-term linkages and inter-forest connections necessary to meet forest management objectives. It stated that the long-term status of the remaining roads, not designated as a Key Route, would be evaluated at the project or watershed scale to determine whether they should remain as intermittent use roads or decommissioned. Such roads would be generally considered candidates for reduction in maintenance standards, stabilization, closure or decommissioning.

Seven years have passed since the system of Key Forest Roads was first identified. During May of 2002, the 1995 Primary/Secondary road system was reviewed, road-by-road, by each district and updated within the context of the Northwest Forest Plan and current transportation policy in FSM7700. The resulting system is now referred as the network of **"Key Forest Roads."** The old ATM nomenclature of "Primary" and "Secondary" are hereby dropped.

II. KEY FOREST ROADS: Not a Decision

Roads analysis is not a decision process. The objective of roads analysis is to provide line officers with critical information for the operation and maintenance of a safe and affordable road system that is responsive to public needs and meets land management objectives with minimal negative ecological effects on the land. The network of **Key Forest Roads**, therefore, does not represent a decision. It can be changed and adjusted over time to respond to changing circumstances such as budgets, land management objectives or other management opportunities.

III. BUDGET CONSIDERATIONS

The direction in FSM 7703 states that it is the policy to determine and provide for the minimum forest transportation system that best serves forest management objectives as identified in appropriate land and resource management plans. The policy also states that it is important that roads analysis consider access needs in relation to realistic funding levels. Based on funding levels and maintenance costs derived for the Pilot

Roads Analysis, there is a $1.2MM annual budget short fall if the network of **Key Forest Roads** are fully maintained to their current objective maintenance levels. See Table 1.

Though the network of **Key Forest Roads** is not the minimum transportation system from a budget standpoint, it is thought to be the minimum system of routes needed to meet anticipated forest management objectives and public access needs. It is likely that maintenance standards could be reduced on a portion of the **Key Forest Roads** and still meet forest management objectives. For example, the highest maintenance cost is $1.13MM for the object maintenance level 3 roads. Maintenance standards, and thus costs, of the level 3 roads (maintained for passenger cars) may be reduced to level 2 (maintained for pickup trucks). The forest-scale analysis is too broad to assess opportunities to change maintenance standards on specific roads, however this issue should be brought forward and evaluated during district, watershed, or project planning.

Table 1. Estimated Annual Maintenance Costs to Maintain Roads to Standard.

Maintenance Level Description	Forest Total Miles	Key Forest Roads Miles	*AM $/Mi	AM Needs for Current Forest Network	AM Needs for Key Forest Roads
1 - BASIC CUSTODIAL CARE (CLOSED)	751	4,025	$25/mile	$18,775	$100,625
2 - HIGH CLEARANCE VEHICLES	4,230	1,038	250	$1,057,500	$259,500
3 - SUITABLE FOR PASSENGER CARS	1,205	1,134	1,000	$1,205,000	$1,134,000
4 - MODERATE DEGREE OF USER COMFORT	113	108	1,900	$214,700	$205,200
5 - HIGH DEGREE OF USER COMFORT	244	238	3,750	$915,000	$892,500
	6,543	6,543		$3,410,975	$2,591,825

***Costs derived from maintenance contracts and force account costs for annual maintenance. Estimated annual maintenance funding level of $1.4. (See Section 4.2.2 of 1998 Pilot Roads Analysis.)**

IV. KEY FOREST ROADS: Selection Guidelines

The goal of the network of **Key Forest Roads** is to provide sustainable access to National Forest System lands for administration, protection, and utilization in a manner consistent with Forest Plan guidance and within the limits of current and likely funding levels.

Key Forest Roads are the roads most traveled to sites within the Forest. They will provide the majority of forest visitor, administrative, commercial, research and other travel needs. These roads will be identified as the key roads to important destination points and provide a network of vital inter-forest connections. They lead recreationists, resource managers, permittees, landowners, commercial users, and emergency services along direct routes into and across necessary areas of the Forest.

A **Key Forest Road** should be operated and maintained to standard consistent with its road management objective. The public will be encouraged to use the system of **Key Forest Roads** for access into and through the Forest.

There are two general categories of **Key Forest Roads**:

1. National Forest System roads that are subject to the Highway Safety Act (FSM 7705). These roads are generally open for use by the public for the standard passenger car. These roads are assigned an Objective Maintenance Level of 3, 4 or 5 as described in the Transportation System Maintenance Handbook (FSH 7709.58).

2. National Forest System roads that are not subject to the Highway Safety Act. These roads are generally rough and opened for use by high clearance vehicles such as the standard pickup truck. These roads are assigned an Objective Maintenance Level of 2 as described in the Transportation System Maintenance Handbook (FSH 7709.58).

Selection Guidelines for a **Key Forest Road** subject to the Highway Safety Act:

- Roads that connect high-use entry points or population centers and provide major access into and through the forest.

- Roads that link with state and county roads: Among road alternatives, select the one that favors the greatest use of state and county road systems.

- Roads that provide the most extensive linkage to roads open for use by high clearance vehicles.

- Roads that are designated as scenic byway or route.

- Roads that provide access to areas where high-use recreation is encouraged.

Selection Guidelines for a **Key Forest Road** not subject to the Highway Safety Act:

- Roads that give the best access to management areas outside the proximity of Key Roads suitable for passenger cars.

- Roads to project sites, research or management areas that cannot be accessed by short-term, temporary roads, or by means other than high clearance vehicles.

- Roads that extend state and county roads and give needed long-term access.

- Long-term roads with only periodic or seasonal restrictions.

- Roads that access developed sites, wilderness trailheads, multiple resource management areas, research areas, and special sites and facilities that require permanent vehicle access (for example fire lookouts, electronic communication sites).

- Long-term roads that are supported by cooperative share-cost agreements or other partnerships and open to public travel.

- Roads critical for long term administrative needs such as fire suppression.

- A single road selection from alternative routes to the same area, site or destination that will generate the least amount of negative resource impacts (An example is selecting a ridge-top road over one within a riparian zone that meets the same destination access needs).

- Roads under special use or road use permit.

VIII. NON-KEY FOREST ROADS

Roads that are not selected as a **Key Forest Road** will generally be candidates for some form of treatment that stabilizes their erosion potential and reduces their impact on the resources. These roads will be considered for closure, stabilization, or, if unneeded decommissioning. Their status will be determined with input from watershed, district, or project planning, NEPA, or as travel management plans are developed in response to local resource and social issues. Declining road maintenance budgets will also be a factor. Non-Key Forest Roads that pose an immediate threat to resources may require a physical barrier to eliminate traffic or may be decommissioned.

Errata Correction Sheet (02/09/2001)

Willamette National Forest

Pilot Road Analysis

Page 5 Executive Summary

1.2. Key Analysis Results and Findings

Second paragraph should read:

- Economics alone (financial efficiency) does not support large-scale road ~~closures or~~ decommissioning in spite of the current imbalance in funding available for road system management.

Appendix A: Economics Process Paper

Page A-5, Item 3 of the 5th paragraph should read:

3. To close the same road would cost $2,000 for closure, $100 a year in minimal maintenance. ~~and $1,600 expected every 10 years for repairs.~~

Page A-5, Item 3 of the 6th paragraph should read:

The goal is to find which scenario(s) prove to be financial viable over the next 20 years by requiring a 20 year discounted investment less than the no change alternative. Under the above assumptions, the no change scenario would require a discounted investment of $5,459. To decommission the same road would require an upfront investment of $10,000 with no additional expenses expected. The second scenario does not make sense to implement for solely fiscal reasons. It is far cheaper to maintain the road at $5,459 as opposed to spending $10,000 to decommission. To close the road would require a discounted investment of ~~$5,270~~ $3459. In other words it would be cheaper to close the road than to keep it open. ~~however, the two scenarios are very close~~.

Contents

Tables

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Maps

1. Executive Summary

This pilot study tests a proposed National Forest and Grasslands Road Analysis Process. Both the proposed road analysis and this pilot project are ***NOT*** decision-making processes. Road analysis is intended to be an assessment tool that is part of a systematic approach to Access and Travel Management (ATM) planning and decision-making. The ultimate decision process for ATM will also consider other elements and information, such as:

- Key Watershed restoration strategies and
- Collaboration with Tribes, local watershed councils and other local, state and federal agencies.

This pilot analysis will be reviewed in concert with five other National Road Analysis pilot reports to determine the final process which will be applied in Fiscal Year 1999 to all National Forests and Grasslands.

1.1. Background

The objective of this analysis is to furnish information that will help us manage a forest transportation system that:

- Is environmentally sound,
- Provides safe access and meets the needs of communities and forest users,
- Can be maintained within our current and projected financial abilities, and
- Facilitates the implementation of the approved Forest Plan direction.

Each National Forest and National Grassland has a unique history of how "their" forest roads and transportation system were developed. Public and community involvement in this development provides a rich history in and of itself that reflects the national, regional and local emphasis through the eras of conservation and environmental thought and decisions. This report reflects the development of the transportation system on the Willamette National Forest (NF) during the decades of intensive timber management. It also describes the existing condition of the transportation system and how it relates to current management objectives, which are significantly different from those in previous decades.

1.2. Key Analysis Results and Findings

The following results and findings are based on analyses documented in the appendices of this document.

- Economics alone (financial efficiency) does not support large-scale road closures or decommissioning in spite of the current imbalance in funding available for road system management.
- Natural resource factors, rather than questions of administrative or public use, are the drivers that identify Forest level observations. Priority setting for road management action needs to be integrated at the appropriate scale (sixth field subwatershed or larger) with completed Northwest Forest Plan watershed analysis recommendations; political, community, public existing agreements; and future interests in issues. The key natural

resource factors to consider on the Willamette NF in defining the future transportation system are fish, wildlife, water quality, and other ecological values.

- Interdisciplinary teams will need to develop a list of key natural resource factors and landscape/ecological data that can be used to sort and rank potential hazards created by the transportation system. In turn, this ranking can be used to identify and define priorities for further action. This information should be integrated with the other factors mentioned previously at the appropriate watershed and community scale for decision-making.
- Previous decisions made by Forest managers, such as defining the primary and secondary road network, should be revisited due to current Forest Plan allocation direction. The existing transportation system may no longer be consistent with management objectives and administrative needs (*e.g.,* Late Successional Reserves [LSRs]).
- Only a few of the existing unroaded areas (approximately 20%) are in land allocations or parts of the Forest where additional road access is needed to implement Forest Plan direction.

We lack key data and baseline analysis necessary for integrating and prioritizing social and community aspects and interests in the national road analysis process. From our Central Cascades Adaptive Management Area and project Access and Travel Management planning and public participation experience, we know collaboration is important and takes quality time spent with people representing all the affected interests. Each interest is specific in its views of the road system and how it should be managed within a watershed and community context.

It is also difficult to retrieve all road management agreements and easements in order to have the complete data set needed for transportation system decision-making. We are not able to retrieve this important data in the pilot analysis timeframe. We have cost-share road agreements and memorandum of understandings with Federally recognized Indian Tribes, Federal, State and local road management agencies. These all need to be factored into the analysis, adding complexity to the analysis process and timelines.

1.3. Next Steps

The results documented in this pilot road analysis will be reviewed by the National Road Analysis Team during the next few months, and will be used to refine the final national road analysis process expected to be available early in 1999.

In the interim, the Willamette NF has several opportunities or options to prepare for further road analysis based on the critique of this pilot effort.

1. Initiate an internal review of the data, methods of analysis and results with the District Rangers and staff. The report identifies some known data problems. Other concerns may be identified through District review. As these are identified, the Forest should undertake action to ensure that critical Forest databases are updated in preparation for the final road analysis process.
2. Develop a Forest level, GIS database of existing road agreements, such as easements and cost-share roads.

3. Develop a Forest strategy and methods for effective public involvement and collaboration that can be applied to future road analyses or Access and Travel Management planning at different scales. Consider prioritizing areas on the Forest for different degrees of collaborative efforts.
4. The resource specialists on the road analysis team could document and “package” analytical methods and tools used and developed in this pilot process, so those tools can be easily transferred and applied to road analysis at the watershed or subwatershed level. They could also be used to update the Forest level analysis when the national process is released.

1.4.

2. Introduction

2.1. Overview of National Forest Road Analysis Proposal

Land allocations, management strategies and the road maintenance budget have changed significantly during the past decade. It has been determined that road analyses are needed on all National Forests and Grasslands to better coordinate our road management programs. The analysis process will provide land managers with a science-based analytical tool to help balance public needs, scientific information and funding levels when determining the size, purpose and extent of future forest road systems.

The Willamette was one of six National Forests selected to test the draft road analysis process developed by the national Forest Service Team. The primary objective of this pilot testing was to assure that the final road analysis process can be implemented efficiently and effectively nationwide. Once pilot tests are completed on October 31, 1998, the draft process will be revised to address lessons learned during the testing phase. It will be subjected to a scientific peer review in early 1999 and suggestions for improvement in the process will be incorporated.

Road analysis is ***NOT*** a decision-making process. Rather it is designed to provide an assessment of the existing forest road system from a landscape perspective. It highlights problem areas and opportunities in the road system, so Forest Service land managers can make better management decisions regarding the transportation system on national forest lands.

While the lack of sufficient maintenance funding is ongoing and serious, it is very important that issues are assessed not only from the economic perspective, but also from social and ecological perspectives. The objective is to provide a safe and environmentally sound transportation system that meets people’s needs at a realistic and sustainable funding level.

2.2. Scope of this Analysis

A Forest-wide road analysis was completed, identifying pertinent ecological, social and economic issues and needs essential to making future decisions about the characteristics of the Forest transportation system. These issues and needs were used to identify road management opportunities that would improve characteristics of the Forest road system to balance the benefits of access with road-associated environmental effects, road management costs and social/community interests.

2.3. Purpose of the Pilot Road Analysis

This project was a pilot process, testing the efficiency of a process developed by a national Forest Service team. Its purpose was to not only perform the analysis but also provide recommendations to improve the analysis process. Pilot testing will assess whether the process is:

- Useful at the field level (at various landscape scales)
- Applicable across wide and diverse geographic areas and ecological conditions

- ✧ Usable by field units with diverse budges and expertise
- ✧ Usable by units with diverse natural resource management objectives
- ✧ Useful for analyzing both roaded and roadless lands
- ✧ Consistent with adaptive management by incorporating a feedback loop.

The process will be further modified based on the knowledge gained from field testing. Once the feedback from pilot tests is incorporated into the process, it will be ready for a rigorous scientific peer review.

3. Background and Context

3.1. Historical Context

The Willamette National Forest includes more than 6,300 miles of road. The road system has evolved over time, but the vast majority of roads were constructed from 1960 to 1990. The first roads built through the Willamette NF were routes across the Cascade mountains to move people and goods from east to west. These early roads followed existing trails used by indigenous groups for thousands of years. As transportation needs changed over time, the routes were reconstructed to higher standards. Trails were normally located along rivers and streams; consequently many of the main roads today are located in riparian zones.

In the early 1900s, road standards were developed calling for "truck trails" to be constructed nine feet wide. These roads were to exclude any excess width. The primary purpose for construction was to provide administrative access for fire protection. Although we don't have any records of these truck trails, they do not account for many of our road miles.

In the 1920s the Regions of the Forest Service were directed to undertake a transportation planning effort to determine the road system required for effective fire protection. Few roads were constructed during that era, but when the CCC was established, planned road projects were available for construction. Again, we have no records of roads built, but the number of miles was quite low.

In the late 1940s demand for timber products increased significantly. Congress began to appropriate large road budgets. Many of the mainline roads were designed and constructed by the Bureau of Public Roads, now the Federal Highway Administration. These roads were normally constructed to highway standards. The Forest Service was responsible for the construction of lower use project roads, such as the roads within a timber sale area. Often, the road location and standards were left to the timber purchaser's discretion. In the urgency to provide timber access, "many miles of primary timber access roads were hastily surveyed and constructed with insufficient attention to possible watershed damage and future requirements" (USDA, 1990c).

In the early 1950s the Forest Service began using strict geometric standards that set limits on grades and curves. Although designed to strict standards, construction practices often allowed slash to be buried within the roadway, a practice that would trigger future road failures as the slash decomposed. A Forest inventory from 1952 shows a total of 693 miles of road on the Willamette NF. Although many of these were main access roads, there is little comparison with the 6,300 miles currently in the inventory.

The vast majority of the roads on the Willamette NF were constructed from 1960 through 1990. During this period road standards and political interests varied significantly. From 1960 to 1976 strict geometric standards were used. When constructing these roads, excavations, often resulting in large road cuts and fills, were required to establish alignment and grade. After 1976 non-geometric design methods were used. With these methods, the road alignment and grade was adjusted to follow the existing contour of the ground as closely as possible, resulting in significantly less ground disturbance. Non-geometric methods are still currently in use.

In the late 1960s and early 1970s, road construction programs were quite large. To ensure that the Forest Service was receiving the quality of road paid for, an emphasis was placed on contract administration. A national training and certification program was developed to ensure that contract administrators were qualified and experienced.

The non-geometric design coupled with well-trained administrators significantly reduced problems associated with road instability. In the early 1980s, new road standards were implemented. These standards allowed the Forest to reduce ecological impacts by setting road standards based upon resource needs for roads. The standards allowed serviceability to be sacrificed in order to mitigate environmental impacts.

Reconstruction by timber purchasers was limited in the early 1980s due to the high cost of the road program. Although short lived, this limit on reconstruction significantly reduced the amount of mitigation funds for resurfacing roads. Loss of surfacing can lead to rutting, erosion, and ultimately sediment delivery to streams.

The Willamette has maintained a large reconstruction budget since the early 1970s. Through this program, many unstable areas associated with early road construction practices have been stabilized.

3.2. Roadless Areas – Historical Context

The issue of roadless areas gained prominence on the Willamette NF during the early 1950s, when forest management (timber harvest and road construction) began to intensify and the Chief of the Forest Service deleted a 53,000 acre area, known as French Pete, from the Three Sisters Primitive Area. Public concern about French Pete and other roadless areas within the Forest increased during the past 40 years. In addition, the issue of preserving roadless areas for their wilderness character and primitive recreation opportunities has expanded. It now includes concerns for providing adequate habitat to sustain viable populations of wildlife, fish, and plants; protecting sensitive soils and unstable lands to maintain water quality; and maintaining representative ecosystems of the region and nation. The Wilderness Act of 1964 resulted in a total of 254,744 acres of congressionally designated wilderness on the Willamette NF by 1968. These areas were mostly on the eastern edge of the Forest along the crest of the Cascade Mountains, many in the Primitive Areas.

Public interest and controversy surrounding roadless areas continued to grow in the 1970s, both on the Willamette (where French Pete continued to be a focal point) and at the national level. In 1971, a national review and evaluation of roadless areas on National Forests was initiated, commonly referred to as RARE I. Ten roadless areas on this Forest were identified in RARE I and over 5,000 comments were received just on the roadless areas of the Willamette. In 1973, the Chief of the Forest Service announced that 274 roadless areas nationwide would be studied for inclusion in the National Wilderness System, four of them on this Forest. None of the French Pete areas were included in these four. The final decision on RARE I was short-lived, however, as it was appealed by various environmental groups and the EIS (Environmental Impact Statement) was found to be inadequate. This resulted in a new review of the roadless areas, referred to as RARE II.

RARE II began in 1977 and, using new criteria, resulted in consideration of 624 roadless areas for wilderness inclusion nationwide, eleven on the Willamette. The French Pete controversy was resolved in 1978 with the passage of the Endangered Wilderness Act. The RARE II EIS was also challenged and determined to be inadequate. As a result, in 1984, the Oregon Wilderness Act added a large series of wildernesses on the Willamette, including Waldo Lake Wilderness, additions to Mt Jefferson, Mt Washington, Three Sisters and Diamond Peak. It also created two new wildernesses on the west side of the Forest in the lower elevations: Menagerie and Middle Santiam. This was a change from the other wildernesses, which are geographically associated with the high peaks of the Cascades. The 1984 Act also created the Bull of the Woods Wilderness, which overlapped both the Willamette and Mt. Hood National Forests.

The next review or evaluation of roadless areas on the Forest occurred in the late 1980s during the development of the Forest Plan. Thirty-one roadless areas (172,007 acres) were evaluated. A detailed discussion of each area's attributes and resource potentials was developed as Appendix C to the Forest Plan FEIS (Final Environmental Impact Statement). In addition to the 31 roadless areas, the Forest also identified 24 other unroaded areas ranging in size from 1,500 acres to 4,500 acres. These areas were too small for inclusion in the roadless area inventory, but were considered large enough to provide semi-primitive dispersed recreation opportunities. In the 1990 Forest Plan, 25 of the roadless and unroaded areas (85,768 acres) were allocated to land allocations that maintained semi-primitive, nonmotorized recreation opportunities.

The most recent changes to the roadless and unroaded areas on the Willamette occurred with the Northwest Forest Plan (a.k.a. The President's Plan) in 1994, which amended the Willamette Forest Plan. Opal Creek Wilderness legislation in 1996 created the Opal Creek Wilderness and established a scenic recreation area overlapping several large parcels of roadless and unroaded areas in the Little North Santiam watershed and the Opal Creek subwatershed.

The following table (Table 1) tracks the acres of roadless and wilderness on the Willamette NF from 1964 to 1990.

Table 1. Roadless and Wilderness acres from 1964-1990.

Classification	1964	1968	1973	1979	1984	1990
Wilderness	191,063	254,744	254,744	301,933	386,863	386,863
Roadless	Unknown	Unknown	357,127	301,227	210,207	172,007
Total Undeveloped	Unknown	Unknown	611,871	603,160	597,070	558,870

4.

5.

6. Current Situation

6.1. Road Statistics

6.1.1. Miles by Maintenance Level

There are 6,364 miles of Forest Development Roads (FDR) in the Willamette National Forest transportation inventory. Twenty five percent (25%) of the road system is in the Maintenance Level 3, 4, and 5 categories (maintained for standard passenger cars). Maintenance Level 2 (maintained for high clearance vehicles) accounts for 63% and 12% are roads currently closed to vehicular traffic (Maintenance Level 1) *(see Table 2 and Figure 1).*

Table 2. Miles of Forest Development Roads by Maintenance Level

Maintenance Level	Miles	Error (+ or -)
1. Closed Road	736	15%
2. Maintained for High Clearance Vehicles	4067	10%
3. Maintained for passenger car, low user comfort, aggregate surface	1191	5%
4. Maintained for passenger car, moderate user comfort	124	2%
5. High standard passenger car road, double lane paved	246	2%
Total	**6364**	

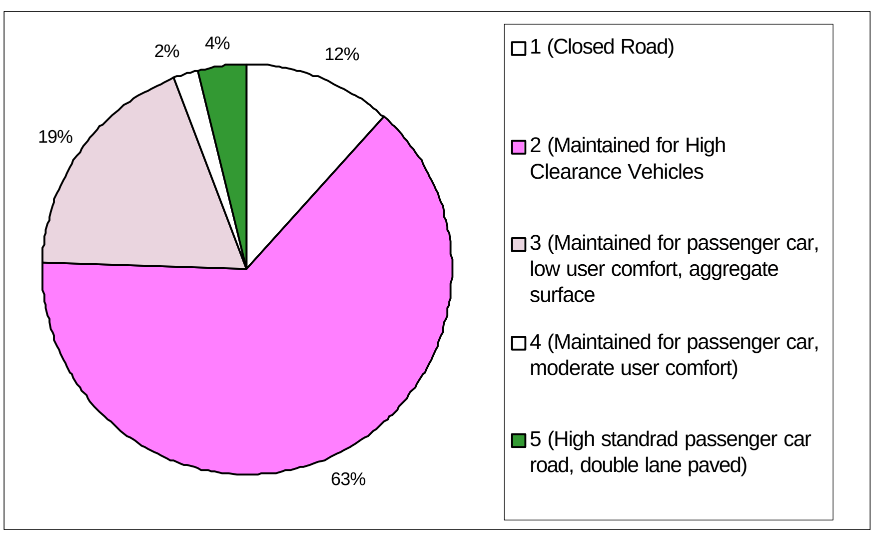


Figure 1. Miles of Road by Maintenance Level

6.1.2. Unclassified Roads

There are 360 miles of unclassified wheel tracks documented as GIS line segments on the TRAN Layer. It is thought that the actual miles of undocumented wheel tracks on the Forest are probably double that amount. In general, it is thought that unclassified roads have a low impact in terms of erosion and sedimentation. A recent road inventory of Coffeepot Head BGEA supports these assumptions *(see Economic Process Paper, Appendix A).*

Unclassified roads typically result from low-standard temporary roads built within the scope of timber sale contracts. Temporary roads are not recorded or mapped in the Forest database. After intended use, such roads are typically decommissioned but are often visible as primitive wheel tracks or show up as features in aerial photos. Unclassified roads also result from unauthorized off-road vehicle use to access dispersed recreation sites.

6.1.3. Data Accuracy

Numerous corrections and revisions have been made to the Transportation database (TMS) since 1992. However, mapping and database errors do exist. Table 2 gives an estimate of the current status of errors in transportation data (i.e. GIS map locations, mile totals, open or closed status, or road existence differing from actual field conditions). About 100 miles of road in the TMS do not have corresponding line segments on the GIS transportation map. Many of these roads are no longer apparent on the ground.

6.1.4. Key Forest Travel Routes

The primary/secondary road system was identified in a Forest-wide Access and Travel Management (ATM) analysis in 1995. These consist of 2,130 miles providing the key travel-routes needed for long-term management of the National Forest. They provide vital linkages to local communities, State and County Highways, private land ownership as well as furnishing inter-forest connections to trailheads and major recreation sites *(see Table 3).*

Table 3. Forest ATM Route Designation

ATM Designation	Miles
Primary (High standard through-routes, arterial linkages, Scenic Byways)	430
Secondary (Key inter-forest connections to interior recreation, forest management, fire response)	1,700
Local (Candidates for reduction of maintenance standards, decommissioning or obliteration)	4,234

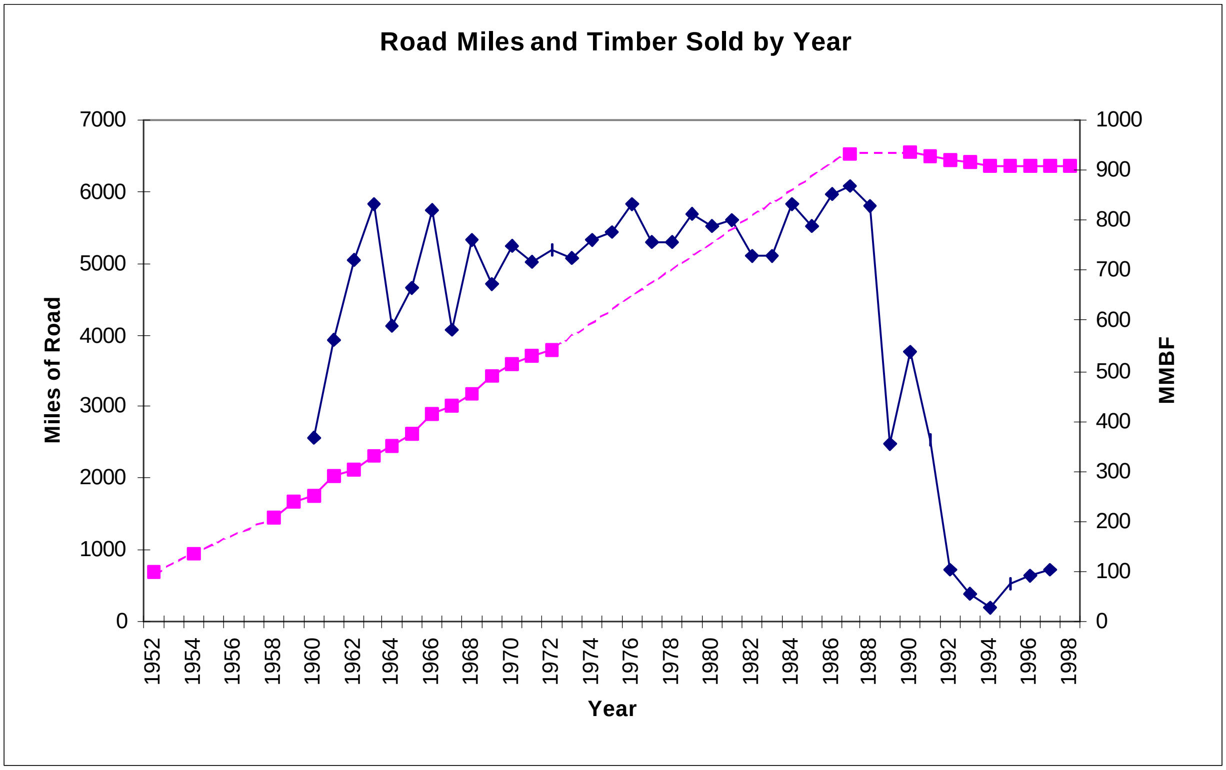
The remaining roads not designated as primary/secondary are generally local routes whose long-term status will be analyzed at the watershed or project scale. These routes are considered candidates for reduction of maintenance standards, decommissioning or obliteration.

6.2. Economic Situation

The range for direct road costs (such as maintenance, repair, closing, etc.) is large because actual costs are directly dependent on the unique characteristics of a particular road or road system, such as topography and soil type.

6.2.1. Background

Figure 2 illustrates the road-building trend on the Willamette National Forest from 1953 to



1998. New road construction averaged in excess of 100 miles per year between 1953 and 1989. These roads were primarily constructed to support timber-related land management objectives prior to the 1990 Willamette Forest Plan as amended by the NW Forest Plan. Each mile of constructed road is dependent on annual maintenance to keep the road safe, environmental risks to an acceptable level, and to protect the road investment. These roads were constructed with the expectation that timber-based land allocations would generate funding for annual road maintenance on a long-term basis.

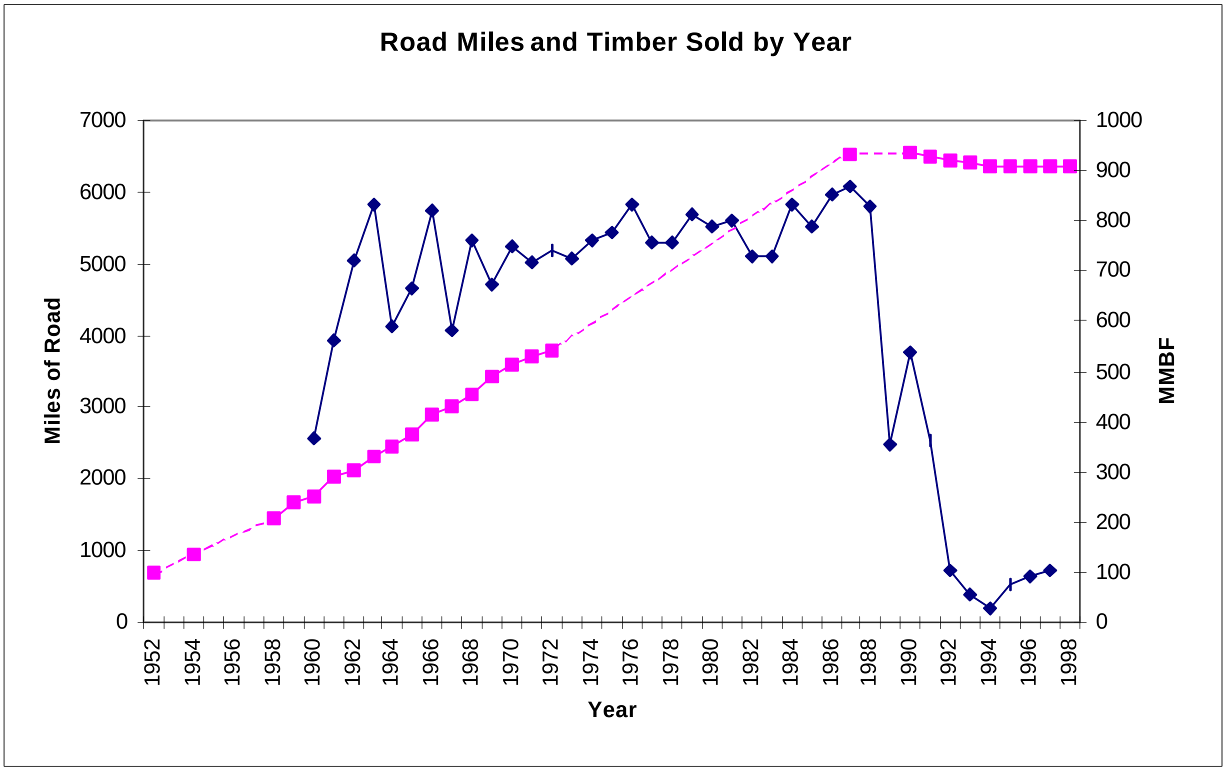


Figure 2. Miles of Forest Development Road from 1953 to 1998

Note: Based on Willamette NF Annual Reports 1953-1972 and 1988-1997.

However, lands suitable for timber harvest declined by 75% when the 1990 Willame
Forest Plan was amended by the NW Forest Plan. As a result, the road maintenance
budget (along with the timber program) declined substantially within a short timefra

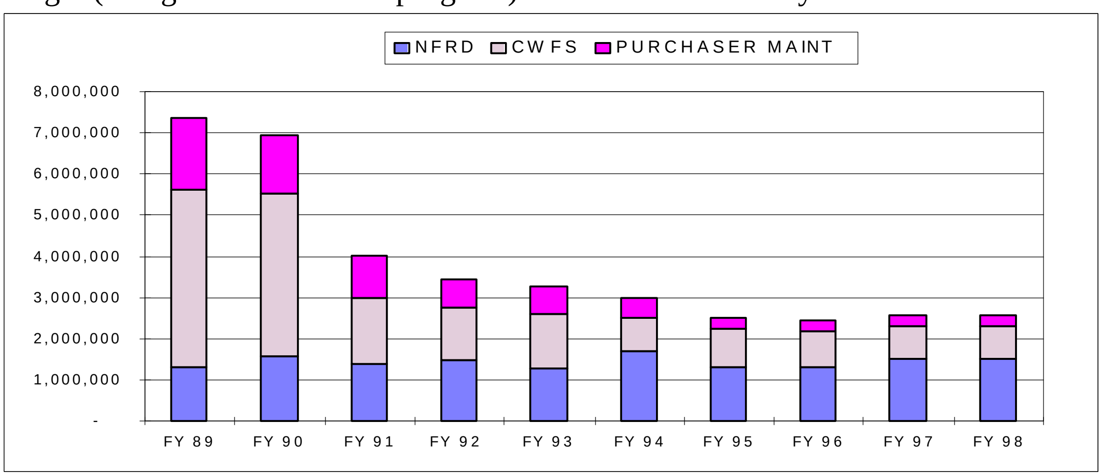


Figure 3 shows a funding decline of $4MM in three years ($7.25MM in 1989 to $3.25MM in 1992). This was largely due to the rapid decline of CWFS (Cooperative Work Forest Service) trust funds, which were funded by deposits generated from log haul. Despite the substantial decrease in traffic volume related to log haul, road maintenance associated with erosion, sedimentation, brushing, and public safety remains.

The current annual road maintenance budget is about $2.4MM *(see*

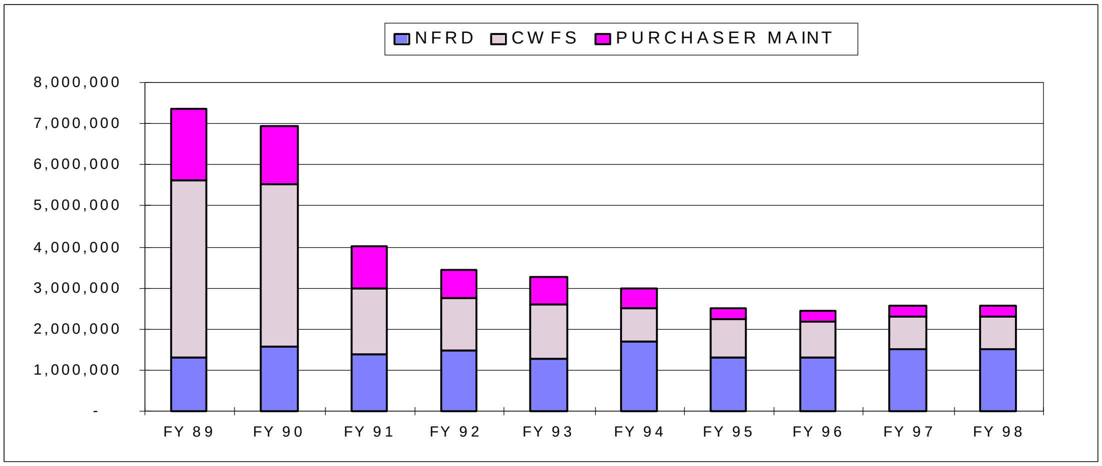
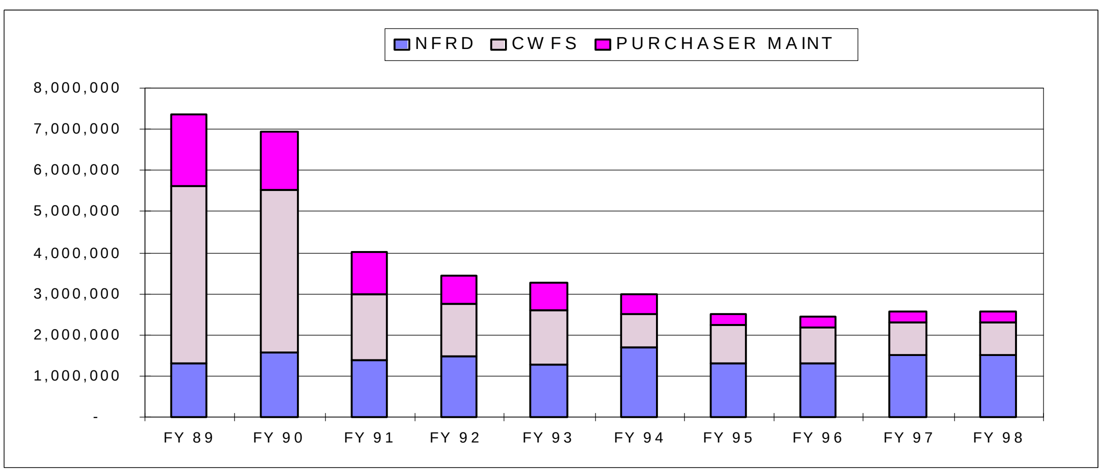


Figure 3*)*. Overhead costs reduce this by nearly 40%, leaving $1.4MM actually available to perform annual road maintenance.

Figure 3. Road Maintenance Funding Levels



6.2.2. Estimated Annual Maintenance Costs

Due to substantial costs associated with reducing the Forest road system, Forest Development Road miles have not decreased significantly since 1989 (*see*

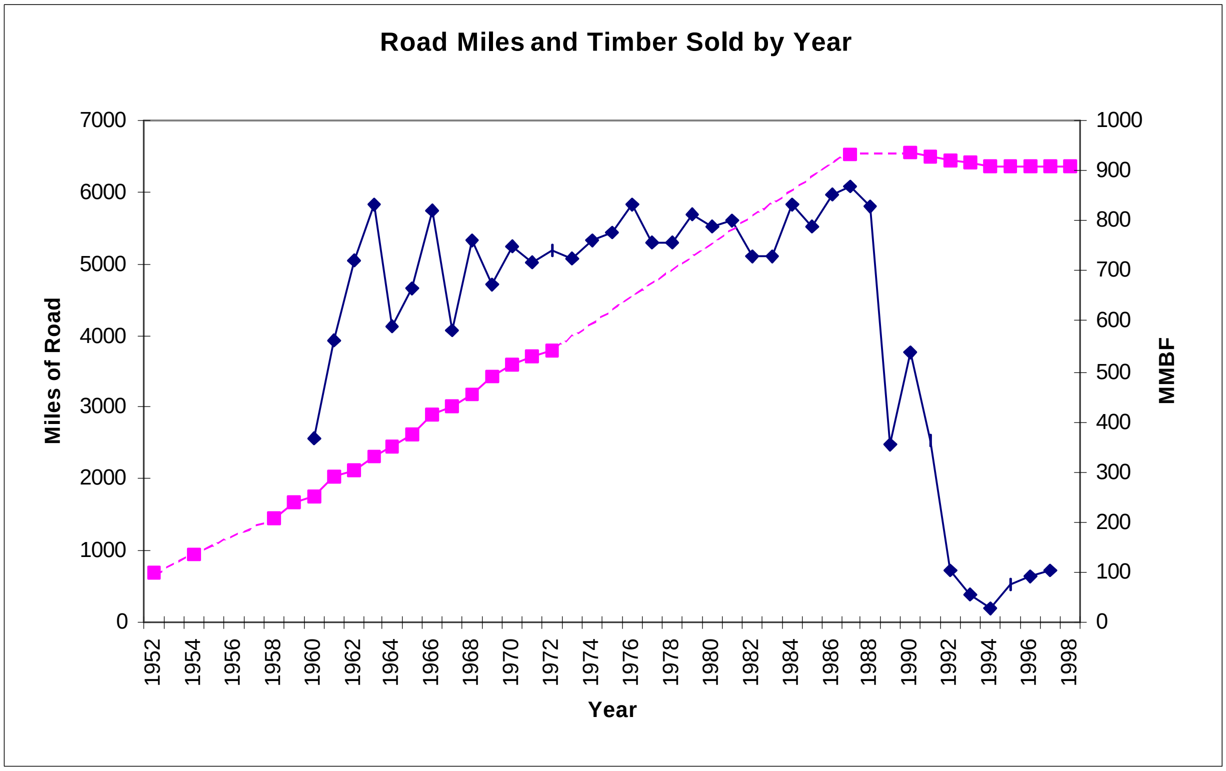


Figure 2). A decline in maintenance budgets without a corresponding reduction of road miles has lead to insufficient funding to maintain the road system in a safe and environmentally sound condition.

Table 4 shows that an estimated $3.4MM per year is needed "on the ground" to perform the necessary annual maintenance. Total funding to the Districts is $1.4MM per year, leaving an estimated "on-the-ground" budget shortfall of $2MM per year.

Table 4. Estimated Annual Maintenance Costs for Road Maintenance to Standard

Maintenance Level	Low Cost/mile	High Cost/mile	Average Cost/mile	Total Funding Needs	Total Funding to Districts	Funding Shortfall
1 (736 miles)	$25	$75	$50	$36,800	$1,400,000 to perform maintenance for all roads	Distribution to Districts
2 (4,067 miles)	$100	$400	$250	$1,016,750		
3 (1,191 miles)	$500	$1,500	$1,000	$1,191,000		
4 (124 miles)	$800	$3,000	$1,900	$235,600		

5 (246 miles)	$2,500	$5,000	$3,750	$922,500		
Total Annual Maintenance Costs				**$3,402,650/yr**	**$1,400,000/yr**	**-$2,000,000/yr**

Estimated funding to fully maintain the primary/secondary road network (key travel routes identified by the Forest to remain open on a long-term basis) is $2.4M. If the entire current road maintenance budget were used to fully maintain the primary/secondary road system, this network would still be underfunded by $1.0M.

Note: Note that this estimate does not include overhead costs, deferred maintenance or capital improvement needs. It is based on current contract costs and district force account costs for annual maintenance.

6.2.3. Road Decommissioning Costs

Preliminary estimates indicate that the Forest is under-funded by more than 50% to maintain the road network to full standard. Over 3,000 miles of the Forest road network would have to be reduced to a near self-maintaining condition (or zero maintenance cost) to be in line with current funding levels. Typical costs for decommissioning (based on contract estimates) for the average road range from $5,000 to $15,000 per mile. Thus, on-the-ground costs to decommission 3,000 miles of forest development roads could be in the $30,000,000 range. This cost does not include planning, public involvement or NEPA (National Environmental Policy Act) related analysis.

6.3. Management Direction

6.3.1. Forest Service Manual

The Forest Service Transportation System is addressed under Title 7700 of the Forest Service Manual (FSM) (USDA 1994). National Forests are directed to have a current forest development transportation plan. Objectives of the transportation system are to provide access to National Forest System lands in order to accomplish management direction and protection objectives while also providing user safety, convenience and efficiency of operations, and minimizing total life-cycle costs of roads. All transportation activities should be integrated with land and resource management planning, incorporating interdisciplinary and cost-effective input to the transportation planning and design process. In addition, Forest Supervisors are directed to “ensure that project development and operation is based on and is consistent with transportation plans”. An area transportation analysis tiered to the Forest Plan is required prior to any development in released inventoried roadless areas.

Economic considerations are important in determining the cost effectiveness of a transportation system. A network analysis establishes various costs of a road system: fixed development costs, variable user-related costs for a resource activity, and the cost of operating and maintaining the network. Roads should be designed economically, while “meeting management direction for resource and environmental protection, development and management of tributary lands, and utilization of the resources”. Equal consideration should be given to safety, impacts on land and resources, and the cost of transportation.

Transportation systems should be evaluated in the context of the ecosystem(s) in which they are located and environmental protection requirements associated with road construction should be identified.

It is important to realize that "forest development roads are not public roads in the same sense as roads under the jurisdiction of public road agencies, such as states or counties. Forest development roads are not intended to meet the transportation needs of the public at large. Instead, they are authorized only for the administration and utilization of National Forest System lands. Although generally open and available for public use, such use is at the discretion of the Secretary of Agriculture. Through authorities delegated by the Secretary, the Forest Service may restrict or control use to meet specific management direction. Commercial users, permittees or contractors may also be required to share in the cost of developing, improving and maintaining forest development roads."

Options for managing traffic on roads are to: encourage, accept, discourage, eliminate, or prohibit use.

6.3.2. Northwest Forest Plan

The following direction is taken from the Standards and Guidelines, Attachment A to the Record of Decision for the Northwest Forest Plan.

6.3.2.1. Roadless Areas and Key Watersheds

To protect the remaining high quality habitats, no new roads will be constructed in inventoried roadless areas in Key Watersheds. Watershed analyses must be conducted in all non-Key Watersheds containing roadless areas before any management activities can occur within those roadless areas.

The amount of existing system and non-system roads within Key Watersheds should be reduced through decommissioning. Road closures with gates or barriers do not qualify as decommissioning or a reduction of road mileage. If funding is insufficient to implement reductions, there will be no net increase in the amount of roads in Key Watersheds. That is, for each mile of new road constructed, at least one mile of road should be decommissioned, with priority given to roads that pose the greatest risks to riparian and aquatic ecosystems.

6.3.2.2. Late Successional Reserves

Road construction in Late Successional Reserves for silvicultural, salvage and other activities generally is not recommended unless potential benefits exceed the costs of habitat impairment. If new roads are necessary to implement a practice that is otherwise in accordance with these guidelines, they will be kept to a minimum, be routed through non-late successional habitat where possible, and be designed to minimize adverse impacts. Alternative access methods, such as aerial logging, should be considered to provide access for activities in reserves.

6.3.2.3. Riparian Reserves

In order to meet Aquatic Conservation Strategy objectives, existing and planned roads should meet the guidelines identified in RF-2 and RF-3:

- Road and landing locations should be minimized in Riparian Reserves
- Watershed analyses should be completed prior to construction of new roads or landings in Riparian Reserves
- Minimize disruption of natural hydrologic flow paths, including diversion of streamflow and interception of surface and subsurface flow
- Restrict sidecasting as necessary to prevent the introduction of sediment to streams
- Avoid wetlands entirely when constructing new roads
- Reconstruct roads and associated drainage features that pose a substantial risk
- Prioritize reconstruction based on current and potential impact to riparian resources and the ecological value of the riparian resources affected
- Close and stabilize, or obliterate and stabilize roads based on the ongoing and potential effects to Aquatic Conservation Strategy objectives and consider short and long term transportation needs.

Guideline RF 4 requires that new culverts, bridges and other stream crossings shall be constructed, and existing culverts, bridges and other stream crossings determined to pose a substantial risk to riparian conditions will be improved, to accommodate at least the 100-year flood, including associate bedload and debris. Other requirements of the road system are to: minimize sediment delivery to streams from roads (RF-5) and provide and maintain fish passage at all road crossings of existing and potential fish-bearing streams (RF-6). Guideline RF-7 directs the development and implementation of a Road or Transportation Management Plan which would include following:

- Inspections and maintenance during and after storm events
- Traffic regulation during wet periods to prevent damage to riparian resources
- Development of the Road Management Objective to establish the purpose of each road.

Guideline MM-2 directs the location of "…roads outside Riparian Reserves. Where no alternative to siting facilities in Riparian Reserves exists, locate them in a way compatible with Aquatic Conservation Strategy objectives."

6.3.2.4. Matrix

One final point of note is found in the section on lynx, where it is indicated that since roads provide access to hunters and trappers, road density may be related to lynx mortality.

6.3.3. Willamette Forest Plan

The following direction is taken from Chapter IV, Forest Management Direction of the Willamette Forest Plan 1990b).

6.3.3.1. Strategic Goals

The strategic goal for Forest management of travelways is to provide visually pleasing and efficient access for the movement of people and materials involved in the use, protection and management of forest lands.

6.3.3.2. Desired Future Condition

The desired future condition (ten years from 1990) includes the construction of approximately 400 miles of new roads, primarily to provide access for timber harvests. While some of these roads would be constructed in currently roaded areas, the expectation at the time was that others would "enter several hundred acre blocks of mature stands within general forest allocations." In addition, the plan called for the reconstruction of 1,740 miles of road in conjunction with timber harvests and recreation management. In some cases, reconstruction projects would correct or alleviate erosion and road stability problems and provide for safe public access.

The projection for 50 years (approximately 2042) was that "many roads will be maintained for timber harvest and public access, while others will be closed during certain times of the year or for certain uses to enhance wildlife habitat and to protect soil and water resource values."

6.3.3.3. Resource Programs and Standards and Guidelines

Interdisciplinary coordination is an essential part of road system management. In terms of resource objectives, rehabilitation or improvement of road stability, soil productivity, water quality, and stream channel stability is an integral part of the soil and water program. Existing roads contributing sediment to streams should be considered for reconstruction to stabilize surfaces, fills and drainage structures (FW-097). Drainage structures should be inspected annually unless identified as low risk (FW-100). Temporary roads should be closed as part of the project work (FW-101, FW-314) and permanent drainage structures removed (FW-102, FW-315). When water quality objectives for water temperature, turbidity and sediment levels cannot be met, enhancement projects should be implemented (FW-114).

Improving the conditions and quality of big-game habitat can be accomplished by emphasis on management of cover quality, forage quality, and open road density. Management practices such as road closures and seasonal restrictions can be used to enhance big-game habitat (FW-141-144). Closures would generally be located on dead end spur roads. Few collector roads are expected to be closed (FW-141).

Vegetation control should be considered along Forest roads (FW-258).

Recreation access should be retained for developed campsites, established old-growth groves, trailheads, and special interest areas. Road closures or access restrictions shall consider the effects on developed and dispersed recreation sites and trailheads. Proposed access restrictions will consider season of use, alternate routes and availability of similar experiences (FW-313). Integrated trail and transportation system planning should minimize existing and future road crossings and other trail/road related conflicts (FW-036). Displacement of Forest trails by new roads should be avoided wherever possible (FW-040).

The Forest Plan provides for the continued development, maintenance and management of the Forest development road system (FW-308). Forest roads shall be located, designed, constructed, and reconstructed based on the following criteria: resource management objectives, environmental needs, safety, traffic requirements, traffic service levels, vehicle characteristics, road users, season(s) of use, and economics (FW-309). Major through-roads, most commercial haul routes, roads in and to developed recreation or administrative sites, and roads leading to moderate or high-use trailheads, should be maintained for low-clearance vehicles (Maintenance Levels 3, 4 and 5) (FW-310). Temporary roads left from past activities should be evaluated as they are encountered during project environmental analysis and rehabilitated as soon as practicable (FW-316).

8. Issues and Key Questions

This chapter identifies road-related issues in the analysis area. In general, *roads* refers to National Forest Development Roads, unless otherwise specified. Most of the Issues and underlying Key Questions are purposely framed as questions to help identify the information and analysis methods that are most appropriate to address the issue. Not all issues are best addressed at the forest-level scale of analysis. Recognizing this, the road analysis team has indicated which scale or scales of analysis was most apropos for each issue and key question. Watershed and project scale issues are included in this list to recognize their importance, but they will not be addressed in this Forest-level analysis.

Note: Some Key Questions correspond to Questions found in the National Forest Road Analysis document Appendices; these are listed in parentheses.

8.1. Economics

1. **How does the road system affect the direct costs and direct revenues to the Agency used in assessing financial efficiency?** (EC 1) *How do we address this at the Forest level?*
2. **What is the Net Public Benefit of the forest road system?** (EC 2) *(NEPA decision levels)*
3. **What are the maintenance costs of the existing road system? How does that compare to recent forest road budgets and projections of future forest road budgets?** *Forest scale*

8.2. Aquatics and Water Quality (AQ)

1. **How, when, and where do roads affect water quality?** [includes sedimentation from both surface erosion and potential increases in mass movements (such as debris avalanches and debris flows) and potential impacts to toes of earthflows producing fine-grained sediments.]

Key Questions

- How and where does the road system affect fine sediment that enters streams, lakes and wetlands? (AQ 1) *Forest scale*
- How and where does the road system affect mass soil movements that affect aquatic or riparian ecosystems? (AQ 2) *Forest and watershed/project scale*
- How and where does the road system modify drainage density which affects water quality and quantity? (AQ 4) *Forest scale and watershed scale*
- How and where does the road system, including all roads on National Forest lands, affect risks to water quality from chemical spills or roadway applied chemicals such as oil, de-icing salts, herbicides, and fertilizers? (AQ 10) *Forest scale*
- How and where does the road system affect wetlands? (AQ 12) *Forest and watershed/project scale*

2. **How and when do roads affect water quantity?** [includes potential increases in peak flows due to interception of subsurface flow, particularly in mid-slope positions, since roads may route water more quickly into stream channels.]

Key Questions

- How and where does the road system modify drainage density which affects water quality and quantity? (AQ 4) *Forest scale and watershed scale*
- How and where does the road system affect movement of groundwater? (AQ 5) *Forest scale*

3. **How and where do roads affect stream geomorphology?** [includes the position of a road or road segment adjacent to a major stream channel. Indicators might be the location of roads in flood plains or adjacent to major streams, where meander patterns may be truncated by a road.]

Key Questions

- How and where does the road system affect key interactions between aquatic and terrestrial systems? (AQ 8) *Forest or larger scale and watershed scale*
- How and where does the road system alter the storage capacity of stream channels for coarse woody debris, sediment and organic matter? (AQ 9) *Forest Scale and watershed scale*
- How and where does the road system affect channel structure and geometry, and isolation of floodplains from their channels? (AQ 11) *Forest scale and watershed scale*

4. **How, when and where do roads affect riparian functions?** [includes the presence of roads in riparian areas and Riparian Reserves (Northwest Forest Plan). This issue is very closely linked with similar issues and key questions for fish and wildlife populations and habitat.]

Key Questions

- How and where does the road system affect mass soil movements that affect aquatic or riparian ecosystems? (AQ 2) *Forest and watershed/project scale*
- How and where does the road system affect movement of groundwater? (AQ 5) *Forest scale*
- How and where does the road system affect key interactions between aquatic and terrestrial systems? (AQ 8) *Forest or larger scale*
- How and where does the road system affect channel structure and geometry, and isolation of floodplains from their channels? (AQ 11) *Forest scale and watershed scale*
- How and where does the road system affect wetlands? (AQ 12) *Forest and watershed/project scale*

8.3. Fisheries

1. **How and where do roads affect fish populations?**

Key Questions

- How and where do roads affect fish spawning/production areas? *Forest and watershed scale*
- How and where do roads restrict fish access to suitable habitat? *Forest and watershed scale*
- How does the use of roads affect fish mortality, especially Threatened, Endangered or Sensitive species? (*e.g.*, anglers, swimmers, poaching, fish roadkill, etc.)

2. How and where do roads affect fish habitat?

Key Questions

- How and where do roads affect meeting state water quality standards for stream temperature? *Forest and watershed scale*
- How and where do roads restrict fish access to suitable habitat? *Forest and watershed scale*

8.4. Terrestrial Wildlife

1. How and where do roads help to create, remove and/or affect different types of available habitat?

Key Questions

- Where are the priority areas and habitats of concern? (TW 1) *Forest scale*
- How and to what extent do roads affect late-successional and interior habitat? (TW 4, TW 5) *Forest scale*
- How and where do roads affect special and unique habitats (*e.g.*, caves, cliffs, meadows)? (TW 7) *Forest and project scale*

2. How and where do roads affect the quality or functionality of existing habitat (*e.g.*, connectivity)?

Key Questions

- How and where does the road system affect the removal of habitat structural components (*e.g.*, hazard tree/snag removal along roads)? (TW 10) *Forest scale*
- How and where do roads restrict habitat connectivity? (TW 5) *Province, Forest and watershed scale*

3. How do roads impact wildlife objectives in reserved lands (LSRs, Riparian Reserves, Administratively Withdrawn Lands)?

Key Questions

- Which late successional related species are affected by roads and how are they affected? *Forest scale*
- What are the current road densities in reserved lands? *Forest scale*

4. What impact do roads have on animal populations or individual animals?

Key Questions

- How and where does the road system (including all roads on Forest lands) affect direct mortality (*e.g.*, road kill, legal and illegal hunting)? (TW 8, TW 9) *Forest and watershed/project scale*
- How do road maintenance chemicals (de-icers, road oils) used on all roads affect wildlife? Which chemicals have adverse affects? *Forest scale*
- How and where does the road system (including all roads on Forest lands) affect the predation rates on certain populations? *Forest scale*
- Where does the current open road densities exceed Forest Plan objectives for big game? *Forest scale*

5. How and where do roads affect Threatened, Endangered and Sensitive species and other species of concern (*e.g.*, Survey and Manage, Protection Buffer)? (TW 6)

Key Questions

- How, when and where does the road system affect TES habitat due to the proximity of roads to key habitat such as nesting and roosting, denning and foraging areas? *Forest scale*
- How and where do road-related human activities (special forest product, firewood collecting) affect TES species (*e.g.*, disturbance)? *Forest scale*

8.5. Botanical

1. How do roads remove/destroy/change plant habitats?

Key Questions

- How and where do roads affect special and unique habitats (*e.g.*, meadows and rock gardens)? *Forest and project scale*
- How do roads impact reserved lands (Late Successional Reserves and Riparian Reserves) which are habitat for rare and unique species?
- What late successional related species are found adjacent to roads and how is their habitat affected? *Forest scale*

2. How and where do roads affect sensitive plant species and other plant species of concern?

Key Questions

- What species are located in habitats with high probability of impact from road building and quarries?

3. How does road maintenance, construction and obliteration contribute to movement of noxious and undesired non-native plant species?

Key Questions

- How and where do roads and their use contribute to spread of exotic species, i.e. noxious weeds? (EF 1) *Forest scale*

8.6. Fire and Fuels

1. How do roads affect the efficiency, costs, effectiveness and safety of fire protection/suppression?

Key Questions

- How and where do roads contribute to fire suppression, i.e. access to areas with high fuels loading, high resource values? *Forest scale*
- How and where do roads provide fire breaks in areas of high fuel loading? *Watershed or project scale*
- How and where do roads contribute to fire suppression safety, i.e. escape routes, safety zones? (PT 2) *Watershed or project scale*
- How and where do roads provide access to fire suppression resources, i.e. water sources, helispots? *Watershed or project scale*

2. How do roads affect the risk of fire occurrence (starts)?

Key Questions

- Which roads have a high amount of use and are coincident with fuel types and fuel loadings that increase risk of large fires? *Forest scale*
- How do fuel type changes immediately adjacent to roads increase probability of human-caused fire starts and spread? *Watershed or project scale*

3. How does the road system affect the efficiency, costs, effectiveness and safety of fuels management? (PT 1)

Key Questions

- Where does the road system provide access to areas of high fuel loading and how does access affect per acre treatment costs? *Forest and watershed scale*
- How does the road system contribute to fuel breaks, block planning for prescribed burning? *Watershed or project scale*

4. How do forest roads affect fire protection/suppression in the urban interface?

Key Questions

- Where do forest roads play a key role in providing adequate ingress/egress for the public and fire suppression forces? (PT 2) *Forest, watershed and project scale*
- Are current maintenance levels consistent with fire suppression and protection objectives in interface areas? *Forest and watershed scale*

- Do any forest roads play a role in local (city, county) contingency plans for fire suppression access and/or public evacuation routes? (PT 2) *Watershed and project scale*

8.7. Forest Products

1. **How do roads provide for the management of forest products in Matrix and Adaptive Management Areas?** (TM 2)

Key Questions

- How much of the area that is suited and available for timber management is accessed by the existing road system and can be logged using conventional yarding systems? *Forest and watershed scale*
- Which suited and available areas are not accessed by the existing road system? (TM 2) *Forest and watershed scale*
- How does road spacing and location affect logging system feasibility? (TM 1) *Watershed scale*
- How does existing road access affect commercial and personal collection of nontimber forest products? (SP 1) *Watershed and project scale*

2. **How does the road system affect silvicultural/vegetation treatment needs?** (TM 3)

Key Questions

- Does the existing road system provide access to areas needing silvicultural treatments, i.e. planting, release, thinning? *Watershed scale*
- How does road access affect the cost and efficiency of different types of silvicultural treatments? *Forest and watershed scale*

8.8. Recreation

1. **Is there now or will there be excess supply or excess demand for unroaded recreation opportunity?** (UR 1)
2. **What is the level and condition of access to developed recreation sites, trailheads and Special Interest Areas?** (RR 4, RR 5) (*e.g.*, some trailheads may have more access roads than needed.)
3. **How and where does the existing road system influence recreation areas?**

Key Questions

- Does road access contribute to use in excess of the capacity of recreation facilities? (*e.g.*, trailheads, wilderness, wild & scenic rivers, etc.) *Forest and watershed scale*

4. **Does the number of roads and/or their condition influence use patterns and qualities of back-country destinations?** *Watershed scale*

Key Questions

- Does road access (number of roads and road condition) contribute to overcrowding and/or resource damage at popular back-country destinations (wilderness, Wild & Scenic Rivers, dispersed sites, trailheads)?

5. **How and where does the current road system meet motorized, driving for pleasure recreation demands?**

Key Questions

- Where are Scenic Byways, Backcountry Byways and other designated recreation-related travel routes? *Forest scale*
- Which forest roads provide loop opportunities desired by 4-wheel groups (street-legal 4-wheel drives)? *Forest and watershed scale*
- What opportunities exist for converting closed roads to ATV trails? (RR 10)

8.9. Heritage Resources

1. **How and where do roads provide access for traditional cultural practice sites for Native Americans?** (SI 4)

Key Questions

- Is limited or selective access to some sites preferred by Native Americans? *Forest and project scale*
- Are roads adversely impacting cultural practices and where? *Watershed and project scale*
- Which areas are desirable for full access? *Forest and project scale*

2. **How and where does road access affect archeological sites and historic properties?** (SI 3)

Key Questions

- Are archeological sites and historic properties adversely affected by the existing road system? (*e.g.*, maintenance, operation and use) *Forest, watershed and project scale*
- How does the existing road system contribute to the efficiency and costs of maintaining historic properties? *Forest and watershed scale*
- How does the existing road system contribute to interpretation and public use of historic sites or other cultural resources? *Forest and watershed scale*

3. **Which roads are historic transportation routes?** (SI 5) *Forest scale*

Key Questions

- Where have historic transportation routes been identified and how does maintenance to historic levels affect other resources? (*e.g.*, Oregon military road and Santiam Wagon Road)

8.10. Social

1. **How might changes in road management affect people's dependence on, need for, and desire for roads and access?** (SI 1&2)

Key Questions

- How and where does the road system connect to other public roads and provide primary access to communities, rural residences and businesses? *Forest and project scale*
- What "personal use" activities are commonly associated with forest development roads (*e.g.*, firewood gathering, berry picking, Xmas tree cutting, etc.)? *Forest and project scale*
- How and where would people's sense of place (and favorite places) be affected? (SI 11) *Uncertain of what scale is possible*

2. **How can we communicate about road management in a manner that is experienced as open, honest and reliable?** (SI 6)

Key Questions

- What forms of communication are viewed as most effective?
- What media do most people feel comfortable with?
- What public participation efforts have been effective? *Forest scale*

3. **What are effective ways to solicit, elicit and gather information from interested and/or affected publics?**

Key Questions

- What collaborative processes have taken place that facilitated decision-making? At what scale?

4. **How and where would changes in the road system, or management thereof, affect certain groups of people (*e.g.*, minorities, ethnic, cultural, racial groups, persons with disabilities, low income groups)?** (CR 1)

Key Questions

- What are the usage patterns of potentially affected groups? *Forest/District scale*
- What opportunities exist to improve or better facilitate use by potentially affected groups? *District scale*
- Has the Executive Order on Environmental Justice been considered in the decision?

5. **How would overall community (of place) economic health be affected by changes in forest development roads?** (SI 7) *Community scale*

Key Questions

- What is the economic composition of community?
- To what extent is community dependent on extractive, commodity forest resources (timber, mining, grazing, etc?)?

- To what extent is community dependent on amenity forest resources (recreation, tourism, etc)?
- What role do roads play in the changing economics of rural communities? (SI 17)

6. **How might overall community (of place) satisfaction be affected by changes to the forest development road system?** (SI 13) *Community scale*

Key Questions

- How cohesive is the community? What lifestyles are represented in the community?
- How resilient is the community? How does the community respond to change?

7. **What is the perceived economic dependency of a community on a roadless area versus the value of that roadless area for its intrinsic existence and/or symbolic value(s)?** (SI 8) *Community scale*

Key Questions

- What are the significant existence and/or symbolic values of the community?
- What is the community lifestyle?
- What values are being asserted from outside the community?

8.11. Lands

1. What is the level of road access to private inholdings (cost-share roads) and what are the physical, biological and social impacts? (GT 2)

Key Questions

- Which inholdings are likely to require or be the source of requests for future access? *Forest scale*
- Are there alternative routes or options for access to private inholdings where current access is creating adverse impacts? *Watershed or project scale*

2. What is the level of road access to lands managed by other federal agencies or the state? (GT 3)

3. What is the level of road access to easements/special use permits, recreation summer homes, mining claims, administrative sites (*e.g.*, gravel), etc.? (SU 1)

8.12. Roadless

1. **What is the amount and location of unroaded areas on the Forest by stratified by size of area and Forest Plan land allocation?** *Forest scale*

Key Questions

- Where are significant aquatic, terrestrial wildlife or ecological values associated with unroaded areas? *Forest and watershed scale*

9. Key Results

9.1. Economic

9.1.1.1. Introduction

The history behind the Willamette's current road system has an important role in how we consider its financial efficiency. The Forest's roads were built primarily to access timber harvest units and for other administrative purposes. High timber revenues coupled with recreation benefits and access for firefighters made the roads financially efficient to build and maintain.

In 1994, the Northwest Forest Plan was implemented with the result that more than 75% of the timber suited lands once available for timber harvest are now in no-harvest land allocations. With this series of events, the primary source of revenue that maintained the current road system fundamentally changed. The objective of the economic questions is to address costs, budget and overall financial efficiency of the current road system.

9.1.1.2. Results and Interpretation

The cost of maintaining the current road system at its prescribed maintenance level is approximately $3.4 million dollars. Approximate expenditure to maintain roads located in matrix lands is $1.8 million; where no programmed timber harvest is planned the cost is $1.3 million. Roads located on private land are expected to cost approximately $248,000 a year.

When revenues from commodity harvest are compared to road maintenance costs, costs on harvestable lands are well below the revenues they generate. This is also true for non-harvestable lands over the next decade as commercial thinning continues to promote late-successional conditions. However, most roads in areas of no-harvest (primarily LSRs) and private land will not financially pay for themselves after the next decade.

Regardless of sufficient timber revenues, the road maintenance budget does not fund roads to prescribed maintenance levels. Continuing to maintain the road system as efficiently as possible within current budget levels, will eventually result in roads that are neither environmentally sound nor maintained to a level safe for users. Decommissioning roads provides an opportunity to make an initial investment and reduce future long-term maintenance costs. Decommissioning a sufficient number of roads will bring our current maintenance costs in alignment with the budget.

The financial efficiency of reducing road maintenance costs by decommissioning was analyzed. Three scenarios were considered: road decommissioning, road closure and continued road maintenance. The results indicate that ***a one-time investment of dollars to decommission roads strictly to bring the road system in alignment with the current budget level is not recommended under current decommissioning costs.*** There will, however, be roads that need to be decommissioned because they pose environmental costs that qualify them for decommissioning.

It is important to note that external costs were not included in this analysis. An external cost is one caused by the agency and imposed on another party without compensation, such as polluting water or degrading scenic beauty. In this same vein, external benefits such as enhanced property values were also not investigated. Estimation of future revenues from timber harvest include both harvest and no-harvest allocations.

9.2. Ecological

9.2.1. Aquatics and Water Quality

9.2.1.1. Introduction and Issues

There are four principle ways in which roads interact with and affect watershed resources and processes in the westside Cascade Mountains of the Pacific Northwest Region.

1) Roads interact and influence the production of both fine and coarse textured sediment, thus influencing water quality.
2) Their position on steep hillsides often intercepts and daylights subsurface flow, routing such flow more quickly to adjacent stream channels, thereby potentially increasing peak flows.
3) Road location within riparian reserves can influence the meander patterns of adjacent streams effecting a stream's ability to move its sediment.
4) Roads within riparian reserves potentially affect a host of processes and resources associated with these reserves, such as the availability of large wood, access to streams by recreationists, and movement of wildlife from upland areas to and through riparian areas.

Four general areas define the broad issues associated with watershed processes:

1. Water Quality
2. Water Quantity
3. Geomorphic (position of a road or road segment adjacent to major stream channels)
4. Riparian

9.2.1.2. Findings and Results

The amount of fine sediments produced by the road system that enter streams, lakes and wetlands was addressed by combining mapped Quaternary Landslides (earthflows) with stream and road locations. The distribution of this combination indicates potential areas of concern for the production of fine sediment. Watersheds containing a high percentage of area in this combination are: The North Santiam River – Blowout to Woodpecker; South Fork McKenzie River; Salmon Creek; and Upper Middle Fork Willamette River.

Soil mapping units (SRI) designated as "unstable" and "potentially unstable" were mapped to show areas that could become involved in surficial landslides, debris flows and debris torrents. It would be appropriate to analyze these in combination with road density. In this case, the hazard would increase with higher road densities within each category. Due to time limitations, these areas were not defined.

Culvert and bridge crossings affect streams and drainages in a watershed by constricting flows during periods of high runoff. They are often the focus points for damage from culvert plugging and subsequent road failure. A map of road and stream intersections was developed to address this issue. It was determined that this information, although vital to road management decisions, would most appropriately be considered at a smaller scale of analysis.

A combination of road mileage with slope position (mid-slope and valley bottom) in riparian reserves was developed in order to assess the impact of roads on potential increases in peak flows by interception of subsurface flow and more efficient routing of water to channels. The average percent increase was 17.1% in valley bottom stream miles and 17.6% on mid-slopes. This means that the active stream network during high flow events is increased by an average of 17.1-17.6%, which would increase the amount of water moving in a channel during a storm event and cause the hydrograph to peak more rapidly. Increased channel erosion locally and downstream could result from such changes. As road density increases, the active stream network increases. Thus, the higher percent increase in roads within riparian reserves, the greater the possibility of stream channel degradation.

9.2.2. Fisheries

9.2.2.1. Introduction

Roads influence the health and distribution of aquatic species on National Forest System lands by several mechanisms:

a) Impacts to riparian areas may result in loss of streamside shade; loss of near-stream vegetation; compaction or loss of floodplains; destabilization of steep slopes adjacent to streams; poaching; vandalism; and litter.

b) Impacts to stream channels due to road construction may lead to excessive fine sediment entering stream channels.

c) There is an increased risk of impacts by roads to stream channels and aquatic species due to road management such as road age, type of surface material, or number of stream crossings.

Two main issues directly related to fisheries were identified: road impacts on *fish populations* and *fish habitat*. In the Pacific Northwest, the focus is on salmonid spawning and rearing, and whether or not the population status of a species is known.

During analysis, the status of fisheries was lumped into the following categories:

- **T&E occupied:** when bull trout, winter steelhead, spring chinook, or Oregon chub (or a combination of these species) occur in the subwatershed and the subwatershed is used primarily for spawning/rearing or migration.
- **Historic T&E:** the subwatershed once supported bull trout, winter steelhead, spring chinook, or a combination of these species and was used for spawning/rearing and migration.

9.2.2.2. Results

Subwatersheds currently occupied by bull trout, winter steelhead, spring chinook or Oregon chub were identified, as were watersheds of historic occupation. The latter will be important for consideration during species recovery planning under the Endangered Species Act. These watersheds were compared to other resource “hot spots” to provide a Forest level list of priority areas for road and transportation system management.

Table 1 in the Fisheries Process Paper (Appendix C) highlights sixth field subwatersheds within fifth field watersheds that may be a priority when considering further steps and designing site-specific actions or projects through future ATM and/or NEPA processes.

9.2.3. Terrestrial Wildlife

9.2.3.1. Introduction

The Forest road network can significantly alter wildlife habitats and negatively impact wildlife populations. The negative effects of roads on wildlife can be classified into three general categories: (1) edge effects; (2) barriers to movement; and (c) avenues for resource extraction and human activities.

Edge effects are the result of the interaction between two adjacent habitats, when the two habitats are separated by an abrupt edge (Murcia 1995). The ecology of forest edges is characterized by changes in biotic (parasites, predators and herbivores) and abiotic (microclimate, disturbance regime) elements. If exposure to the edge modifies the features of the forest beyond their range of natural intrinsic variation, then the fragment’s area will be effectively reduced for conservation purposes (Murcia 1995).

Forest fragmentation can threaten native wildlife populations by eliminating blocks of continuous habitat or by degrading the quality of remaining habitat for those species sensitive to an increase in the amount of forest edge. Currently, roads and the history of intensive timber harvesting are the major causes of forest fragmentation on the Willamette National Forest.

A second major impact of roads on wildlife is as a barrier to species movement. The barrier effect is sensitive to both road width and traffic density (Forman and Hersperger 1996). As road width and traffic density increase, roads become more effective barriers to movement (Reudiger 1996). When populations become subdivided, there is increased risk of demographic fluctuation, local extinction of subpopulations, less recolonization after local extinction, and a progressive loss of local biodiversity (Soule 1987).

Finally, the extensive network of Forest Service roads also creates opportunities for humans to extract natural resources. Indeed, the construction of the vast majority of the Willamette’ road system was to extract timber. In addition to timber harvest, many animals (*e.g.*, deer, elk, and bear) are hunted, and most hunters camp and hunt close to roads. Generally speaking, human influences on the forest are greatest near roads and decrease steadily with distance from roads.

9.2.3.2. Results and Interpretation

High road densities can pose problems for wildlife populations due to biological and abiotic edge effects associated with roads. These effects were summarized by "roadsheds," which are large blocks of land separated by major (state) highways. The state highway system divides the Willamette National Forest into six distinct roadsheds. Since many species do not cross major highways or suffer high mortality rates when attempting to cross them, roadsheds may represent regions into which some populations are subdivided.

The amount of interior habitat varies greatly among roadsheds, from a low of 7.7 square miles in Roadshed 1 (6% of the roadshed) to a high of 60.1 square miles in Roadshed 6 (16%). In each roadshed, over 40% of all the land is affected by edge effects. Edge effects impact 31-49% of current spotted owl habitat and 22-41% percent of interior habitat in the six roadsheds on this Forest *(see Figures 3 and 5, Wildlife Process Paper, Appendix D)*. These statistics indicate that a large percentage of late-successional habitat, upon which many plant and animal species depend, incurs negative impacts from roads.

Areas of concern based on road densities in connected, late-successional habitat were identified. The highest priority are those areas with road densities of 6-8 miles/mi^2. Note that several areas in the highest road density categories are in Late-Successional Reserves (LSRs). Since these areas are managed for late-successional dependent species, it is of concern that some of the highest road densities in connected, late-successional habitat occurs in the LSRs.

Species not dependent on late-successional habitat, such as elk, can also be negatively impacted by high road densities. Of the 53 High Emphasis Areas for big game on the Willamette NF, 26 (49%) have road densities that exceed WNF Land Management Plan objectives. Of the 110 Moderate Emphasis Areas for big game, 36 (33%) have road densities exceeding the objectives. On an acreage basis, 218,493 acres (43%) of the land in High Emphasis Level exceed the objectives, whereas 270,163 acres (29%) in Moderate Emphasis Level exceed the objectives (Table 5). **Map 6** *Road Densities in Big Game Emphasis Areas* displays the Big Game Emphasis Areas where WNF Land Management Plan objectives for big game are not being met.

Table 5. Number of acres exceeding objectives for big game

Big Game Emphasis Level	Total # acres in Emphasis Level	# acres exceeding objectives for Big Game (% of total acreage)
High	508,533	218,493 (43%)
Moderate	930,321	270,163 (29%)
Low	352,025	0 (0 %)

9.2.4. Botanical

9.2.4.1. Background

Historically, roads were built along riparian lowlands and ridgelines due to both economics and feasibility. Roads naturally intersect with special habitats along ridgelines because these areas are often rocky, with little soil development; factors which favor development of meadows or rock gardens rather than forest. As roads were built through these habitats, fill was often placed on top of the existing habitat. The resulting changes in drainage patterns, changes in soil composition and introduction of noxious weeds from roadside shoulders may cumulatively result in significant alteration of the existing plant community.

Another botanical feature affected by roads is the introduction and movement of noxious weeds. People, animals and machinery move noxious weeds from place to place; roads provide constantly disturbed habitats, devoid of competing vegetation, for establishment of weeds. Weed populations are found along road shoulders, in dispersed campsites, hunting camps, trailheads, timber harvest landings--anywhere there is a ground-disturbing activity.

Road maintenance also contributes to the movement of weed seed, especially along the crest of the Cascades. Knapweed is by far the greatest problem in this area. The largest concentrations of this weed are along the major highway corridors (Hwy 20, 22, 126, and 58). One factor is the movement of seed from cinder pits (waste disposal areas) as it is used to treat icy highways in the winter. Another factor is the large amount of recreational traffic moving back and forth over the Cascade crest.

9.2.4.2. Results and Interpretation

9.2.4.2.1. Special Habitats

A significant number of special habitats have been affected by roads. Table 6 illustrates the percentage of habitats affected by roads using polygons of one acre or larger from all land allocations (including Wilderness and other roadless areas). When analyzed at the watershed level, many of the percentages of habitats impacted are 50% or more.

Table 6. Intersection of Roads with Forestwide Special Habitat Polygons

Habitat Type	Acres Affected By Roads	Total Acres Forestwide	Percentage of Habitats Affected By Roads
Rock garden	25.7	1013.3	2.5
Mesic Meadow	554.3	15703.4	3.5
Dry Meadow	204.7	4344.8	4.7
Shrub	520.6	8067.8	6.4
Rock Outcrop	98	2267.5	4.3
Wet Meadow	124.6	2420.2	5.1
Talus	1151.5	43364	2.6
Pond	15.6	242.2	6.4

9.2.4.2.2. Sensitive Plants

The most commonly affected sensitive plant is *Romanzoffia thompsonii*, Thompson’s mistmaiden, found in rock gardens adjacent to roads on Detroit, McKenzie, Middle Fork, and

Blue River Ranger Districts (RDs). Of particular concern to this species is any change in hydrology from maintenance or restoration activities.

Other sensitive plants impacted by roads include *Aster gormanii*, Gorman's aster (grows along ridgeline scree slopes on Detroit and Sweet Home Ranger Districts); *Cimicifuga elata*, tall bugbane (South Santiam watershed where a skid road provides access for grazing ungulates); *Frasera umpquaensis*, Umpqua swertia, (a road bisects its meadow habitat at the headwaters of the Fall Creek drainage); and *Montia howellii*, Howell's montia (found in vernal pools in a trailhead parking lot).

9.2.4.2.3. Late-Successional Species

A number of survey and manage species have the potential to be affected by roads. Of particular importance are the known sites of *Hydrothyria venosa*, an aquatic lichen, and *Racomitrium aquaticum*, an aquatic bryophyte, because of their extreme sensitivity to sedimentation. Populations of *Hydrothyria* and *Racomitrium* located in areas with potential road failures or in areas scheduled for road reconstruction should be considered "hot spots."

9.2.4.2.4. Noxious Weeds

Analysis of noxious weeds using GIS layers focused on new invader populations. Table 6 shows the number of new invaders affected by road corridors. Almost every population of new invaders documented on the Forest is associated with a road.

Table 7. Number of New Invader Noxious Weed Sites Adjacent to Roads

Weed Species	Number of Sites
Spotted knapweed	76
Himalayan and Evergreen Blackberry	55
Meadow knapweed	15
Yellow toadflax	7
False brome	6
Diffuse knapweed	5
Giant knotweed	3
Dalmatian toadflax	1
Houndstongue	1

The number of newly invading weeds located in watersheds throughout the Forest varies. The McKenzie, Willamette Middle Fork Downstream Tributaries, and South Santiam watersheds have the highest density of weed infestations. These areas should be considered "hot spots" for weed infestation. It is recommended that road projects build costs of weed prevention into their budgets, that seeding occur immediately after construction, that vehicles used by contractors be steam-cleaned when moved from infested areas, that only certified weed-free seed be used for revegetation, that only weed free rock sources be used for road construction and that roads be closed wherever feasible to reduce the number of weed travel corridors.

9.3. Social

9.3.1. Fire and Fuels

9.3.1.1. Introduction

Roads have both a positive and negative effect on wildland fire suppression and fuel management on the Willamette National Forest. As a benefit, road networks provide access to water sources, lookouts, helispots, and other fire resources used in fire suppression and fuel management activities. In roaded areas, response time is reduced, thereby increasing firefighter efficiency and effectiveness in suppressing both human and natural fires. Roads also provide barriers or fire breaks for fire suppression and fuels activities. From a safety standpoint, roads provide anchor points for line construction, escape routes and safety zones. In some cases wildland fire strategies have been developed around road networks (USDA 1998).

Forest roads and other forms of transportation systems also have negative impacts, such as an increased risk of human-caused fires. Human-caused fires along roadways throughout most of the Forest have a random distribution. However, there are some public high-use areas with significantly higher human-caused fire frequencies. The majority of these areas were identified along major Oregon state highway corridors and railroad transportation systems within the Willamette National Forest boundary.

9.3.1.2. Results and Interpretation

9.3.1.2.1. Fire Suppression

In 1994, the level of fire suppression efficiency on the Forest was measured by an analytical process known as the National Fire Management Analysis System (NFMAS). Efficiency of transportation by emergency and other vehicles on Forest road systems played a key role in the NFMAS process. Vehicles were utilized as the primary mode of transportation in 87% to 90% of representative fires analyzed. The high utilization of vehicles was primarily due to the high road density on this Forest.

Based on the scope of this pilot road analysis, available data and the timeframe, quantifiable changes to fire protection efficiency and effectiveness were not analyzed. Forest fire managers are planning to recalibrate NFMAS by March of 1999. If travel management is identified as an issue based on current and future road closures, primary suppression response methods will be adjusted.

Safety in relation to travel management on the Forest, along with all other safety considerations, is the highest priority for firefighters and the public. Issues such as road surface type and condition, road clearances, visibility of roadways on corners, maintenance levels, and traffic levels are just a few of the safety issues emergency vehicle drivers encounter when responding to wildland fires. The scope of this analysis (Forest level) was too broad to adequately consider such site-specific information, which is best addressed at the watershed scale of analysis. When safety issues dealing with access and travel management on the Forest cannot be mitigated, other forms of transportation or methods of suppression will be utilized by fire managers.

9.3.1.2.2. Access for Fuels Management

It is anticipated that future fuel management and prescribed burning on the Forest will decline at the project level but may increase at a landscape scale. In the future, if management ignited fires are used to meet wildland fire objectives at an ecological scale, road systems may be utilized to provide effective barriers during the ignition and holding stages of a prescribed burn. At this time, however, this program is still in the planning stage. Again, these are issues best analyzed and managed at the watershed scale of analysis rather than the Forest level.

9.3.1.2.3. Access to Fire Resources

Fire resources are defined as lookouts, helispots, helibases, developed water sources, developed incident base camp locations, radio hill top sites, preattack fire breaks, and other related areas on the Forest. An analysis of these resources was not attempted in relation to access and travel management due to the nature and scope of this analysis.

Helispot, preattack fire breaks and developed water sources should be reviewed at the watershed rather than Forest scale of analysis. Road access to permanent lookouts and radio hilltop sites or trailheads leading to such facilities should be retained and maintained.

9.3.1.2.4. Public Access in Relation to Fire Occurrence

The high density of roads on the Forest have contributed to a higher frequency of human ignitions in some areas (USDA 1998). It can also be assumed that public high use areas have higher then average human ignitions. Greater access to such areas as dispersed campsites, backcountry camping and hunting may contribute to the higher incidence of human-caused fires – up to a point. Areas with the highest road densities are generally highly industrialized and therefore are less appealing to recreationists and hunters as camping sites.

The road density assessment does not indicate a linear correlation between road mile density and human-caused fires on the Forest. Frequency and distribution of human-caused fires may be related to factors other than road densities. At this point, more analysis is needed.

At this time, analysis does not verify the need to alter, close or change road systems based solely on human-caused fire occurrence.

9.3.2. Forest Products

9.3.2.1. Introduction

Roads provide access to the forest for planning, designing and implementing a wide range of timber harvest activities. These same roads provide access for equipment that can perform logging and harvesting operations. They also provide access for people and equipment that complete subsequent vegetation management treatments. In addition, roads provide access to individuals gathering special forest products such as Christmas trees, floral greenery, mushrooms, fence posts, and firewood.

All timber and most non-timber forest products are harvested within 2,000 feet of a road. Most timber comes from within 1,500 feet of a road. Non-timber products, such as firewood and fence posts, are primarily collected within 100 feet of a road.

9.3.2.2. Results and Interpretation

There are 444,577 acres of suitable and available matrix and Adaptive Management Area (AMA) lands within 2,000 feet of a road. Conversely, 15,734 acres of suitable and available matrix lands are not within 2,000 feet of a road.

Any watershed or project area with a significant percent of the area further than 2,000 feet from a road will need to include either road construction or alternative logging systems (such as helicopter or other aerial systems) in project design. Not as readily apparent, however, is the need for logging spur roads to access individual harvest units.

Under the Northwest Forest Plan, streams are surrounded by buffers of up to 680 feet, where no timber harvest is allowed. This tends to constrain timber harvest to narrow slices of land between stream buffers, often requiring short spurs to create feasible logging options. Thus, under the Forest Plan, more miles of road must be constructed to reach the “slices” of land available for harvest.

The total matrix area over 2,000 feet from a road exceeds five percent of the entire watershed acreage in only one watershed (Blue River). This is somewhat skewed by the HJ Andrews Experimental Forest. Three watersheds exceed two percent: South Santiam, McKenzie Minor Tribs and Quartz Creek. All others have less than two percent of the land area not accessed by a road (within 2000 feet).

9.3.3. Recreation

9.3.3.1. Introduction

Maintaining a viable road system is the key to our ability to provide the diverse recreation settings necessary to meet our desired condition as stated in the Willamette Forest Plan. At the same time, the existence and/or condition of roads may contribute to overuse and, ultimately, a diminishment of visitors’ recreation experiences.

We seek to identify recreation settings of varying characteristics ranging from large, remote undeveloped areas to small, easily accessed and highly developed sites. The majority of developed recreation sites on the Forest are accessible via double-lane asphalt-paved or double-lane all-weather gravel roads. The existing road system provides very adequate access to all recreation areas, developed and dispersed.

As with recreation sites, the maintenance of a viable road system is a key to providing the diverse recreation opportunities available on the Willamette NF. Two hundred thirty-six (236) trailheads service 1,779 miles of both wilderness and non-wilderness trails. Trailheads are, for the most part, accessed by collector roads, but a few are on main arterials or secondary roads. The road system is adequate for the current public demand for trail access, but during the next 40 years demand will exceed the ability to respond with additional miles of trail and trailheads.

In addition, the Forest has two congressionally designated Wild and Scenic Rivers: the North Fork of the Middle Fork Willamette, and Upper McKenzie. In the Forest Plan, nine river segments were identified that have river-related values meeting criteria for eligibility as Wild and Scenic Rivers. Most of these have an arterial or collector road within the corridor boundary. These roads are likely to be considered essential for recreation.

The Forest also has 44 Special Interest Areas (SIAs) and 34 Old Growth Groves. Many of these are served by arterial or collector roads, but some are not accessed by roads at all.

9.3.3.2. Results and Interpretation

Driving for pleasure is the primary use of the main forest road system on the Willamette NF. There are several Scenic Byways and back-country drives on the Forest.

- McKenzie Pass-Santiam Pass Scenic Byway (McKenzie Bridge to Sisters, Oregon)
- West Cascades Scenic Byway (Estacada to Oakridge, Oregon)
- Diamond Drive (from Oakridge, Oregon along the Middle Fork Willamette River to Lomolo Lake and the Rogue River-Umpqua Scenic Byway)
- BLM/USFS back-country drive (begins at State Highway 20 and the Quartzville Road at the east end of Foster Reservoir; ends at State Highway 22 and the Straight Creek road)

Overuse of roads is not a constant issue on the Forest, although it does occur at some sites, such as Detroit Reservoir, along the McKenzie River and along Fall Creek. The road system provides easy access to all of these areas, but does not contribute adversely to exceeded capacity.

Local roads that disperse use into river corridors may have an effect on vegetation and soil, ultimately contributing to erosion. River Management Plans for the two designated Wild and Scenic Rivers identified the need to close certain local roads. For the eligible rivers, some local roads or non-system roads have been closed over time. Further determination of road closures is best analyzed by the Districts through Watershed Analyses or a Level of Acceptable Change (LAC) process.

In general, there are no “hot spots” relating to Wild and Scenic Rivers, Special Interest Areas and Old Growth Groves that should be addressed at the Forest level during this analysis. There may, however, be opportunities to consider the number of local roads within Wild and Scenic River corridors and/or leading to SIAs or Old Growth Groves if they are concurrently identified as contributors to the decline of other resources, such as fish, wildlife or water quality.

In terms of trail access, a forest-wide trailhead map was generated by GIS. Several trailheads fell into areas that are considered “hot spots” in regards to other resources. Focus of analysis should be placed on these trailheads first, to determine whether they are in the best location for visitor needs with emphasis on resource protection. These trailheads are listed in the Recreation Process Paper (Appendix H).

Recreation use in semi-primitive unroaded areas of the Forest is predicted to exceed the practical capacity for that setting between 2010 and 2040 (USDA 1990b). We have no better data than this (Forest Plan) to address future roadless area demands.

There are no known use or access issues at the Forest level. The evaluation of this question is best completed at the District level during the Area Plan or Watershed Analysis processes.

9.3.4. Heritage Resources

9.3.4.1. Introduction

Heritage Resources include many forms of archaeological, historical, and cultural properties.

Archaeological sites typically exist in the form of buried deposits of stone tools and debris resulting from tool manufacture. Road construction, maintenance, road use, and associated erosion can destroy or damage the integrity of archaeological deposits.

Historic sites, in contrast, exhibit a broader range of artifact types, materials, and features in their assemblages. They often include structures as a dominant component, though an archaeological component may also exist. Historic properties also include engineering features and travel corridors, such as early roads, trails, railroad routes, monuments, dams, and bridges. Often modern roads were developed over historic transportation routes.

Cultural properties are considered to be locations of traditional cultural activities of indigenous people and their descendants, and may not manifest themselves with distinguishable physical remains. Some tribes have reserved certain rights which must be recognized and access accommodated in land management decisions.

Currently the Willamette National Forest works with four federally recognized tribes who have ancestral ties to the land we manage. These are the Confederated Tribes of Grand Ronde Community of Oregon, the Confederated Tribes of the Siletz Indians of Oregon, the Confederated Tribes of the Warm Springs Indians, and the Klamath Tribe. Of these, only the Warm Springs and Grand Ronde assert claims to ceded lands within the Forest's bounds.

9.3.4.2. Results and Interpretation

It is well known that many archaeological sites on the Forest have been directly impacted by initial road construction, continued road maintenance, and erosion, which results in irretrievable data loss when unmitigated. In order to analyze the effects of the current road system on archaeological sites and historic properties it would be necessary to correlate the locations of each and examine site-specific information for evidence of impacts. Over 2,000 archaeological sites have been documented on this Forest.

Using existing data to conduct an analysis of road system effects on archaeological sites would require the comparison of site locations obtained from these records with the current road system. A cumbersome and time consuming process, analysis would best be accomplished at a district or watershed scale, where more site-specific information is available.

On the other hand, historic sites (especially structures) are more conducive to adaptive uses such as interpretation and recreation rental opportunities, so access for interpretation as well as maintenance may be more desirable in some cases.

Currently, 74 historic structures are listed on the Forest inventory. Comprehensive specific data on maintenance efficiency and costs are not readily available, but may be obtained by a record search and interviews, primarily at the district level.

As a general rule, historic properties with road access have been more often utilized and more efficiently maintained. Exceptions to this are properties accessible by road (or roads and short trails) but located some distance from a ranger station. Often these properties are the target of public abuse and vandalism. Costs associated with maintaining these properties are relatively high. Typically, archaeological sites found on this Forest would not require maintenance unless the site has been impacted by other management or public activities.

Interpretive efforts are generally focused in areas of high public use. Interpretive panels are currently found along many main travel routes and in recreation sites. Interpretation of more fragile archaeological sites takes the form of off-site interpretation, such as brochures or displays. Historic sites currently utilized for recreation or interpretation are listed in the Heritage Resources Process Paper in Appendix I.

Many historic transportation routes, such as old wagon roads, trails and railroad routes, have been adversely affected by road development. As transportation systems evolved over time, modern roads often followed existing historic routes. In some areas, this resulted in obliteration or fragmentation; however, some pristine segments have survived. Some current roads could be closed and routes rehabilitated to a historic character; some could be converted into interpretive trail routes.

Using district computer databases, a list of archaeological sites and historic properties with documented impacts from (1) road maintenance or (2) road or bridge construction was generated. Due to technical difficulties accessing some district databases, only about half of the districts were represented in this list. Of these, there were 86 incidences of sites impacted by road maintenance and 312 sites impacted by road or bridge construction. A simple analysis shows that about 29% of the sites on these districts have recorded impacts from roads.

9.3.5. Social

9.3.5.1. Introduction

While the natural and heritage resources managed by the Agency are generally well studied and inventoried, those attributes of forest management that fall into the realm of values and culture are less well known and are not easily accessible for the purpose of this analysis. Fortunately there are a myriad of methodologies and a wealth of social scientists available to help this Forest develop a database that would provide better information for local analyses when decisions are ripe at the appropriate scale.

The Issues and Key Questions identified for this aspect of the analysis suggest information crucial to informed decision-making. However, attempting to address them at this level and in this timeframe, when decisions are not ripe and citizens are not involved, is both frustrating and fruitless.

The Interdisciplinary Team has been able to bring natural resource data to the analysis describing physical conditions across the landscape. Unfortunately, our GIS system contains no equivalent in terms of social conditions.

9.3.5.2. Results and Interpretation

A careful review of *Analysis of Public Comments: Final Scoping Report (Proposed Rulemaking of Administration of the Forest Development Transportation System)* revealed five common and important themes which have resonance locally:

- Good decisions can only come from the local level with strong involvement by the public.
- The Agency is subject to too much external influence. (Perception of that influence varied widely.)
- "Wilderness" areas and "roadless" areas are one and the same in the minds of many. These are perceived to be very, very special places.
- There is substantial opposition to closing roads (for a variety of reasons), especially "ghost" roads.
- For any given opinion or belief expressed by anyone, there will be an opinion or belief expressed that represents the exact opposite.

Given our ability to identify environmental "hotspots," it is unlikely that a strong argument opposing decommissioning, obliterating, stabilizing, or closing any roads that jeopardize water, fisheries, wildlife or public safety would surface. When site-specific decisions are needed due to potential environmental impacts, early and extensive involvement of communities of both place and interest will not only inform the decision maker, but can be used to ferret out information unavailable to this analysis.

9.3.6. Lands

9.3.6.1. Introduction

The Willamette National Forest has many private inholdings, both large blocks of single owner "checkerboard" land ownership patterns and smaller, scattered ownership of a residential or small woodlot nature. Over time, there have been 12 major transportation system cost-sharing areas of some kind on the Forest. Of these, eight areas are still in operation on Sweet Home and Detroit Ranger Districts.

Although the cost-sharing mechanism for the remaining four areas have ended, the reciprocally granted, perpetual easements are still in place. The Forest does not have an exact count of these easements, but would *roughly* estimate 200. While the source documents for right-of-way grants to private parties are kept in the Forest's files, no compilation of these documents has been undertaken, either by computerized database or mapping.

9.3.6.2. Results and Interpretation

Unilateral action by the Forest Service on roads to which other parties have rights is rare. In cost-share areas, it requires Washington Office oversight. In almost all cases, easements granted to private parties have some type of due process provision for the private party included in the termination clause. Consequently, closing a road under easement or terminating that easement, and thereby terminating the private party's legal rights to the road, is complicated. The same is true for relocation or reconstruction of roads under easement. An additional factor for shared roads is the cost the private party has assumed for construction of these roads.

9.3.7. Roadless Values

Roadless areas are undeveloped lands on the Forest that have no improved roads. Areas in an unroaded condition have been inventoried on the Forest at least three times: as part of the National Roadless Area Review and Evaluation (1973), the National Roadless Area Review and Evaluation (1979), and during the National Forest Management Act, Forest Plan development (1984-1989).

In recent years, the issue of unroaded lands on National Forests has become greater and more diverse than simply identifying the potential for inclusion in the National Wilderness Preservation System. In a broad sense, there is a diversity of values regarding roadless areas and these values often conflict. As the total amount of roadless area not included in the wilderness system continues to decline on the Forest, there is increased interest in the value of smaller unroaded areas.

9.3.7.1. Results and Interpretation

The primary issue of unroaded areas in this analysis is the amount and location of unroaded areas on the Forest stratified by size of area and Forest Plan land allocation. The key question is: *Where are the significant aquatic, terrestrial wildlife or ecological values associated with unroaded areas?*

Inventoried roadless areas mapped in 1984, total 210,509 acres. Of these, the area still roadless in 1998 is 112,166 acres. When the original area of 210,509 acres was overlaid with current Forest Plan land allocations, 45,164 acres (about 21%) were in land allocations allowing timber harvest. The remaining 165,345 acres (about 79%) are in land allocations that do not allow programmed timber harvest.

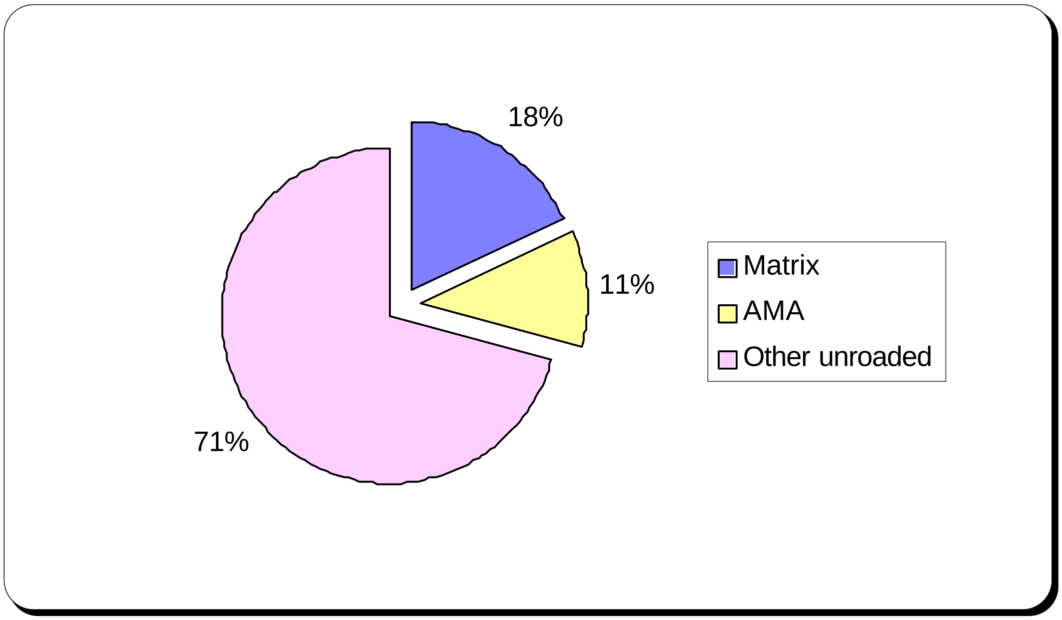
The moving window analysis of unroaded areas resulted in a total of 303,579 acres identified as unroaded and not harvested within the past 40 years and greater than 1,000 acres.

After screening, the total unroaded land area is broken down as follows *(see Figure 4):*

- ✓ 55,062 acres in matrix (timber harvest allowed)
- ✓ 33,237 acres in Adaptive Management Areas (AMA)
- ✓ 215,280 acres in remaining unroaded areas greater than 1,000 acres, in land allocations that preclude programmed timber harvest and where no future needs for additional road access are identified.

Our recommendation is to continue refinement of the unroaded map at the watershed level, identifying areas of significant ecological values and where they overlap with unroaded areas.

Figure 4. Total Unroaded Lands on the Forest



10. Options and Priorities

After reviewing and discussing the results of the analysis of Issues and Key Questions, the Willamette Road Analysis Team arrived at the following conclusions:

- Economics alone, financial efficiency, does not support large-scale road closures or decommissioning in spite of the current imbalance in funding available for forest roads. Road decommissioning is a capital investment, just as road construction was, and decisions regarding these investments must be based on a sound analysis of resource values. This highlights the importance of prioritizing areas for further transportation system decisions based on ecological and social factors.
- The analysis shows that access for recreation, fire suppression, vegetation management (including timber harvest), and other administrative uses is adequate and not likely to be a significant concern except on a site-specific or individual road basis. Access issues for these management needs are best addressed at a smaller, more site-specific scale. They are not a driver in this Forest level road analysis.
- Resource issues such as fish, wildlife, water quality, and other ecological values are the drivers that identify Forest level priorities for further transportation system analysis and decision making.
- As shown by the aquatics and wildlife analyses, roads create many types of potential hazards that can be displayed spatially and analyzed quantitatively in a variety of ways. Even the limited number of potential hazards identified in this assessment, when overlaid spatially, indicate that some type of hazard exists wherever there is a road.
- Resource values were overlaid with hazards (fish habitat, wildlife habitat, T&E habitats of both fish and wildlife, Forest Plan objectives, municipal watersheds) to identify where the hazards create risks of adverse impacts on resource values and identify "priority" areas. The result was similar; because of the large number of values identified, risks were nearly as ubiquitous as the hazards.
- In order to meet one of the original objectives of the assessment (to identify relative priorities and options for the transportation system), the team subjectively narrowed the list of hazards (quaternary landslides and road densities > 6 mi/mi^2 in mid-slope and valley bottoms) and resource values (T&E fish, impacts on Late Successional Reserves and high emphasis big game areas). These were then overlaid to identify sixth field subwatersheds where multiple hazards and values exist. The results are displayed on the Subwatersheds of Concern map and in Table 8 and Table 9.
- **All** of the hazards and **all** of the resource values and access needs, however, will have to be considered for the analysis that will result in decisions implementing changes in road access and transportation system management (*e.g.*, determining which roads will be decommissioned or managed at a different maintenance level).
- The current Forest policy to maintain access provided by the current arterial and collector road system may need to be revisited in the mapped Late Successional Reserves. Roads in these areas were built to a standard (including maintenance standard) based on compliance

with significantly different land management objectives. The current land management objectives may be achievable with a different standard of road or less roads than previously assumed.

- Only a handful of unroaded areas are in land allocations or parts of the Forest where additional road access is needed to implement current Forest Plan direction. About 79% of the inventoried roadless areas and 78% of the unroaded areas >1000 acres are in land allocations that preclude timber harvest.
- A significant component lacking in the integration of results was information on the social aspects of the transportation system. The Social Process Paper (Appendix J) details the difficulties in addressing the social Issues and Key Questions and identifies opportunities and available measures to address information deficiencies. The road analysis team endorses the need for community collaboration at all levels of forest road assessment and analysis, particularly where decisions to change or modify the current level of access are anticipated (subwatershed or project level). Collaborative efforts go beyond simple public information and require a significant investment of time and agency resources. Therefore, areas should be prioritized based on social values for different levels of collaboration during forest road analysis, just as areas have been prioritized in this assessment based on ecological values.
- Related to the above conclusion, is the team's observation that a majority of individual concerns about roads relate to specific roads and locations on the Forest. This is based on comments received on the National Roads Policy and past comments on the Forest Plan. Interest in assessments to establish priorities and process for further decision making at the Forest level was limited to regional and national interest group representatives with an interest in influencing regional and national policy on forest roads.
- Another significant information gap vital to the forest road analysis is the lack of information at the forest scale on the number and location of roads for which the Forest has entered into easements and cost-share agreements with private parties. This is significant, because the Forest can not unilaterally make decisions about managing these roads.

10.1. Identifying Subwatersheds of Concern

The sixth field subwatersheds rated as Very high, High, Moderate and Low-moderate in Table 7.1 were identified based on an interdisciplinary determination of key resource hazards and resource values. As previously mentioned, the hazards and values were narrowed to provide differentiation or relative levels of priorities among the Forest subwatersheds.

To establish different levels of concern, the resource values and resource hazards were assigned numerical values as follows:

- Quaternary landslides - Present in subwatershed = 1; Not present in subwatershed = 0.
- Road densities greater than 6 miles/mile^2 on midslopes or in valley bottoms - Present in subwatershed = 1; Not present = 0.

- Fisheries - Occupied T&E (or formally proposed T&E) habitat = 2; Historical T&E habitat = 1; Not present = 0.
- Big Game (High emphasis areas only) - Open road densities exceeds Forest Plan objectives by more than 1 mile/mile^2 = 2; Open road densities exceeds Forest Plan objective by less than 1 mile/mile^2 = 1.
- Late successional connectivity (within Late Successional Reserves only) - High impact to connectivity = 2; moderate impacts to connectivity = 1.

Subwatershed scores of 6 or greater were ranked as Very high level of concern; scores of 5 were High; scores of 4 were Moderate and scores of 3 were Low-moderate.

Quaternary landslides were selected as one of the hazards for evaluation because these geologic features are best analyzed at a landscape scale and are features that can produce significant amounts of fine sediment due to presence of forest roads, especially at mid-slope and valley bottom positions. Road densities greater than six miles/mile^2 in mid-slope and valley bottoms were the other hazard chosen by the team for inclusion in the evaluation. Road densities of this level have been identified by both fish and wildlife biologists in consultations for threatened and endangered species, as having significant adverse impacts on habitat and populations. Also, this road density on mid-slopes and valley bottoms has been associated with increases in peak flows in some studies and the subsequent impacts on stream channels and fish habitat.

The resource values chosen were based on meeting legal requirements of the Endangered Species Act and impacts due to forest roads above current Forest Plan objectives. Occupied or historic Threatened and Endangered fish habitat was the first concern identified, since it has implications for meeting legal requirements of the Endangered Species Act. The other two resource values, big game habitat and late successional habitat, were identified in those areas where analysis indicated that road impacts significantly exceeded Forest Plan objectives.

It is obvious that including different hazards, resource values or assignment of values would change the identification of subwatersheds of concern or their ranking. The team considered adding municipal watersheds as a resource value in the exercise, since there was agreement that municipal water supplies are a significant resource value. However, when the team evaluated how the results would change, adding municipal watersheds resulted in only minor changes in the relative ranking of the subwatersheds and an additional 12-15 subwatersheds identified as Moderate or Low-moderate concern. This is just one example of how different hazards and resource values could affect prioritization.

The road analysis team recognizes that the subjectivity mentioned above could raise questions about the overall value and creditability of the assessment and has three points in response.

1. The prioritization of the subwatersheds in Table 7.1 is only one product or outcome of the forest road assessment. While it provides Forest managers with interdisciplinary input to determine where to focus follow-up access and travel management efforts, it is not the only useful product of this assessment. The other tools and analysis summarized in Section 6 and detailed in the Process Papers (Appendices A-M) will improve the efficiency and consistency of ATM and access decisions at the watershed and project level.

2. This is ***NOT*** a decision making process; final decisions to decommission, maintain, or construct forest roads are not being made or directed by this assessment. Other resource values and hazards caused by roads will be considered in local context and with public involvement and review before decisions are made to change the current level of forest access.
3. This assessment is only one source of information and input to future decisions regarding Forest roads and access. As illustrated in Figure 5, managers have several sources of information to consider during the decision-making process for forest roads. While it may be desirable to incorporate all of these sources of information into one grand analysis, it is not a realistic or feasible expectation.

Figure 5. Analysis, Options, Decisions

Table 8 Results of evaluating overlap of significant hazards and resource concerns. Sixth field watersheds ranked in the order of most hazards and resource concern overlaps.

Watershed and 6th field no.	Level of Concern	Quaternary Landslides present.	Road Density >6 mi/sq. mile	Fish Status	Exceeds high emphasis big game objectives	Late Succession Connectivity impacts in LSRs	Other resource concerns
Hills Creek 22 1	Very High	Y	Y	Historic & T&E occupied.	Y < 1 mi/sq. mi.	Y High impact	Road density in riparian reserves > 6 mi/sq mi. Affected special habitats >75%
Lookout Res 19 1	Very High	Y		T&E occupied (OR chub)	Y > 1 mi/sq. mi.	Y Moderate impact	Key Watershed for O. Chub Affected special habitats >85%
S. Santiam 06 1	High		Y	T&E occupied	Y < 1 mi/sq. mi.	Y Moderate impact	Municipal Watershed
UMF Wil 21 3	High	Y		T&E occupied	Y > 1 mi/sq. mi.		
UMF Wil 23 4	High	Y	Y	T&E occupied	Y < 1 mi/sq. mi.		Road density in riparian reserves > 6 mi/sq. mi.
UMF Wil 23 6	High	Y	Y	T&E occupied	Y < 1 mi/sq. mi.		
UMcKenzie 07 7	High		Y	T&E occupied	Y > 1 mi/sq. mi.		Key Watershed Municipal Watershed
S. Santiam 06 7	High	Y		T&E occupied	Y < 1 mi/sq. mi.	Y Moderate impact	Municipal Watershed
UMcKenzie 07 3	Moderate		Y	T&E occupied	Y < 1 mi/sq. mi.		Key Watershed Municipal Watershed
UN Santiam 78 4	Moderate	Y	Y	Historic T&E	Y > 1 mi/sq. mi.		Municipal Watershed
UN Santiam 78 6	Moderate	Y	Y	Historic T&E	Y < 1 mi/sq. mi.	Y Moderate impact	Key Watershed Municipal Watershed

Watershed and 6th field no.	Level of Concern	Quaternary Landslides present.	Road Density >6 mi/sq. mile	Fish Status	Exceeds high emphasis big game objectives	Late Succession Connectivity impacts in LSRs	Other resource concerns
UN Santiam 79 2	Moderate		Y	Historic T&E	Y < 1 mi/sq. mi.	Y Moderate impact	Key Watershed Municipal Watershed
Horse Cr. 14 1	Moderate	Y		T&E occupied		Y Moderate impact	Key Watershed Municipal Watershed
Salmon Cr. 18 1	Moderate	Y	Y	Historic T&E		Y Moderate impact	
S. Santiam 06 3	Moderate			T&E occupied	Y > 1 mi/sq. mi.		Municipal Watershed
N. Santiam 78 3	Moderate-Low	Y		Historic T&E	Y > 1 mi/sq. mi.		Municipal Watershed
Breitenbush 92 2	Moderate-Low	Y	y	Historic			Municipal Watershed
Mid Santiam 05 4	Moderate-Low	Y			Y < 1 mi/sq. mi.	Y Moderate impact	
S. Santiam 06 9	Moderate-Low		Y	T&E occupied			Municipal Watershed
Mck Tribs 11 1	Moderate-Low	Y		T&E occupied			Municipal Watershed
Fall Creek 15 1	Moderate-Low	Y		Historic	Y < 1 mi/sq. mi.	Y Moderate impact	
Fall Creek 15 2	Moderate-Low	Y		Historic		Y Moderate impact	
Fall Creek 15 3	Moderate Low			Historic		Y High impact	
Fall Creek 15 5	Moderate-Low			Historic		Y High impact	

Watershed and 6th field no.	Level of Concern	Quaternary Landslides present.	Road Density >6 mi/sq. mile	Fish Status	Exceeds high emphasis big game objectives	Late Succession Connectivity impacts in LSRs	Other resource concerns
Salt Creek 21 2	Moderate-Low	Y				Y High impact	
UN Santiam 79 3	Moderate-Low	Y	Y	Historic			
UMF Will 23 5	Moderate-Low	Y		T&E occupied			
SFMcKenzie 13 5	Moderate-Low		Y	T&E occupied			Municipal Watershed
SFMcKenzie 13 9	Moderate-Low	Y		T&E occupied			Municipal Watershed
U McKenzie 07 1	Moderate-Low			T&E occupied	Y < 1 mi/sq. mi.		Municipal Watershed
S. Santiam 06 6	Moderate-Low	Y			Y < 1 mi/sq. mi.	Y High impact	Municipal Watershed

Fish - Historic habitat denotes areas now blocked by dams that were once occupied by either winter steelhead, spring chinook or bull trout.

Quaternary Landslides- These are large, deep-seated, slow moving earthflows that move in a slow, episodic manner. They are of a recent geologic era (10,000 years to present).

Table 9. Other Resource Access considerations in Subwatersheds of Concern.

Watershed and 6th field no.	Recreation Issues	Historic Routes	Fire Level of human caused fires	Trails	Commodities Acres of "unaccessed matrix"	Other Area in LSR allocation
Hills Creek 22 1			low	1 trailhead	91 acres	In LSR 221
Lookout Res 19 1		Oregon and Eastern Railroad	high	12 trailheads	256 acres	In LSR 222
S.Santiam 06 1	Eligible W&SR	Santiam Wagon Road (SWR)	low	4 trailheads	2 acres	In LSR 215
UMF Wil 21 3		Oregon Central Military Wagon Road (OCMWR)	high	1 trailhead	325 acres	In LSR 222
UMF Wil 23 4	Eligible W&SR	OCMWR	moderate	3 trailheads	274 acres	
UMF Wil 23 6	Eligible W&SR	OCMWR	moderate		426 acres	
UMcKenzie 07 7		Old McKenzie Hwy	very high		243 acres	
S.Santiam 06 7	Eligible W&SR	SWR	low		23 acres	In LSR 215
UMcKenzie 07 3	W&SR	Old McKenzie Hwy	very high	2 trailheads	648 acres	
UN Santiam 78 4			high		82 acres	
UN Santiam 78 6	Eligible W&SR	Hogg Railroad	high		106 acres	In LSR 214
UN Santiam 79 2	Eligible W&SR	Hogg Railroad	very high		12 acres	In LSR 214
Horse Creek 14 1			low		105 acres	In LSR 218
Salmon Cr. 18 1			moderate		484 acres	
S.Santiam 06 3			low		14 acres	
N.Santiam 78 3			high		0 acres	In LSR 213
Breitenbush 92 2	Eligible W&SR		moderate		361 acres	

Watershed and 6th field no.	Recreation Issues	Historic Routes	Fire Level of human caused fires	Trails	Commodities Acres of “unaccessed matrix”	Other Area in LSR allocation
Mid Santiam 05 4			low	3 trailheads	4 acres	In LSR 213
S.Santiam 06 9			low		2112 acres	
Mck Tribs 11 1			low		48 acres	In LSR 217
Fall Creek 15 1			moderate		4 acres	In LSR 219
Fall Creek 15 2			moderate		42 acres	In LSR 219
Fall Creek 15 3			moderate		0 acres	In LSR 219
Fall Creek 15 5			moderate		0 acres	In LSR 219
Salt Creek 21 2		OCMWR	high		396 acres	
UN Santiam 79 3	Eligible W&SR	Hogg Railroad	very high		448 acres	
SFMcKenzie 13 5			moderate			
SF McKenzie 13 9	Eligible W&SR		moderate			
UMcKenzie 07 1			very high			
S.Santiam 06 6		SWR	low			In LSR 215

Wild and Scenic River- Watersheds containing river segments identified as eligible for W&SR designation in the Forest Plan or those currently designated as W&S are identified. The assumption is that a reduction of the miles of road with the potential or existing W&SR boundary could be beneficial to the attributes that distinguish the river segment as wild and scenic. Environmental issues (sedimentation, fish habitat, vegetation loss) and social issues (overcrowding, litter, sanitation) could be addressed through road management decisions in these areas.

Fire - Very High > 150 fires in 25 year period; High > 90 fires; Moderate >40 fires; Low < 39 fires. Based on the analysis presented in the fire process paper the assumed relationship is that decreased road densities MAY reduce the incidence of human caused fires. Therefore reducing open road densities in those watersheds with very high and high incidences of human caused fires could be beneficial. The issue of access for fire suppression is not addressed in this matrix, however, in areas with existing high road densities, reductions in the miles of maintenance level 1 and 2 forest roads may not significantly impact fire suppression access. Site specific assessment is required to fully address these issues, however.

Other - LSRs **-** Within the portion of the sixth-field watershed that is in LSR there may be opportunities to reduce not only the amount of Maintenance Level 1 and 2 roads (local roads) there may also be an opportunity to consider changing management on entire collector road systems within the LSR either by reducing the amount of the collector roads or lowering the maintenance levels to a 1 or a 2 to reflect the changed use of the road in the LSR allocation.

11. Process Critique

There were two primary purposes driving this forest road assessment. The first was to complete a Forest level assessment of Forest roads and access-related issues on the Willamette National Forest. The other was to test the draft road analysis process developed by the Washington Office Road Analysis Team and to provide comment and feedback to the team on that process. The Willamette Forest Road Analysis Team recognized the dual purposes of this assessment from the beginning, and, early in the assessment, discussed possible ways of evaluating the Draft Road Analysis throughout the two-month process. Many of the resource specialists included a summary process critique at the end of their process papers. Following is the team's combined critique and feedback.

The Six-Step Process

In general, the team felt that the six-step process outlined in the draft analysis process document was useful. While it basically describes a generic, resource planning/assessment process used in many different contexts throughout the agency, the team felt that it was useful to describe the process specifically in the context of a road analysis. One team member related a recent experience on an interdisciplinary team working on an Access and Travel Management Plan at the watershed level and suggested that had they used the six steps as a model it could have eliminated or reduced much confusion or "wheel spinning" early in their analysis. The only caveat the team suggests for the six-step process is that it remain a guide or model for forest road analysis and not a prescription as the only planning model for forest road analysis.

Data

This is a common topic in the critique of any analysis or planning process. The team's comments on data in relationship to this assessment can be summarized in five categories.

- **Accuracy**: This was a major concern with the Forest transportation layer in this analysis for obvious reasons. Some of the team members had experience with project level analyses, where more roads actually existed on the ground than were shown in the transportation GIS layer. In other cases, reviews by District Rangers indicated that not all existing road closures were updated in the database. Because this layer was crucial to many of the resource analyses for this assessment, the transportation planner on the team compared the road information on the Forest transportation layer to at least two areas where roads had been intensively surveyed and field verified. Based on these comparisons, he developed an estimate of the potential error in the transportation layer. This was very useful in helping other team members to make an objective evaluation of the road data and determine if or how the potential differences between the database and actual road miles would affect the results or interpretation of the analysis.

- **Consistency**: Some of the data layers used in these resource analyses were obviously mapped at different levels of intensity across the Forest. The best example is the Forest stream GIS layer. While there is a Forestwide stream coverage, due to different levels of mapping at watershed or Ranger District levels or different mapping techniques, the number of streams displayed varied, especially for intermittent streams. The ideal is to have consistent mapping across the entire area analyzed, in this case the Forest. However, at a minimum, resource specialists conducting the analysis and managers using the results should be aware of differences within a single data layer and factor this into any interpretation of the results.

- **Different Scales of Data** This was another concern and has to be recognized in any kind of analysis. In an effort to provide data coverage for the entire Forest, data gathered at different scales and different levels of detail was used. This is similar to the above issue about consistency of mapping or data available.
- **Availability**: It was readily obvious that data simply did not exist to address some of the Issues and Key Questions. The best example of this was in response to the social issues and questions. As noted in some detail in the Social Process Paper (Appendix J), some of the basic baseline social data and information does not exist. Other resource examples are stream surveys to address the fisheries issues and questions. The team's best advice is to highlight the gaps in data availability as soon as possible in the process and consider alternative means of addressing the issues and questions.
- **Format**: In some cases, information or data to address or answer the issues and key questions existed, but it was not in a format easily or readily accessible at the Forest level. At times, this was not a significant deterrent to the assessment because it was determined that the issue or question was most appropriately addressed at a smaller scale (watershed or project) and the data would be usable at that scale. An example was the information on archeological sites and how they have been impacted by roads.

  However, in other cases, the lack of information or data in a format that could be readily analyzed at the Forest scale did detract from the assessment. The best example was the road easement and cost-share information. Knowing the location and nature of these agreements would have been useful information to overlay with other resource information to get a better idea of future workload and potential complexity of further road analyses in specific watersheds or subwatersheds.

Timeframe

The Willamette NF Road Analysis was completed in approximately 10 weeks beginning in late August and ending in mid October. Although Forest managers knew about the pilot road analysis in early August, the team did not get fully organized and operational until late August. Since it was the type of project that, in the best of situations, displaced or postponed existing work and, in the worst case, added to existing workloads, most of the team felt pressured by the timeframe given for the analysis. Most of the team adopted the approach that the timeframe was fixed and adjusted the level or intensity of their analyses to fit the time available. This also required prioritizing the analyses most meaningful to the results and the desired product (perhaps a beneficial outcome of the short timeframe).

The team suggests that in similar situations managers and supervisors allow team members "focused time" to work on assessments to the extent possible. Even within compressed timeframes, team members who were able to devote blocks of time to the analysis felt better about the assessment process than team members who had to continue to cover other program responsibilities and projects. Those with focused time were also better able to interact with each other in an interdisciplinary manner.

Public Involvement

Due to the compressed timeframe for the pilot assessment, the team and line officers understood and agreed up-front that there would not be any public involvement or collaboration. The team's reaction to this lack of public involvement and participation was mixed. The concern was that it is a missed opportunity and will subject the assessment to criticism that it is inaccurate or inadequate simply due to the lack of opportunity for public input. On the other hand, given the scale of the assessment and the determination that many public use issues are site-specific and thus most appropriately addressed at a smaller scale, it wasn't clear what kind of public input could have been solicited and how it would have affected the analysis.

First, the team recommends that future assessments allow time necessary for public involvement and collaboration. However, the type of involvement and collaboration will vary depending on the scale of the road assessment (Forestwide versus subwatershed) and the degree of public interest in a particular area. Secondly, the type and level of public involvement should be commensurate with the scale and expected products/outcomes. In other words, if it is an assessment to prioritize where site-specific analysis should be done, it is important that the public knows the objective, and understands that concerns about access to particular areas will be addressed at a different scale in a separate process.

Internal Review

Due to the compressed timeframe, this pilot Forest Road Analysis was undertaken by an interdisciplinary team of Forest resource specialists in the Forest Supervisor's Office and the analysis results were not available for review by the District Rangers prior to producing the assessment report. Thus, the likelihood of errors in the assessment was increased, in large part due to database inconsistency and quality problems previously mentioned. The lack of internal review also prevented field verification of criteria and rating procedures, which in the long run undermines the utility of the assessment. The team suggests that while the initial report is reviewed by the National Road Analysis Team, the report and analysis results should also be thoroughly reviewed by the Districts. Then the Forest road team should be reconvened for the time necessary to make any needed adjustments or corrections identified in the review.

Definitions

Early in the assessment process the team realized that they did not have a common understanding of forest road terminology. This created a significant distraction when attempting to identify and discuss the issues. As a result, the Glossary was the first section of the report written. This lack of common understanding and use of road terminology is likely to increase exponentially with extensive public involvement. Due to the variety of terms used to describe and define forest roads, conditions, treatments, and closures, the team strongly suggests that the National Road Analysis emphasize the use of standard definitions.

Issues and Key Questions

Due to the compressed timeframe, the team used the list of Issues and Key Questions in the Appendices of the Draft Road Analysis Procedure as the basis for identifying issues and key questions for the Willamette Forest Pilot Road Analysis. Going into the process somewhat "cold" and with a definite sense of urgency to move forward, some of the team members felt that they didn't have enough time to adequately assess the appropriateness or value of the suggested issues and key questions. Although team members felt that all of the suggestions in the Appendices raised legitimate Forest road and road access issues, they began to feel that not all of them were necessarily pertinent or important at the Forest scale of analysis. The team's suggestion is to de-emphasize the use of standard issues and key questions in the National Road Analysis Procedure, and perhaps replace them with a list of possible resource concerns.

Scale

Scale was an important consideration throughout this road analysis. Beginning with the development of issues and key questions and continuing through the process paper documentation, the team continually evaluated and debated the appropriateness of the scale for addressing different issues and questions. The conclusion is that different scales of road analyses and assessments have their own strengths and weaknesses. The Forest scale of road analysis provides a strong basis for dealing with programmatic issues such as road impacts on fish and wildlife--especially T&E species where the analysis provides useful information for consultation and recovery strategies. It also provides a means of determining areas with numerous hazards due to inherent soil conditions, geologic features, stream densities, and their intersection with the existing road system. The Forest scale is also the most appropriate level for identifying unroaded areas and evaluating landscape strategies for these areas.

On the other hand, the Forest scale analysis is limited in its ability to identify road use and road user issues, such as dispersed recreation use, access for management needs and fire suppression. It is also difficult to identify or prescribe treatments for site-specific road hazards such as culverts, local areas of instability and other road failures. The team appreciates the wide variety of conditions and situations among the National Forests and the possibility that, in some cases, the issues of scale may not be as pronounced as they are in Western Oregon. However, in most cases, it may be beneficial to recognize that the most efficient road analysis should be undertaken at multiple scales. In the case of the Willamette NF, the team feels that the Forest Road Assessment provides priorities, options, analysis tools, and sets the context for road analysis (Access and Travel Management) at a smaller scale such as the watershed or subwatershed level.

Other Assessments

The Willamette NF (and other National Forests in the area of the Northwest Forest Plan) have completed watershed analyses following a prescribed process with some similarities to the Draft Road Analysis Procedure. In addition, assessments have been completed on the Late Successional Reserves created by the Northwest Forest Plan. Although neither the watershed analyses nor the LSR assessments focused on roads, both roads and their impacts on other resources were analyzed and explored in these assessments. The team looked at these other assessments during this road analysis and developed a summary of all the recommendations from the watershed analyses pertaining to forest roads and road access. Findings and analyses from the LSR assessments were incorporated into the terrestrial wildlife analysis. The team suspects that the Willamette and the other Northwest Forest Plan Forests are not unique by having a variety of other landscape assessments and analyses completed in the past two to five years that have analyzed forest roads and their impacts. The team recommends that the national team consider options to integrate the required road analysis with other landscape or watershed scale assessment processes already in place. This may enhance the overall efficiency of the analyses.

12.

13. Team Members and Contributors

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Completion of this report involved many people, far too numerous to list here. Many of these contributors provided their time and expertise from the Forest, Ranger Districts, Regional Office, and Washington Office Road Analysis Team.

15.

16. 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.

Big Game Emphasis Area (BGEA) – Mapped areas with specific management objectives delineated in the Willamette National Forest Plan (1990) consisting of one to several subwatersheds and ranging from 1,000 to 15,000 acres. Each emphasis area has been assigned a rating of high, moderate or low and may overlap one to several management areas.

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 *(see "Regulated Use").*

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, re-vegetating 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.

Forest Ecosystem Management Assessment Team (FEMAT) - A team that developed a report titled "Forest Ecosystem: An Ecological, Economic and Social Assessment" commonly referred to as "the FEMAT Report." The FEMAT is Appendix A of the Final Environmental Impact Statement (FEIS), on Management for Late- Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl.

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

Forest Plan - The Willamette's 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 Development Road - *See "Roads".*

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.

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 cross-country travel over natural terrain (*e.g.*, motorcycles, all-terrain vehicles, four-wheeled drive vehicles, and snowmobiles *(see also ATV)*).

Open Road Density - Roads receiving more than one round trip per month as per Memorandum of Understanding with Oregon Department of Fish and Wildlife.

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.

Quaternary Landflow – Large unstratified geological areas of slow-moving landflows. Primarily applied to basalt and andesite flows that overlie clayey tuffaceous rocks.

Recreation Opportunity Spectrum (ROS) - Land delineations that identify a variety of recreation experience opportunities. They are categorized into six classes: Primitive, Semi-primitive 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:

> *Forest Road*: A road wholly or partly within, or adjacent to, and serving the national forest system and which is necessary to protect, administer, and use the national forest system and its resources (23 USC 660.103).
>
> *Forest Development Road*: A "forest road" under the jurisdiction of the Forest Service (FSM 7705).
>
> *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 associated with such uses as timber sale contracts, land and minerals needs or special use permits. These roads are not intended to be a part of the forest development transportation system and not necessary for future resource management (FSM 7705).
>
> *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.

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.

17.

18. REFERENCES

Forman, R.T., and A.M. Hersperger. 1996. “Road ecology and road density in different landscapes, with international planning and mitigation solutions”. Pages 1-23 in Proceedings of the Florida Department of Transportation/Federal Highway Administration Transportation-Related Wildlife Mortality Seminar, G. Evink, D. Ziegle and J. Berry, eds. Orlando, Florida, April 30-May 2, 1996.

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

Rakestraw, Lawrence and Mary. 1991. *History of the Willamette National Forest*

Reudiger, B. 1996. “The relationship between rare carnivores and highways”. Pages 24-3 in Proceedings of the Florida Department of Transportation/Federal Highway Administration Transportation-Related Wildlife Mortality Seminar, G. Evink, D. Ziegle and J. Berry, eds. Orlando, Florida, April 30-May 2, 1996.

Soule, M. 1987. “Viable populations for conservation”. Cambridge University Press, Cambridge, England.

USDA Forest Service, Forest Service Handbook 7709. 1988. Transportation Handbook, Process for Access Management, 7709.55.

USDA Forest Service. 1990a. Emergency Relief for Federally Owned Roads, Disaster Assistance Manual, Publication No. FHWA-FL-90-008.

USDA Forest Service. 1990b. *Land and Resource Management Plan, Willamette National Forest*.

USDA Forest Service. 1990c. *The History of Engineering in the Forest Service, A Compilation of History and Memoirs, 1905-1989*. Publication No. EM 7100-13.

USDA Forest Service, Forest Service Manual 2600R-6 Suppl 2600-90-2. 1990d. Wildlife, Fish, and Sensitive Plant Habitat Management Policy 2610.3.2. WO Amendment 2600-90-2.2) "Recognizes State fish and wildlife...with management responsibilities for wild on National Forests and includes them as partners in planning and implementation of activities that effect wildlife and fish."

USDA Forest Service, Forest Service Handbook 7709. 1991a. Transportation Systems Operations Handbook, Travel Management. 7709.59-91-1.

USDA Forest Service, Region 6 Forest Service Manual, 7700. 1991b. Road restrictions information requirements and traffic management. R-6 Suppl 7700-91-1.

USDA Forest Service, Forest Service Handbook 7709. 1992. Transportation System Maintenance Handbook, Maintenance Level Descriptions, Maintenance Activities and Maintenance Standards, and Maintenance Sharing. WO Amendment 7709.58-92-1.

USDA Forest Service, Forest Service Handbook 7100. 1993. Forest Visitor Maps content required. R-6 Suppl 7109.13a.

USDA Forest Service, Forest Service Manual 7700. 1994a. Transportation System. WO Amendment 7700-92-6.

USDA Forest Service, Forest Service Manual, 7700. R-6 ID 1994b. Access and Travel Management, maintenance and funding. R-6 Suppl 7730-94-6.

USDA Forest Service, Siuslaw National Forest. 1994c. *Siuslaw National Forest Access and Travel Management Guide*. Corvallis, Oregon.

USDA Forest Service, Willamette National Forest. 1995. *Willamette National Forest Access and Travel Management Guide*. Eugene, Oregon.

USDA Forest Service, Washington Office. 1998. Road Analysis: A Procedure for Informi Management Decisions on the Future Characteristics of the National Forest Transportation System.

USDA Forest Service and USDI Bureau of Land Management. 1993. *Forest Ecosystem Management: An Ecological, Economic, and Social Assessment - Report of the Forest Ecosystem Management Assessment Team*, (FEMAT). Portland, Oregon.

USDA Forest Service and USDI Bureau of Land Management. 1994a. *Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl*. Portland, Oregon

USDA Forest Service and USDI Bureau of Land Management. 1994b. *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl. Standards and Guidelines for Management of Habitat for Late-successional and Old-growth Forest Related Species Within the Range of the Northern Spotted Owl*. Portland, Oregon.

USDA Forest Service and USDI Bureau of Land Management. 1994c. *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl*. Appendix J. Portland, Oregon.

US Department of Agriculture and US Department of Interior, 1994b. *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl*. Appendix J. Portland, Oregon.

US Department of Agriculture and US Department of Interior. 1997. *An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath an Great Basin, Volume III. PNW-GTR-405. Pacific Northwest Research Station*. Portland, Oregon.

19.

20. Appendices – Process Papers

Appendix A	Economics
Appendix B	Aquatic and Water Quality
Appendix C	Fisheries
Appendix D	Terrestrial Wildlife
Appendix E	Botanical Species
Appendix F	Fire and Fuels
Appendix G	Forest Products
Appendix H	Recreation
Appendix I	Heritage Resources
Appendix J	Social Issues
Appendix K	Lands
Appendix L	Roadless Values
Appendix M	Current Road Status
Appendix N	Time and Cost Estimate

Willamette National Forest Pilot Road Analysis

Appendix A

Economics Process Paper

October 1998

<u>Errata Correction Sheet (02/09/2001)</u>

Willamette National Forest

Pilot Road Analysis

Page 5 Executive Summary

1.2. Key Analysis Results and Findings

Second paragraph should read:

- Economics alone (financial efficiency) does not support large-scale road ~~closures or~~ decommissioning in spite of the current imbalance in funding available for road system management.

Appendix A: Economics Process Paper

Page A-5, Item 3 of the 5th paragraph should read:

3. To close the same road would cost $2,000 for closure, $100 a year in minimal maintenance. ~~and $1,600 expected every 10 years for repairs~~.

Page A-5, Item 3 of the 6th paragraph should read

The goal is to find which scenario(s) prove to be financial viable over the next 20 years by requiring a 20 year discounted investment less than the no change alternative. Under the above assumptions, the no change scenario would require a discounted investment of $5,459. To decommission the same road would require an upfront investment of $10,000 with no additional expenses expected. The second scenario does not make sense to implement for solely fiscal reasons. It is far cheaper to maintain the road at $5,459 as opposed to spending $10,000 to decommission. To close the road would require a discounted investment of ~~$5,270~~ $3459. In other words it would be cheaper to close the road than to keep it open. ~~however, the two scenarios are very close~~.

Introduction

The history behind the Willamette's current road system has an important role in how we look into its financial efficiency. The Forest's roads were built primarily to access timber harvest units and for other administrative purposes. Some of those same roads also provided the primary access to lakes, trails, campgrounds, and much needed access during firefighting operations. High timber revenues coupled with recreation benefits, and access for firefighters made the roads financially efficient to build and maintain. This was also reinforced in the 1990 Willamette Forest Plan where continued road building to ``complete" the Forest's road system was part of the preferred alternative (USDA 1990). Lawsuits and court injunctions ensued over spotted owl habitat limiting harvest levels. In 1994 the Northwest Forest Plan was implemented and resulted in more than 75% of the timber suited lands available for timber harvest now in no-harvest land allocations. With this series of events the primary source of revenue that maintained the current road system, fundamentally changed. The objective of the economic questions is to address costs, budget, and overall financial efficiency of the current road system.

Process Description and Documentation

In this analysis we addressed three key questions listed in the order they are dealt with in this paper:

EC-1: *How does the road system affect the direct costs and direct revenues to the Agency as used in assessing financial efficiency?*

EC-2: *What is the Net Public Benefit of the forest road system?*

Closely related to the above questions but address in Appendix M is key question EC-3 which asks:

"What are the maintenance costs of the existing road system? How does that compare to recent forest road budgets and projections of future road budgets?"

When stated the analysis of question EC-1 relies on data presented by key question EC-3.

EC-1: ***How does the road system affect the direct costs and direct revenues to the Agency as used in assessing financial efficiency?***

General Analytical Process

In this analysis we examined whether the Agency's revenues covers its direct budget costs, as specifically related to roads. With timber revenues a driving force in generating road maintenance funds, we stratified the analysis by timber suitable and timber unsuitable lands. Timber suitability was defined by land management allocations outside of riparian reserves. Other factors such as soil and wildlife management requirements were not considered deciding factors. This coarse stratification is a sufficient for a forestwide analysis. Most timber haul routes will need to travel some distance through timber unsuitable lands to reach the mill; however, these roads will mostly be primary and secondary roads which are not considered a changing element in this analysis. Objectives for private lands are not controlled by the Forest, however, money is spent on maintaining roads within the Forest's private land inholdings and therefore these areas are included in the analysis. The stratification of the Forest Plan management allocations is shown in the table below.

Table 1. Stratification of Land Management Allocations

Classified	Management Areas
Harvest	10A, 10B, 11A, 11B, 11C, 11D, 11E, 11F, 14A, 17,
Noharvest	1, 1-6E, 2A, 2B, 4, 5A, 6D, 6E, 7, 8, 9B, 9C, 9D, 10C, 10E, 10F, 12A, 12B, 13A, 13B, 16A, 16B
Private	All nonfederal land within the forest proclaimed boundary
Water	All water bodies within the forest proclaimed boundary

Using the above stratification, the current transportation system is describe as an inventory of direct costs and direct revenues of the roads on the Forest. External costs were not included in this analysis. An external 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. Revenues include estimation of future revenues from timber harvest from both harvest and no harvest allocations.

A primary goal of this analysis is to examine the fiscal effectiveness of maintaining or decommissioning roads in areas with and without a flow of long-term revenues. Because of their direct applicability, the results and interpretation of this analysis will utilize the same costs presented in the Results section for key question EC-3.

Results

As presented in key question EC-1, to maintain the current road system to its prescribed maintenance level would require approximately $3.4 million dollars. This is the total amount regardless of its current stratification. The table below breaks down the $3.4 million dollars according to harvest, nonharvestable, and private lands.

Table 2. Road Inventory and maintenance costs.

Category	Maintenance level	Miles	Unit cost/mile	Average cost
Harvest	none	318		
	1	417	$ 50-$ 100	31,275
	2	2,406	$ 100-$ 400	601,500
	3	671	$ 500-$1,500	671,000
	4	56	$ 800-$3,000	106,400
	5	105	$2,500-$5,000	393,750
			subtotal	1,803,925
No-harvest	none	187		
	1	188	$ 50-$ 100	14,100
	2	1,213	$ 100-$ 400	303,250
	3	373	$ 500-$1,500	373,000
	4	61	$ 800-$3,000	115,900
	5	138	$2,500-$5,000	517,500
			subtotal	1,323,750
Private	none	411		
	1	30	$ 50-$ 100	2,250
	2	279	$ 100-$ 400	69,750
	3	108	$ 500-$1,500	108,000
	4	12	$ 800-$3,000	22,800
	5	12	$2,500-$5,000	45,000
			subtotal	247,800
			total	**3,375,475**

Using the road maintenance costs presented under key question EC-3, the approximate expenditure to maintain roads located matrix lands is $1.8 million and $1.3 million in lands where no programmed timber harvest is planned. Roads located on private land are expected to cost approximately $248,000 a year.

Roads in all stratifications provide direct revenues. Revenues below are based on a compilation of several sources. The predicted future volume of timber on our harvestable lands is base on estimations calculated during implementation of the Northwest Forest Plan and represent our best look into the future production of timber commodities. Predicted timber volume of thinnings on non-harvestable lands was predicted in the Mid Willamette Late Successional Reserve Assessment (USDA 1998). This estimate is limited to only Late Successional Reserves. Value per unit for timber volume was estimated based on the 1997 TSPIRS report. The value of $197/mbf accounts for all timber direct and indirect costs (costs associated with appeals and litigation) outside of road revenues and expenses. The value of $197/mbf for is the resulting balance for 1997s regeneration harvest and commercial thins volumes combined. The value of timber from LSRs which will be strictly commercial thins can be expected to be lower.

Table 3. Timber related revenues

Stratification	Product	Predicted future volume (MBF)	Revenue/MBF	Revenue from commodity harvest and recreation per year	
				First decade	Out decades
Harvest	Regen/thin	136,000	$197	$26,792,000	$26,792,000
No-harvest	thin	32,000	$197	$6,304,000	0
			Total	$33,096,000	$26,792,000

Sources of additional revenues outside of timber include grazing, land uses, minerals, recreation and special uses. During fiscal year 1997 we collected $341,311 (USDA, 1997). These collections are historically very small compared to timber revenues; however, would not exist without the availability of roads. These additional revenues were derived from the National Forest Statement of Receipts for fiscal year 1997.

When revenues from commodity harvest are compared to road maintenance costs, costs on harvestable lands are well below the revenues they generate. This is also true for nonharvestable lands for the next decade as commercial thinning continues to promote late successional conditions. These results are supported by the 1997 TSPIRS report where timber harvest netted $17 million dollars once all costs were accounted. Costs accounted for include KV related activities; however, do not include payments to states. If payments to states (25 million in 1997) were included the forest would have a net loss in revenue. Important to point out; however, is payments to states must be met regardless of timber revenues. With no timber revenues the net loss would be much greater than 8 million.

Regardless of sufficient timber revenues, the road maintenance budget does not fund roads to prescribed maintenance levels. Decommissioned roads provides an opportunity to make an initial investment and reduce future long-term maintenance costs. Decommissioning a sufficient number of roads will bring our current maintenance costs in alignment with the budget. This is discussed in the next section.

Decommissioning Costs

Decommission costs range greatly depending on the unique characteristics of the road and its surrounding topography. Below is a reiteration of the decommission costs from key question EC-3.

Table 4. Decommissioning Costs

Risk level	Unit cost per mile
low	$ 2,000-$ 5,000
moderate	$ 5,000-$15,000
severe	$15,000-$30,000

Most roads in areas of no harvest (primarily LSRs) and private land will not financially pay for themselves after the next decade. An analysis was completed to study 3 opportunities for these roads. Maintenance level 2 roads are used in these examples because of they make up the bulk of the roads under consideration for change.

1. No change, continue to maintain the road at its prescribed level
2. Decommission the road so no additional maintenance or repairs are needed
3. Close the road and drop its maintenance and repairs to a minimal level.

Under these three scenarios the following assumptions were made:

1. Under the no change scenario, maintenance costs are $250 a year, repair costs are $1,600 expected every 10 years.
2. To decommission the same mile of road would cost $10,000 of initial investment and no additional expenses such as repairs would be expected.
3. To close the same road would cost $2,000 for closure, $100 a year in minimal maintenance, and $1,600 expected every 10 years for repairs.

The goal is to find which scenario(s) prove to be financial viable over the next 20 years by requiring a 20 year discounted investment less than the no change alternative. Under the above assumptions, the no change scenario would require a discounted investment of $5,459. To decommission the same road would require an upfront investment of $10,000 with no additional expenses expected. The second scenario does not make sense to implement for solely fiscal reasons. It is far cheaper to maintain the road at $5,459 as opposed to spending $10,000 to decommission. To close the road would require a discounted investment of $5,270. In other words it would be cheaper to close the road than to keep it open; however, the two scenarios are very close.

An increase or decrease in any one of the above assumptions would change the 20 year discounted investment and possibly alter its status as financially viable or not.

Below is a summary of the sensitivity of the assumptions under each opportunity:

1. Under the no change scenario, if maintenance costs were greater than $600 a year then decommissioning the road would make sense. A maintenance cost of greater than $600 a year, however, is unlikely. The highest maintenance cost estimated for a maintenance level 2 road is $400 dollars a year. If repair costs exceed $5000 every ten years then decommissioning the road would make sense. This change is also highly unlikely. Repair costs are derived from actual repair costs from two large storm events over the last 44 years on the forest and inflated to 1998 dollars. To account for smaller storms where repair costs records were not located, anticipated repair costs were increased approximately 20%. Increasing the costs to 5,000 per mile per decade requires the expectation for damage to increase three fold over the next twenty years from that of the last 44 years.
2. If decommissioning costs were reduced to or below $5,500 per mile then decommissioning would be a viable option over maintaining the road at its current prescribed level.
3. If closing the road increased from $2,000 to $2,500 or maintenance costs increase from $100 to $125, or repair costs increase to more than $1,800 every ten years then it would no longer make sense to close the road but to maintain.

Under these scenarios a typical road not posing a high risk to the environment or safety would not make economic sense to decommission. Decommissioning roads with an objective to bring the road maintenance costs in alignment with the budget is not recommended. Closing roads may be a viable option under the above assumptions; however, the difference in the 20 year discounted investment is less than $200 dollars, so careful analysis of costs would be important.

Interpretation

This assessment presents a disturbing picture of the current road system and its budget. To continue to maintain the roads as efficiently as possible with the current budget will eventual result in roads not maintained to a level safe for users and managers nor environmentally sound. Currently a one-time investment of dollars to decommission roads strictly to bring the road system in alignment with the current budget levels is also not fiscally responsible unless costs presented in this paper change significantly. There will, however, be roads that need to be decommissioned because they pose environmental costs that make them worthy of decommissioning.

Worthy goals of the Forest should be:

- Decommission roads that pose environmental hazards and/or safety hazards.
- Look for opportunities to reduce the miles of roads that do not or will not contribute substantially to future timber commodities, recreation, or other legitimate uses on the forest.
- Close roads after careful analysis of their costs versus other opportunities.

- On the remaining roads minimize direct road costs in order to maximize financial efficiency.

A one-time investment of dollars to decommission roads strictly to bring the road system in alignment with the current budget level is not recommended under current decommissioning costs.

EC-2: *What is the Net Public Benefit of the forest road system?*

Discussion

An economic analysis of net public benefit played a small role in the Road Analysis. The overall objective discussed during the first Road Analysis meeting was providing an assessment that will help managers decide the merits of closing, relocating, upgrading, or decomissioning exisiting roads and building new roads. Driving forces meeting this objective will most probably be biophysical and financial factors and not specifically measured by net public benefits. In addition, the true measure of net public benefit can not be obtained. Some outputs and effects cannot be adequately valued in the time frame allocated and without the use of social analysis techniques.

During subsequent NEPA analyses where alternatives are evaluated, an economic analysis that results in a ranking of alternatives in relation to their Net Public Benefit and benefit/cost ratio would be useful to the decision maker. Results from the ecological and social analyses completed for this assessment will provide input for the economic analysis of alternatives from which response coefficients can be applied. Scale for this project will be driven more by the scale from which specific alternatives are analyzed.

Process Critique - All questions

External costs were not included in this analysis. An external 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. Attempts to measure the value of the costs in benefits in dollars can be largely subjective. These factors, however, do influence the decision making process. In cases where non-priced benefits are impossible to value in a marketplace they still need to be weighed by the decision maker.

Examples of information not considered or known in this economic analysis are listed below. These items also represent examples of cost and benefits that may necessitate decommissioning roads despite the direct costs.

Following is a list of incomplete accounting costs for closing or decommissioning existing roads:

- ✓ Less fragmentation of habitat
- ✓ Less erosion and stream sedimentation
- ✓ Increased soil productivity

- ✓ Less introduction of exotic species
- ✓ Less risk of fire
- ✓ Less litter and other human impacts
- ✓ Less wildlife stress
- ✓ Less modification of ecological processes
- ✓ Less noise
- ✓ Less pollution
- ✓ Less road kill
- ✓ Potential increase in unroaded area
- ✓ Loss for excluded uses and users
- ✓ Increased management cost
- ✓ Increased cost for research that requires access
- ✓ Increased inventory and monitoring cost

Another key piece of missing information is future revenues from timber commodities. Though actual revenues for 1997 were used, timber values and overall revenue are sensitive to the marketplace, harvest levels, and current management practices.

References

USDA Forest Service, Willamette National Forest. 1955-1998. Willamette National Forest Annual Report.

USDA Forest Service. 1990. *Land and Resource Management Plan*, Willamette National Forest.

USDA Forest Service, Forest Service Handbook 1909. 19 88. Economic and Social Analysis Handbook, 1909.17.

USDA Forest Service, Willamette National Forest. 1997a. Statement of Timber Sale Revenues and Expenses, TSPIRS.

USDA Forest Service, Willamette National Forest. 1997b. National Forest Statement of Receipts, All Resources Reporting.

USDA Forest Service, Willamette National Forest. 1998. Mid Willamette Late Successional Reserve Assessment.

USDA Forest Service, Washington Office. 1998. Road Analysis: A Procedure for Informing Management Decisions on the Future Characteristics of the National Forest Transportation System.

Phillips, Richard. 1998. Personal communication. Region 6, Regional Economist.

Willamette National Forest Pilot Road Analysis

Appendix B

Aquatic and Water Quality Process Paper

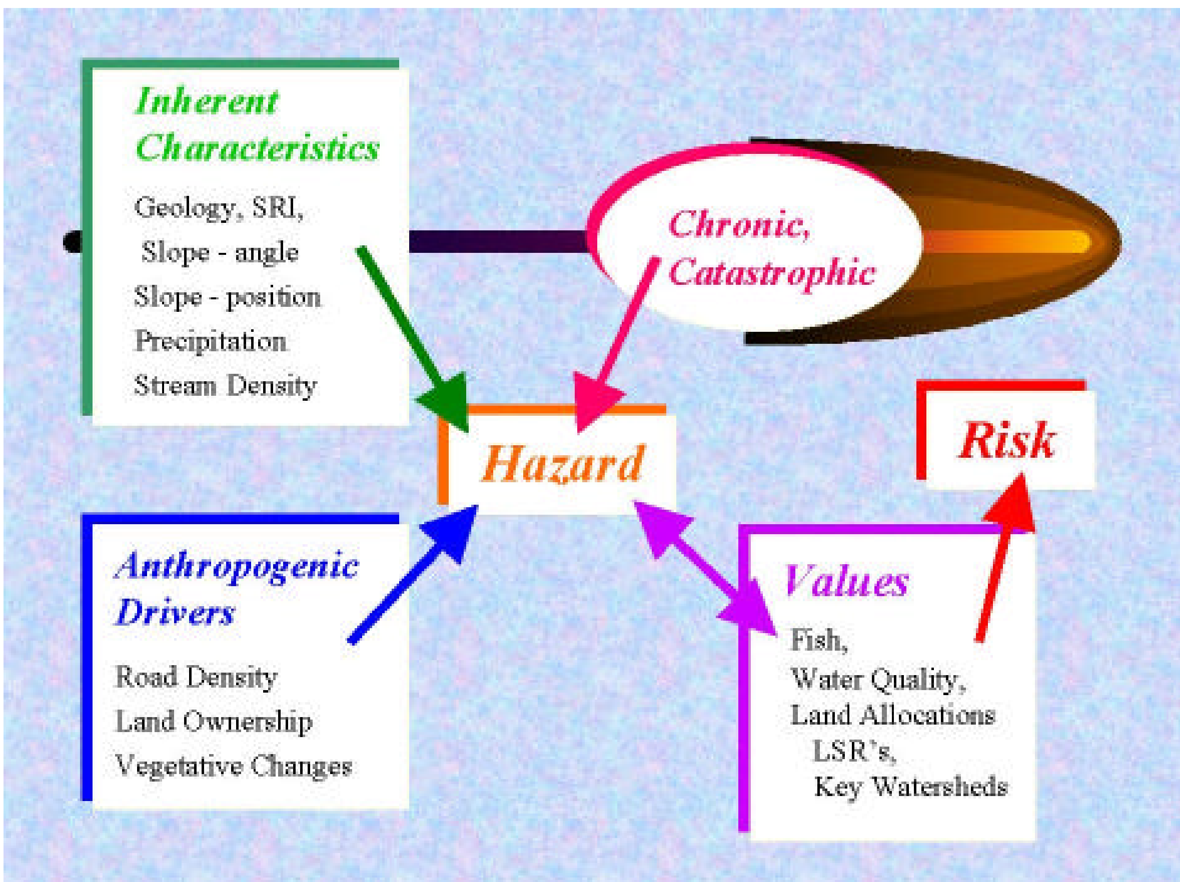
October 1998

Introduction

Roads interact and affect watershed resources and processes in four principle ways in westside Cascade Mountains of the Pacific Northwest Region. Roads interact and influence the production of both fine and coarse textured sediment thus influencing water quality, their position on steep hillsides often intercepts and daylights subsurface flow, routing such flow more quickly to adjacent channels potentially increasing peak flows. Additionally, road location within riparian reserves can influence the meander patterns of adjacent streams effecting a streams' ability to move its sediment and finally, roads within riparian reserves potentially affect a host of processes and resources associated with such reserves - everything from the availability of large wood, access to streams by recreationists, and movement of wildlife from upland areas to and through riparian areas.

While we will be doing a Forest-wide look at road conditions it is only by examining the distribution of various parameters of impact at a watershed and perhaps subwatershed scale that we can begin to understand the spacial distribution and intensity of those impacts.

The following simplified conceptual diagram will serve to order the process thinking about how watershed resources were assessed in this analysis.



Each watershed or landscape has a set of Inherent Characteristics which predispose it to impacts from Anthropogenic Drivers. These Inherent Characteristics are such things as the underlying geologic types, the soil characteristics, the slopes, the amount and distribution of precipitation and the stream density. All of these can be displayed as frequency distributions. Displaying information in this manner allows the analyst to view the distribution between various watersheds and to determine those more or less predisposed to impacts. Once this is determined a set of change agents, called Anthropogenic Drivers in the above diagram, act upon the Inherent characteristics to produce a Hazard. Hazards will vary across a watershed in response to different characteristics being acted upon and the spatial distribution of hazards will likewise be variably distributed.

Acting upon these various hazard areas are a set of physical processes, either chronic or catastrophic in nature, that produce impacts in terms of the four broad issues listed below. An example of such processes is the interception of subsurface flow by roads in middle slope positions within a watershed and the routing of such flows more quickly to adjacent channels potentially increasing peak flows and moving additional fine and coarse textured sediment. This is the point in the analysis process where Key Questions are asked in an analytical mode and the results displayed as frequency histograms.

Since the real work of Roads Analysis is basically a risk analysis the results of the interactions of the physical processes on various hazards must be analyzed in light of the particular value that we assign to a given area. Such values could include areas of known bull trout habitat, municipal watersheds, and the various land management allocations shown in Forest plans. It is at this point that the bias of the analyst, which reflects in some cases, the bias of society plays a role in determining the risk associated with a particular road segment.

Issues and Key Questions

As stated above roads can affect watershed conditions and process in four general areas which define the broad **Issues**:

1 - Water Quality-- as reflected by sedimentation from both surface erosion and potential increases in mass movement such as debris avalanches and debris flows and potential impacts to toes of earthflows producing fine grained sediment. Due to a stochastic climate acting upon a highly variable landscape, both in terms of process and formation, sediment is produced in a series of pulses often associated with periods of high flow. A risk assessment must be set in terms of the driving variable, i.e., sediment is not produced at all times within a watershed and is not produced in equal quantities for each individual storm event. Some are bigger than others and climate is the driving variable.

2. Water Quantity-- as reflected by potential increases in peak flows due to interception of subsurface flow particularly in mid-slope positions by roads and routing of water more quickly to stream channels.

3. Geomorphic- as reflected by the position of a roads or road segments adjacent to major stream channels - potentially reflected by flood plain location. Assessment would be for areas adjacent to major streams that potentially have their meander bends truncated due to road location.

4. Riparian - as reflected by the presence of roads within NWFP riparian reserves. Assessment would not be for Wildlife impacts to riparian reserves but the two may end up coincidental.

Key Questions for Water Quality:

AQ1 - ***How does the road system affect fine sediment that enters streams, lakes and wetlands?***

AQ2 - ***How does the road system affect mass soil movements that affect aquatic or riparian ecosystems?***

AQ4 - ***How does the road system modify drainage density which affects water quality and quantity?***

AQ10 - ***How does the road system affect risks to water quality from chemical spills or roadway applied chemicals, such as oil, de-icing salts, herbicides, and fertilizers?***

AQ12 - ***How does the road system affect wetlands?***

Key Questions for Water Quantity:

AQ4 - ***How does the road system modify drainage density which affects water quality and quantity?***

AQ5 - ***How does the road system affect movement of groundwater?***

Key Questions for Geomorphic:

AQ8 - ***How does the road system affect key interactions between aquatic and terrestrial systems?***

AQ9 - ***How does the road system alter the storage capacity of stream channels for coarse woody debris, sediment, and organic matter?***

AQ11 - ***How does the road system affect channel structure and geometry, and isolation of floodplains from their channels?***

Key Questions for Riparian:

AQ2 - ***How does the road system affect mass soil movements that affect aquatic or riparian ecosystems?***

AQ5 - ***How does the road system affect movement of groundwater?***

AQ8 - ***How does the road system affect key interactions between aquatic and terrestrial systems?***

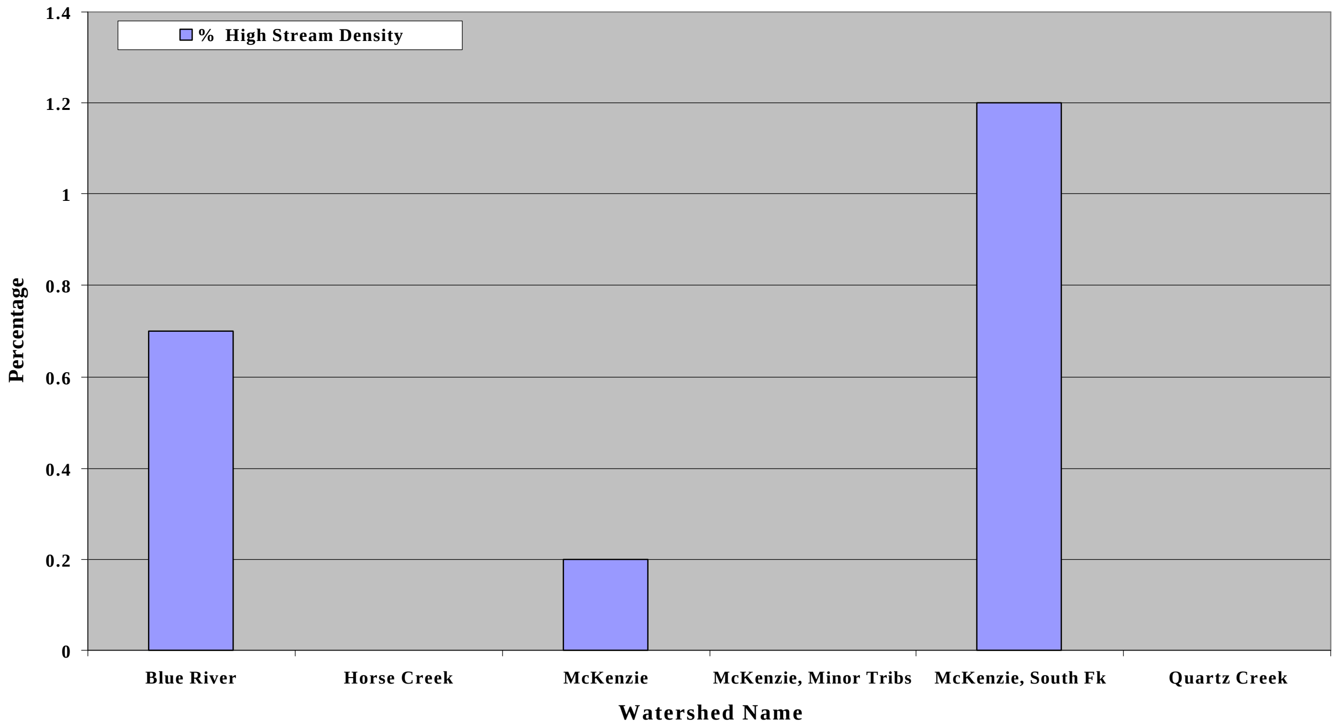
AQ11 - ***How does the road system affect channel structure and geometry, and isolation of floodplains from their channels?***

AQ12 - ***How does the road system affect wetlands?***

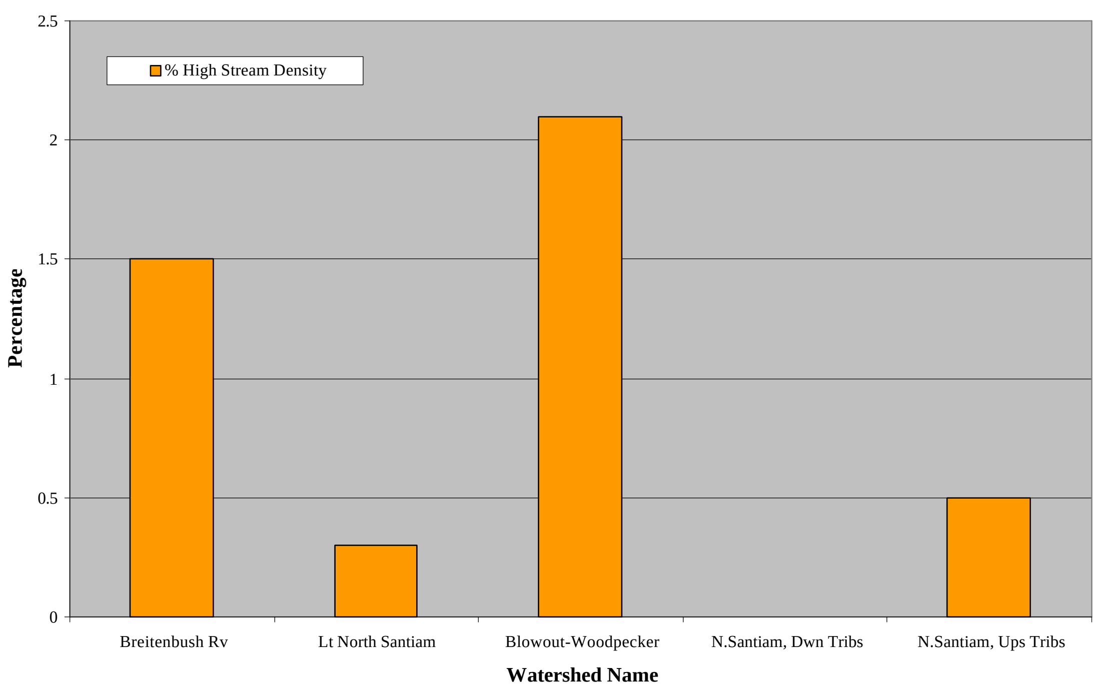
Analysis Techniques and Tools

A series of initial maps and associated data were produced to assess inherent conditions of watersheds across the Forest. **Map ra5: Stream Density** was constructed using the Moving Windows AML in ARC-INFO and was initially meant to assess particular locations in a given watershed that have higher stream densities and to help to sort between watersheds having a higher percentage of area in high stream density. This map pointed up the difficulties of doing this at a Forest scale. Intermittent streams were not mapped in a consistent manner across the Forest and thus some watershed, i.e., South Fork of the McKenzie River, show extremely high levels of stream density. In this watershed intermittent streams were extended into all of the contour crenulations shown on a topographic map. Field verification of streams was done in other watersheds. Thus comparisons of streams density across the Forest, between watersheds, becomes a relatively meaningless exercise. Comparisons of stream density by sub-watershed within each larger watershed may be more meaningful if consistent mapping techniques were applied in the watershed. In an attempt to deal with this discrepancy we determined stream density using only perennial streams, as their known locations and mapping are more consistent across the Forest. (**Map ra5: Stream Density - Illustrating density of Class 1-3 only)**. The following two histograms illustrate that there are only minor portions of each watershed in high stream density classifications but those areas should be the ones that are of particular interest for further investigation. (Note: I did not display all of the watersheds on the Forest - the histograms are for demonstration purposes. They serve to point out the type of analysis that should be done on a sub-basin level.)

% High Stream Density - McKenzie Sub-basin



% High Stream Density - North Santiam Sub-basin

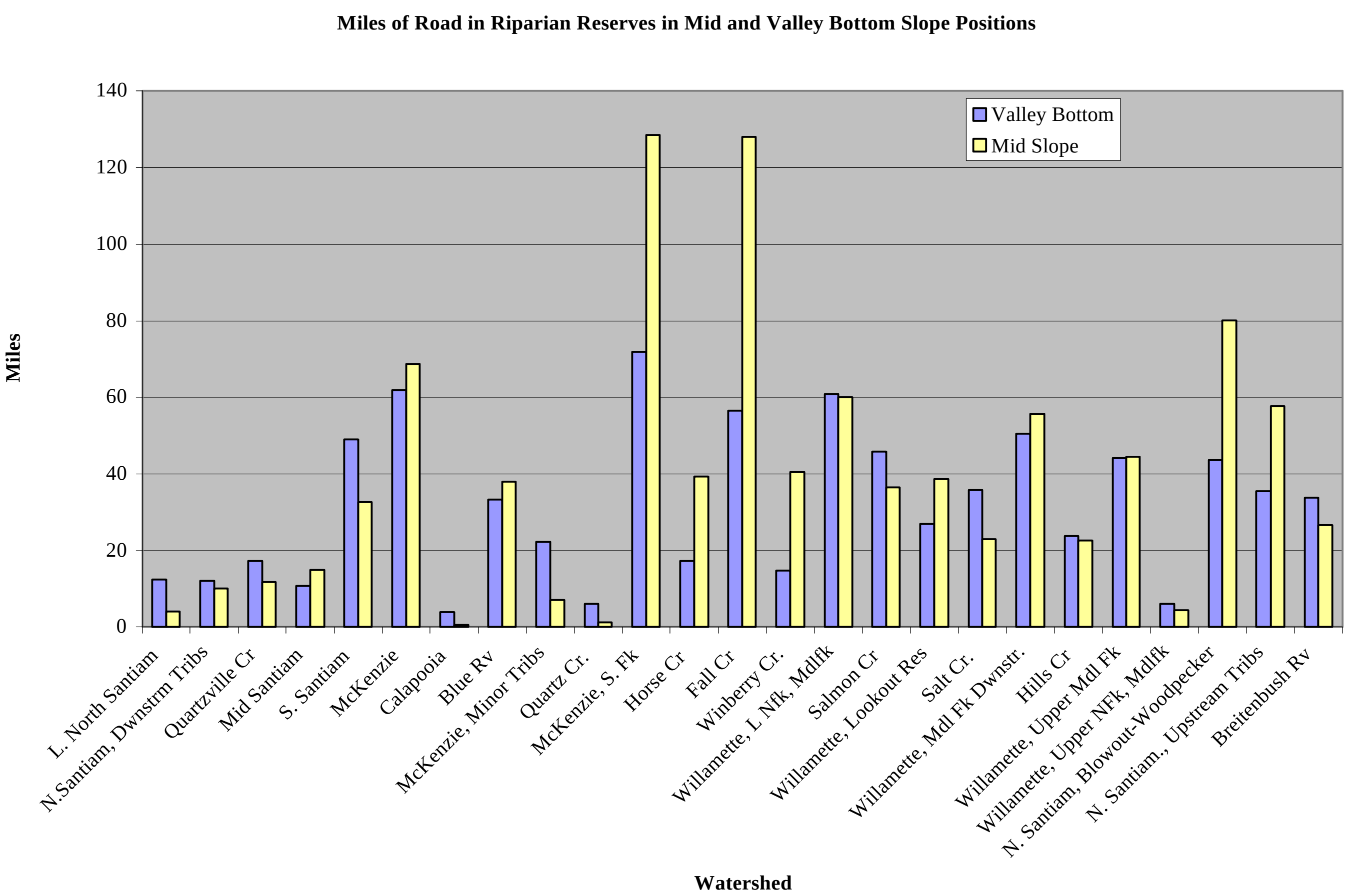


While this exercise helped to point out some areas in particular watersheds of high stream density it does not deal with periods of flooding and sediment movement when all of the stream network is active. Thus a consistently mapped GIS stream layer is critical to a Forest-wide analysis.

Map ra4: Road Density was constructed using the Moving Windows AML in ARC-INFO and the most current transportation layer in our GIS. .

SLOPE ANGLE distribution and **SLOPE POSITION** distribution was also done Forest-wide. Slope angle was done from a 10 meter DEM. Slope Angle was determined using 0-20, 21-40, 41-60, 61-80 and > than 80% slope categories. Slope Position distributions were done from the 10 meter DEM using the SLOPEPOSITION command in ARC-INFO originally designed by David Hatfield, R6PNW Regional Office. The command creates a grid of slope position from a grid of elevation. In order to deal with sinks and peaks in the slope profile a 50 meter default value was used to smooth the slopes. This was done to level small peaks so that the uphill flow accumulation of data is continuous along the ridgetops. The grouping of valley bottom, mid-slope and ridgetop were done by grouping the bottom 10% into valley bottom, the middle 80% into mid-slope, and the upper 10% into ridgetop.

Soil Resource Inventory (SRI) and Geology map layers were used directly from the Willamette National Forest GIS data layers. SRI data is updated through field verification on an on-going basis by District soil scientists.



Findings and Results

AQ1 - How does the road system affect fine sediment that enters streams, lakes and wetlands?

This question was addressed using a combination of mapped Quaternary Landslides (earthflows) with streams and roads located on such terrain. **Map qa1** shows the distribution of the combination of road, stream and earthflow areas and as such would indicate areas of greater concern for the production of fine sediment. Watersheds shown in pink on the map: North Santiam River - Blowout to Woodpecker, South Fork McKenzie River, Salmon Creek and Upper Middle Fork Willamette River are the watersheds that contain a high percentage of area in the above combination. In the combined chart and map of sub-watersheds with areas of environmental concern all of the subwatersheds that contained these earthflows were listed.

AQ2 - How does the road system affect mass soil movements that affect aquatic or riparian ecosystems?

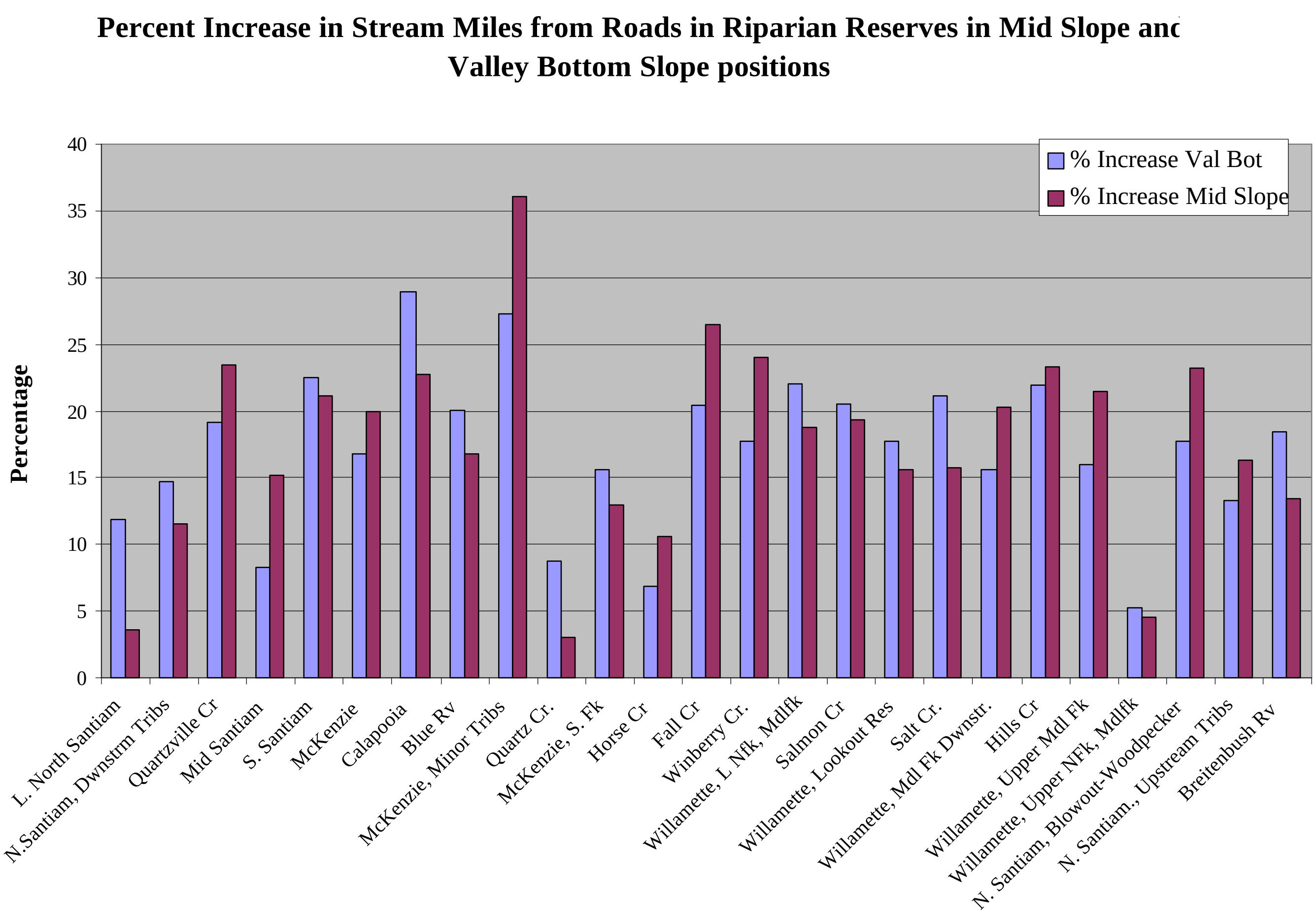
Map ra6: Unstable soils and Quaternary Landslides was developed to show areas of concern for mass soil movements. Soil mapping units (SRI) designated as Unstable and units designated as Potentially Unstable were mapped in an attempt to show areas that could become involved in surficial landslides, debris flows and debris torrents. Quaternary Landslides were mapped as areas of mass movement that could be impacted by roads and potentially produce greater quantities of fine sediment. This map was originally designed to be an overlay for other layers but due to mapping and viewing considerations it became very problematic. It would be appropriate to use as a combination of road density with the particular unstable area classifications. The hazard in this case would increase with higher road densities within each category. Due to time limitations we did not attempt to define areas.

While culvert and bridge crossings do not affect the drainage density in a watershed they do affect streams and drainages in a watershed by constricting flows during periods of high runoff. Additionally, they often are the focus points for damage from culvert plugging and subsequent road failure adding to the amount of soil mass movement. **Map aq2a: Road and Stream Intersections** was developed to begin to address this question of channel change as a result of road crossing. Two levels of analysis were attempted with this map. First we tried to densify the map using 100 foot contour intervals to see if crossing varied by position in the watershed. The second method of examining this data involved determining the distribution of crossings by slope position.

AQ4 - How does the road system modify drainage density which affects water quality and quantity?

A combination of road mileage with slope position in riparian reserves was developed in order to assess the impact of roads in mid-slope and valley bottom slope positions on the potential for increases in peak flows due to interception of subsurface flow and more efficient routing of water to channels. The concept of hydrologic connectivity is important in determining the extent of these impacts. To determine the extent of channel extension we used the miles of road within riparian reserves, as defined in the Northwest Forest Plan, as an indicator of hydrologic connectivity. Field verification of such connectivity would be ideal but beyond the scope of this analysis. The following histogram displays the miles of road by watershed within riparian reserves.

The issue of different stream mapping causing different stream densities shows up once again in the above histogram with the South Fork of the McKenzie River and Fall Creek showing the highest number of miles in mid-slope riparian reserves. This undoubtedly is an artifact of the mapping problem mentioned above. To address the question of increases in peak flows due to interception of subsurface flow by roads it is important to take into both slope positions shown in the histogram. (See below for discussion on riparian impacts) To attempt to account for the differences in mapping techniques used by different Districts, a histogram of percent change in stream miles was developed by assuming that the miles of road within riparian reserves became part of the active stream network, especially during a storm event.



As with the earlier histogram this one presents a somewhat bias picture of the potential for actual channel change due to increases in the stream network from roads within the riparian reserves. For instance, the Calapooia River watershed only contains 13.5 miles of Valley Bottom streams and 2.2 miles of Mid Slope streams (as mapped on National Forest Land) and there are 3.9 and 0.5 miles of road in each of the respective classes. Thus a percent increase is rather dramatic but an actual channel impact will be negligible due to small overall amount of road. The average percent increase in Valley Bottom stream miles was 17.14% with a median value of 17.75%. The average percent increase in Mid-Slope stream miles is 17.57% with a median value of 18.81%.

AQ8 - How does the road system affect key interactions between aquatic and terrestrial systems?

AQ9 - How does the road system alter the storage capacity of stream channels for coarse woody debris, sediment, and organic matter?

AQ11- How does the road system affect channel structure and geometry, and isolation of floodplains from their channels?

The above three questions were addressed by combining the Road Density mapping with the Riparian Reserves as identified for individual stream segments in the Northwest Forest Plan **(Map w2 - Road Densities in Riparian Reserves)** It is not possible at the Forest level of analysis to determine how the functions of floodplains and channel structure and geometry are affected by a particular road location. However by knowing the locations of high road density, defined in this analysis as > 4 mi/sq mi, a District analyst could prioritize field locations for on the ground examination. Additionally, by looking at the miles of road in riparian reserves in valley bottom slope positions an approximation of riparian impacts to areas along major streams becomes possible.

AQ10- How does the road system affect risks to water quality from chemical spills or roadway applied chemicals, such as oil, de-icing salts, herbicides, and fertilizers?

Due to time limitations we did not address this question. Major transportation routes thru the Forest, namely Oregon State highways, are where the majority of the de-icing and herbicide applications take place and they transport a great deal of chemicals via truck traffic. A risk assessment was done by the Eugene Water and Electric Board, the water purveyor for the city of Eugene, and other risk assessments were done by the Oregon Department of Transportation on these cross state routes. These documents are available from the various agencies.

AQ12- How does the road system affect wetlands?

(see Appendix E, Botany process paper)

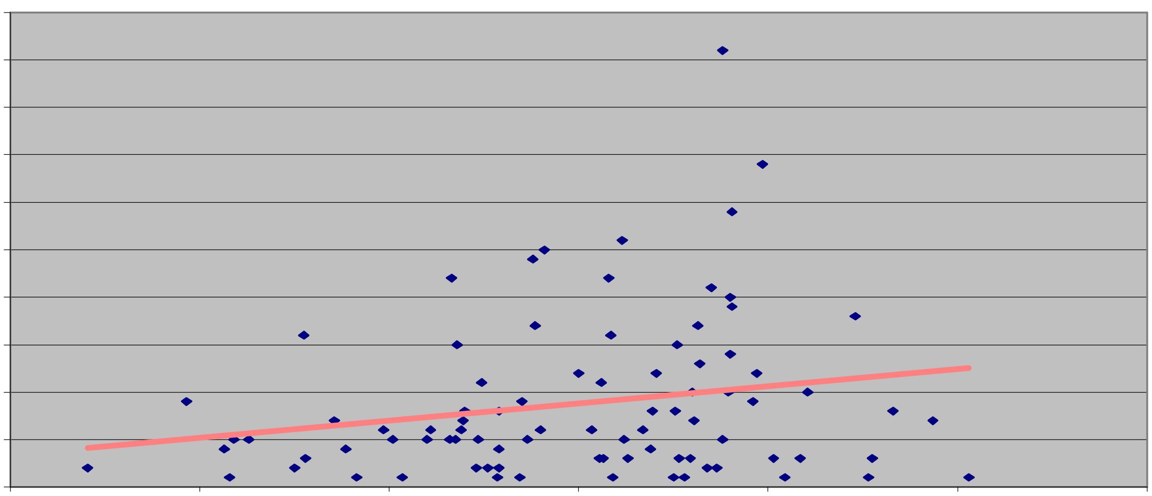
Synthesis of Data

In order to develop areas of particular concern two maps were developed **(Maps ra3 - Slope Position).** These maps show combined areas of high road density, mid-slope position, high stream density on earthflow terrain. Initially a map was developed using a high road density calculation of >4 mi/sq mi. Numerous areas across the Forest showed up as meeting the above criteria in the combination. So much so as to not be extremely helpful in prioritizing areas for on the ground examination where various road repair or removal options could be applied. The reason we chose >4mi/sq mi was to correspond to stated levels of concern for fish species resulting from that road density. A second iteration of this map was completed using a >6 mi/sq mi criteria for road density and this proved to be much more definitive. Small areas that could be called 'hot spots' showed up and would be useful of watershed scale, on the ground examinations. In the combined chart and map of sub-watersheds with areas of environmental concern all of the subwatersheds that contained the areas of >6 mi/sq mi were listed (see Map ra3 – Slope Position).

Further Investigations:

The Forest has catalogued all of the ERFO and the majority of the non-ERFO sites resulting from the floods of 1996. This information will serve to validate in a real sense some of the projections of inherent vulnerability about particular portions of watersheds. There are over 1,000 ERFO sites catalogued from the 1996 storms and an additional 200+ non-ERFO sites. In addition we have ERFO sites from the 1986 storm event and are currently working on other past storm events. Investigations using this data will allow us to validate some of the assumptions we have made around the driving variables for flood damage. For instance, we examined the relationship between road density by sub-watershed across the Forest with number of ERFO sites recorded for each. The following figure is a scatter chart of this data with a linear regression line fit to it.

As is clearly evident there is a lot of variability in the data and road density alone does not expla the distribution of ERFO sites across the Forest. Further investigations of this data using such parameters as Bedrock Geology, Geomorphology, Precipitation Intensity, Slope Position, Slope Angle etc. could all be combined or mixed in various ways to attempt to analyze the data and validate the



biases used in our analysis.

The roads analysis will nest nicely with the need for new techniques for assessing Watershed Cumulative Effects. Much of the conceptual structure and the analysis techniques can be used and augmented for this type of analysis. This work will continue during this year with a completion date around the end of calendar year 1999.

Process critique

Doing a roads analysis at the Forest level presents some problems for the analysis of watershed resources. Comparisons of such things as stream and road density is only possible if consistent mapping was used across the Forest for identifying such items. In the case of streams this was not done. One District had field verified streams, including intermittents, while another extended the drainage network to all contour crenulations. Such differences result in different stream densities between watersheds, i.e., the watershed with the extended contour crenulation mapping, showed much higher stream density than those elsewhere on the Forest. Thus while it may be possible to discriminate between subwatersheds in a watershed where the same mapping techniques were employed it becomes problematic when comparing between watersheds across the Forest.

Sediment production in Pacific Northwest watersheds is closely tied with climatic variability and the process does not contain a temporal component that would allow an analyst to set the hazard in terms of their potential for occurrence.

There has been some discussion about accuracy of the data. It is my opinion that consistency is more important than accuracy especially for stream mapping. It is doubtful if we will ever be able to accurately map all of the streams on the Forest, especially when dealing with the extent of the intermittent channels. Consistency of mapping would allow us to make comparisons between watersheds and sub-basins. Under the current mapping this is not possible.

References

Benda, L.E., Miller, D.J., Dunne, T., Reeves, G.H., Agee J.K., Dynamic Landscape Systems, in River Ecology and Management, Chapter 11, edited by R. Naiman and R.Bilby, Springer-Verlug, N.Y., 1998.

Caine, N.,: Rainfall intensity-duration control on shallow landslides and debris flows, Geografika Annaler 62A:23-27, 1980.

Jones, J.A., Grant, G.E., 1996, Peak Flow Responses to Clearcutting and Roads in Small and Large Basins, Western Cascades, Oregon, Water Resources Research, Vol. 32, No.4, Pages 959-974.

Lewis, H.W., Technological Risk, Chapter 2, W.W. Norton and Company, N.Y., 1990.

Sidle, R.C., Pearce, A.J., O'Loughlin, C.L., Hillslope Stability and Land Use, American Geophysical Union, Water Resources Monograph 11, 1985, p 90.

Ziemer, R.R., Temporal and Spatial Scales, in Watershed Restoration:principles and pracitces, edited by J.E. Williams, C.A. Wood and M.P. Dombeck, American Fisheries Society, 1997,

Willamette National Forest Pilot Road Analysis

Appendix C

Fisheries Process Paper

October 1998

Background Statement

Aquatic species of interest on the Willamette NF include those currently considered as PETS (proposed, endangered, threatened, or sensitive): bull trout (threatened); spring chinook (proposed threatened); winter steelhead (proposed threatened); and Oregon chub (endangered). Also of interest are native rainbow trout (including the McKenzie "redside" rainbow); native coastal cutthroat trout (including Hacklemann cutthroat); introduced summer steelhead; and introduced brook trout. Several other fish species occur on the forest, but they will not be discussed in this pilot project, including five sculpins, two dace, two lamprey, mountain whitefish; suckers; squawfish; and warmwater fishes that have been introduced into the reservoirs behind Army Corps of Engineer dams.

Roads influence the health and distribution of aquatic species on National Forest System lands by several mechanisms:

a) impacts to riparian areas can lead to: loss of streamside shade; loss of nearstream vegetation which would otherwise provide a pathway for nutrient inputs (e.g. insects, leaves) and large woody material: reduction or loss of a filter which prevents sediment from entering the stream course; compaction or loss of floodplains; destabilization of steep slopes adjacent to streams; channelization of the stream course; allowing access to people that may result in behaviours such as poaching, vandalism, or litter, and localized erosion from vegetation removal/trampling.

b) impacts to stream channels due to inherent/natural characteristics of watersheds where road building on soils with moderate and/or high potentials for fine sediment; unstable soils; or severe erosion, especially on steep slopes, may lead to excessive fines entering stream channels. The fines are likely to settle in relatively low gradient, depositional sections of stream channels that are often favored as spawning sites by salmonid species. Fines interfere with reproductive success by interrupting the ability of eggs to metabolize and/or smothering young fish that have not emerged from the interstitial spaces of spawning gravel areas.

c) increase in risk of impact by roads to stream channels and aquatic species due to events related to management: the age of a road, the surface material, the number of stream crossings and drainage features, the density of roads, together with the percent of a watershed that has been harvested (e.g. hydrologically unrecovered) are all factors which can interact with the inherent characteristics to increase the risk that roads in a given watershed may be impacting beneficial uses such as fish reproduction, distribution, and survival. Such events are most likely to occur through chronic impacts (e.g. sedimentation from road and roadside run-off, fish distribution restrictions and alterations in stream channel morphology due to improperly sized or placed culverts), or to more significant episodic events such as floods or catastrophic fires which may lead to increased runoff and impacts to water quantity and quality.

Process description and documentation

Issues and Key Questions

The two main issues identified which are directly related to fisheries are:

1. ***How and where do roads affect fish populations?***
2. ***How and where do roads affect fish habitat?***

The issue begins with identifying which watersheds and subwatersheds are important for fish or other aquatic organisms of interest. In the Pacific Northwest the focus is salmonid spawning and rearing, and whether or not the population status of a species is known. The methodology for determining sample units and status was similar to that used for the Interior Columbia Basin Ecosystem Management Project (Volume III PNW GTR-405 USDA/USDI 1997). Sixth Field subwatersheds were the sample unit and the status of naturally producing populations was rated with the following criteria:

- **Present – strong:** (no populations are known to meet this criteria which includes: stable or increasing numbers; all major life history forms are present that were historically present; and the population includes 500 adults within the Sixth Field. It is probable that some of our native cutthroat and rainbow trout populations meet this criteria, but we do not have valid information to document this).
- **Present – depressed:** (populations that meet this criteria must have one of the following characteristics: a major life-history component has been eliminated; numbers are declining or less than half of the historical habitat is occupied; or total abundance is less than 500 adults).
- **Absent:** this was modified from the ICBEMP to be defined as Sixth Fields where the species is extinct (primarily due to passage blocking large flood storage dams on the Willamette National Forest) and does not include subwatersheds that were never occupied by the species.
- **Present** migration corridor (does not support spawning or rearing, but functions as a route or wintering area for migrating fish).

During analysis with other resource areas the criteria listed above were lumped into the categories of :

- "**T&E occupied**" which means that either bull trout, winter steelhead, spring chinook, Oregon chub or a combination of those species occur in the subwatershed and the subwatershed is used primarily for spawning/rearing, or migration.
- "**Historic T&E**" which means that the subwatershed once supported bull trout, winter steelhead, spring chinook, or a combination of those species and was used for spawning/rearing and migration.

Subwatersheds currently occupied by bull trout, winter steelhead, spring chinook or Oregon chub were identified, as were watersheds of historic occupation, which will be important for consideration during species recovery planning under the Endangered Species Act. These watersheds were compared to other resource "hot spots" to provide a Forest level idea of priority areas for road and transportation system management.

Table 1. Sixth Field subwatersheds important for fish production or migration

Fifth Field/ Sixth Field	Bull Trout	Spring Chinook	Winter Steelhead	Oregon Chub	Native Resident
Little North Santiam					
01-1	absent	present - d			present
01-2		present - d			present
Breitenbush					
02-1	absent	absent	absent		present - d
02-2	absent	absent	absent		present - d
Middle North Santiam					
78-2		absent	absent		present - d
78-4		absent	absent		present - d
78-6	absent	absent	absent		present - d
78-7	absent	absent	absent		present - d
Upper North Santiam					
79-1	absent	absent	absent		present - d
79-2	absent	absent	absent		present - d
79-3	absent	absent	absent		present - d
South Santiam					
06-1	absent	absent	present - d		present - d
06-3		present - d	present - d		present - d
06-9			present - d		present - d
McKenzie					
07-1	present - d	present - d			present - d
07-3	present - d	present - d			present - d
07-4	present - d	absent			present - d
07-5					present - d
07-6	absent	absent			present - d
07-7	present - d	present - d			present - d

Fifth Field/ Sixth Field	Bull Trout	Spring Chinook	Winter Steelhead	Oregon Chub	Native Resident
Calapooia					
09-1		present - d	present - d		present - d
Blue River					
10-1		absent			present - d
10-2					present - d
10-4					present - d
Lower McKenzie					
11-1	absent	present - d			present - d
11-3	present - d	present - d	Summer steelhead		present - d
Quartz Creek					
12-1		present - d	summers		present
South Fork McKenzie					
13-1	migrate	migrate			present - d
13-2	migrate	present - d			present - d
13-3	migrate	present - d			present - d
13-4	present - d	present - d			present - d
13-5	present - d				present - d
13-6	present - d	present - d			present - d
Horse Creek					
14-1	present - d	present - d	summers		present - d
14-2	present - d	present - d	summers		present - d
Fall Creek					
15-1		present - d	present - d		present - d
15-2		present - d	present - d		present - d
15-3		present - d	present - d		present - d
Winberry					
16-1		present - d	present - d		present - d

Fifth Field/ Sixth Field	Bull Trout	Spring Chinook	Winter Steelhead	Oregon Chub	Native Resident
North Fork Middle Fork Willamette					
17-1	absent	absent			present
17-2	absent	absent			present
17-5	absent	absent			present
Salmon Creek					
18-1	absent	absent			present - d
Lookout Reservoir 19		absent		present	present - d
Salt Creek					
20-1	absent	absent		present - d	present - d
20-2	absent	absent			present - d
Middle Fork Willamette					
21-3	migrate	present - d			present - d
21-4	migrate	present - d			present - d
Hills Creek					
22-1	absent	present - d			present - d
Upper Middle Fork Willamette					
23-1	present ?	absent ?			present - d
23-3	present ?	present - d			present
23-4	present - d	present - d			present - d
23-5	present ?	present - d			present - d
23-6	migrate	present - d			present - d
Upper North Fork Willamette					
24-1	absent	absent			present

Documentation will be provided by having a Forest-wide map that illustrates: administrative boundaries, lakes, Class I and II streams, 5th Fields ("watersheds"), 6th Fields ("subwatersheds"), with certain 6th Fields highlighted for importance, especially of spawning, of the various salmonids and the Oregon chub. This map will be produced on a transparent mylar layer so that it can be posed on top of the transportation layer, hydrological and geological information/areas of concern. Recreation, other social, wildlife and other spatially located information can also be compared to aquatic values for further analysis. Spatial knowledge can be obtained of the areas of high risk to aquatic beneficial uses based on either inherent or managed characteristics. Another result will be a table highlighting 6th Field subwatersheds within 5th Field watersheds that may be a priority for taking further steps and designing a site-specific action or project through later ATM and/or NEPA process.

Findings and Results

Key Questions from the 8/16/98 Appendices - Fisheries/Aquatics response:

AQ(1) ***How does the road system affect fine sediment that enters streams, lakes, or wetlands?***

At the Forest scale a map was produced of quaternary landslide geology, which was presumed to be a high risk source for fine sediments to aquatic systems. We do not take direct measurements of fine sediment in our streams, but have made estimates for embeddedness or substrate size distribution of individual channel habitat units during low flow summer stream inventories. At the scale of analysis done for Pilot Roads there is no definitive answer for this question as it relates to site specific aquatic species habitat or survival. During watershed analysis some riparian roads were noted as affecting fine sediment in aquatic habitat due to chronic maintenance problems.

AQ(2) ***How does the road system affect mass soil movements that affect aquatic or riparian ecosystems?***

A count of ERFO (flood events from major weather systems in 1964, 1986, and 1996) sites was summed for each Sixth Field subwatershed and compared to overall road density in that Sixth Field. There was a slight increase in the trend of ERFO sites as road densities increased, but without further evaluation of the watershed characteristics and the ERFO data this information does not provide any great insight.

AQ(3) ***How does the road system affect sedimentation downstream (aggradation of channels, reservoirs)?***

In the Western Cascades major channel changes, including noticeable aggradation often occur during high flow flood events. The road system, as well as harvest units, were documented as contributing to stream aggradation at specific sites on the Forest after the floods of 1996. The result of the Pilot Road Analysis at the Forest scale points to watersheds with high numbers of stream/road crossings. Further analysis, which would look site specifically at channel reaches that are impacted needs to be done at a smaller scale than the Pilot effort.

There is evidence of aggradation in areas of the large flood control reservoirs, but the contribution of non-road causes (e.g. wind and wave erosion, amounts of previous riparian harvest, and natural sedimentation) cannot be easily separated from the influence of roads.

AQ(4) ***How does the road system modify drainage density which affects water quality and quantity?***

Not addressed by fisheries. Ditto for AQ (5) How does the road system affect movement of groundwater?

AQ(6) ***How does the road system affect invasions of non-native aquatic species?***

As of 1998, the Willamette National Forest has not had a significant problem of accidental or intentional releases of non-native aquatic plants or animals (with the exception of bull frogs and warmwater fishes which were introduced many years ago for the most part). Non-native aquatic plants are beginning to be of concern. Many of these introductions are tied more to the presence of large amounts of reservoir habitat, and less tied to the road system. The road system does allow the State of Oregon to accomplish fish stocking for recreational fishing. They use a combination of native and non-native salmonids, and have used less non-native species/stocks as ecological concerns have increased over native aquatic species.

AQ (7) ***How does the road system affect at-risk aquatic species through changes in public access resulting in increased fishing-related mortality or habitat loss?***

The fact that most of the main rivers and many of the larger fish-bearing tributaries outside of Wilderness have riparian roads has allowed people access for legal and illegal angling. Where we have an at-risk species, such as bull trout, which has been impacted by many factors (State of Oregon eradification efforts in the 1950's and 1960's; habitat impacts due to pre-1990 National Forest management practices; and liberal angling regulations up to the mid-1990's) there is concern about poaching and it does occur. Part of this issue relates to dispersed camping site access to rivers, part to the lack of both state and Forest Service law enforcement capabilities, and part due just to the location of roads next to streams where bull trout migrate, spawn and/or rear. The U.S. Fish and Wildlife Service would like the Forest Service to take a hard look at these roads in the long term, as they relate to bull trout recovery. In some cases the road is an established paved travel route (e.g. scenic byway) and there is limited possibilities to relocating the road. Dispersed access is an issue that can be (and is being) addressed to a certain extent, but not significantly analyzed in this pilot effort.

Habitat loss due to roads located in riparian areas does contribute to loss of shade, loss of floodplain, constriction of channel reaches, and has allowed for easy access to remove large instream or near-stream wood until policies changed for a wider range of ecosystem values in the 1990's. These types of impacts are fairly common on the Willamette National Forest outside of Wilderness and many of these situations were identified in Watershed Analysis. As follow-up to Watershed Analysis some of these site specific impacts will be addressed or are currently being addressed. There are some key stream reaches occupied by at-risk bull trout, winter steelhead, and spring chinook that do not have riparian roads and these areas provide refugia that are likely to remain protected into the future.

Due to time and a limited data set, we did not take a statistical look at fish population status as correlated with road density. In the Columbia Basin assessment the result was documented that there was an increasing absence and decreasing proportion of strong non-anadromous salmonids with increasing road densities at the Sixth Field subwatershed scale. The strongest aquatic populations were associated with the lowest mean road densities.

AQ (8) ***How does the road system affect key interactions between aquatic and terrestrial systems?***

Density of roads within Riparian Reserves was analyzed during this Pilot effort. That analysis helped the team to identify the subwatersheds with the greatest amount of riparian road densities. The legacy of forest management prior to 1990, as discussed above, has left the landscape with many riparian roads and significant riparian areas that were clearcut to the streambank. Many of the impacts were analyzed during watershed analysis and included looking at stream temperature increases that could only be explained by timber harvest, which involved riparian harvest and sometimes roads and even landings in riparian areas. This in turn has impacted the ability of streams to support native salmonids due to loss of habitat complexity, and in some cases where warmer temperatures occur we have observed the movement upstream of fish species associated with warmer stream temperatures (e.g. redside shiners, squawfish, suckers).

AQ (9) ***How does the road system alter the storage capacity of stream channels for coarse woody debris, sediment, and organic matter?***

Due to the significant road infrastructure on the Willamette, some of it built before fish passage in smaller tributaries was of concern to managers, we know that the road system has altered the capacity of stream channels for large woody material. This is primarily due to culverts which are undersized, easily plugged by woody material, or failing because of their age. It is less clear if sediment and organic matter are prevented from moving downstream due to culverts. Because the road system has allowed for removal of instream and nearstream large woody material prior to 1990, that type of activity has allowed for **an increase** in the movement of sediment and organic matter downstream due to the decrease in hydraulic complexity of stream channel reaches (in contradiction to the question which talks about **prevention** from moving downstream). This lack of hydraulic complexity has been studied on the Willamette National Forest at Quartz Creek by Oregon State University, however the role of roads is not explicity examined in the study which covers several years of stream channel and fish data from 1988 to the present (1998).

AQ (10) ***How does the road system affect risks to water quality from chemical spills or roadway-applied chemicals, such as oils, de-icing salts, herbicides, and fertilizers?***

A main railroad follows along areas where the endangered Oregon chub reside. A main highway on the Forest crosses the two primary bull trout spawning streams left in the Western Cascades of Oregon. At this time the biggest impact from winter road treatments on the highway is the tons of cinder rock used to provide traction. These cinders end up in the spawning streams and are of concern to spawning and rearing habitat conditions. Salts are not the primary winter highway treatment, so have been less of a concern. Newer chemicals are being used, but based on the MSDS information they appear to be relatively safe. The biggest risk is most likely from transport of chemicals which could have a major affect on aquatic life if (when) a truck or railroad accident occurs.

AQ (11) ***How does the road system affect channel structure and geometry, and isolation of floodplains from their channels?***

This was not answerable at the Forest scale. We currently have smaller scale efforts ongoing on portions of the Forest which does get at this question: 1) Fall Creek ATM, and 2) Blue River Watershed Road Risk Assessment Study. The Fall Creek ATM effort uses an interdisciplinary risk/value analysis by road segment. The Forest took examples of ATM efforts on the Umpqua NF and carried them into site specific ATM for the Willamette NF's Fall Creek watershed with some modifications. The Blue River effort also works at the road segment scale. Examples of the site specific forms for data collection on Blue River will be attached to the final report. Watershed analysis also provides some examples of identified important stream reaches that are impacted by the road system due to constriction of the channel.

AQ (12) ***How does the road system affect wetlands?***

From an aquatic biological perspective, the road system has impacted small wetlands through both interception of existing small wetlands and creation of small wet areas by ground water interception. As awareness of the value of wetlands has increased over the last decade the road system has had less impact on existing wetlands of all sizes during road location and construction.

AQ (13) ***What indicators are most useful to define interactions between water, aquatic ecosystems, and roads?***

The following information is being collected in Blue River Watershed (see examples of field forms):

- Adequate information at a road segment scale for type, condition, and number of stream crossings.
- Road segment interaction with a stream's floodplain, where the road is parallel to the stream.
- Road surface type.
- Culvert fill failure risk.
- Sustained steep (>15%) road grades in excess of 500 feet.
- Percent of road with sideslopes >51%.
- Other items of interest for looking at impacts to the aquatic ecosystem:
- Road maintenance records, at a minimum a record of maintenance accomplished (date, type) including knowledge of site specific chronic or severe maintenance sites.
- Documentation of known spawning reaches with review by state and other agency biologists.
- Tracking of temporary road locations, construction, and decommissioning or obliteration, which is vital to endangered species act consultation, but not currently tracked in the Forest road database.

Key questions (in addition to the questions **AQ (1-13)** are:

- ***Where do the inherent and/or the managed characteristics of a watershed, with respect to aquatic values, display a high risk to aquatic beneficial uses?***

We did look at this in a cursory manner and the results are provided in the Pilot report.

- ***Where do streams/rivers have a road (or multiple roads) in the riparian reserve on both sides of the channel?***

There are places on the Forest where a multiplicity of roads appear, and site specific analysis is needed to define the need and proper amount of road. We did not get to this for scale and time reasons.

- ***Where are chronic maintenance problems or trouble spots and can they explain any stream channel or fish population conditions?***

Some of the Watershed Analyses provided very useful information on location of road maintenance problem sites, which is allowing the districts to follow-up at a project scale. This question also relates to the importance of knowing something about fish population status, which takes coordinated interagency and stakeholder cooperation to be most efficient and cost-effective for identifying populations to monitor.

References

US Department of Agriculture and US Department of Interior. 1997. *An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basin, Volume III.* PNW-GTR-405. Pacific Northwest Research Station. Portland, Oregon.

Appendix D

Terrestrial Wildlife Process Paper

October 1998

Contents

Introduction

The road network on the Willamette National Forest is extensive, totaling over 7300 miles of paved and unpaved roads. This road network can significantly alter wildlife habitats and negatively impact wildlife populations. The negative effects of roads on wildlife can be classified into three general categories: (a) edge effects; (b) barriers to movement; and (c) avenues for resource extraction.

Edge effects

Roads and intensive timber harvesting are the major causes of forest fragmentation on the Willamette National Forest. Forest fragmentation can threaten native wildlife populations by eliminating blocks of continuous habitat or by degrading the quality of remaining habitat for those species sensitive to an increase in the amount of forest edge. Forest fragmentation exposes the organisms that remain in the fragment to the conditions of a different surrounding habitat, and consequently, to what have been termed ‘edge effects’. Edge effects are the result of the interaction between two adjacent habitats, when the two habitats are separated by an abrupt transition (edge) (Murcia 1995).

The ecology of forest edges is characterized by changes in biotic elements (parasites, predators, and herbivores) and abiotic elements (microclimate, disturbance regime), both of which have been documented in bird and plant communities (Paton 1994; Yahner et al. 1989). If exposure to the edge modifies the features of the forest beyond their range of natural intrinsic variation, then the fragment’s area will be effectively reduced for conservation purposes (Murcia 1995). Although the juxtaposition of two contrasting habitats can produce effects on both, our concern is the effect of edges on the remnant forest patches.

During the daytime, forest edges typically have lower humidity, higher air temperatures, higher soil temperatures, increased solar radiation, lower soil moisture, and higher windspeeds, than interior forest. Physical edge effects from roads are expected to be similar, although smaller in magnitude, than edge effects from clearcuts into forests. On the Willamette National Forest, microclimatic variables in clearcuts can extend up to 240 m into adjacent late-successional forest (Chen et al. 1993, 1995, 1996; Brosofske et al. 1997).

The direct and indirect effects of altered microclimate along the forest edge manifest themselves in several ways. For example, several studies have shown that depredation and parasitism rates of birds’ nests increase as forests are fragmented into smaller and smaller patches (Hartley et al. 1998; Paton et al. 1994; Keyser et al. 1998). Amphibian distributions and abundance (Demaynadier et al. 1998), as well as plant distribution and abundance (Fraver 1994), are also known to be influenced by proximity to edges. In addition to these effects, noise from dense vehicular traffic degrades habitat, especially for avian communities (Klein 1993; Reijnen et al. 1995; Reijnen et al. 1996), and big game such as deer and elk (Thomas et al. 1979; Lyon 1983; Lyon et al. 1985; Wisdom et al. 1986).

Barriers to movement

A second major impact of roads on wildlife is as a barrier to species movement. The barrier effect is sensitive to both road width and traffic density (Forman and Hersperger 1996). As road width and traffic density increase, roads become more effective barriers to movement (Reudiger 1996). Roadkilled animals are conspicuous examples of the barrier effect. Many species also avoid roads. In this case, most animals remain at some distance from roads, and rarely or never attempt to cross. Hence, a once continuous large population is fragmented into smaller subpopulations. When populations become subdivided, there is increased risk of demographic fluctuation, local extinction of subpopulations, less recolonization after local extinction, and a progressive loss of local biodiversity (Soule 1987).

Avenues for resource extraction.

The extensive network of Forest Service roads also creates opportunities for humans to extract natural resources. Indeed, the construction of the vast majority of the Willamette's road system was to extract timber. In addition to timber harvesting, many animals (e.g., deer, elk, and bear) are hunted, and most hunters camp and hunt close to roads. "Special products" such as fungi, lichens, berries, and mosses are increasingly being collected on the Forest, and firewood collecting has traditionally been a common activity on the Willamette. To reduce hazards for public and Forest Service activities, snags (standing dead trees) are routinely removed from near roadsides. Generally speaking, human influences on the forest are greatest near roads, and decrease steadily with distance from roads.

Road density as an index to measure ecological effects of roads

Road density is a useful measure of the ecological effects of roads in a landscape (Forman and Hersperger 1996). Road density is defined as the total length of miles per unit area (e.g., miles/sq. mile). As road density increases, edge effects, barriers to faunal movement, population fragmentation, and human access usually increase, leading to significant changes in the biological community.

With the availability of GIS (Geographic Information Systems), it is very easy to calculate road densities across the landscape and display the results on a map. In this report, we calculated road densities in habitats of concern (using a "moving window" analysis originally developed for grizzly bear habitat analysis) and displayed the results on maps. This allowed us to locate priority areas, or "hot spots", for potential, future road closures and decommissioning.

A caveat on road data used in these analyses

For this pilot analysis, we used the best road data available for the Willamette National Forest, the transportation layer in GIS. Although there are known inconsistencies in the quality of the data across the Forest (see *Section 4: Current Situation* of the Willamette National Forest Roads Analysis), we feel the accuracy of the layer is acceptable for setting priorities for most wildlife and TES (threatened, endangered, and sensitive species) issues. Nevertheless, an updated transportation layer that is consistent across the Forest is desired so that priorities can be established with a higher degree of accuracy and reliability.

Process Description

List of issues and key questions

In the beginning of this analysis, we considered answering fourteen different questions pertaining to the impact of roads on wildlife and their habitats (**Table 1**). Of this original list of issues and key questions, we carried out analyses for the eight questions for which we had sufficient data to do so (questions 1-8 in Table 1). Because the results from two of the eight analyses (questions 7 and 8, Table 1) provided little additional insight, the results from these two questions are not reported here.

The six questions addressed in this document provide two general types of information:

a. *Quantitative* information on the overall, negative impact that roads have on habitats of concern (Questions 1-3).

b. *Geographically* explicit information on where priority areas, or "hotspots", are located (Questions 4-6). The maps produced to address Questions 4-6 will probably be the most useful for identifying areas of concern for wildlife.

How each key question was addressed

In this section, we briefly discuss the methodology used to address each of the six questions we analyzed for this report (Table 1).

Question 1: *Roadsheds created by state highways*

This was a very simple analysis, conducted at the Forest scale. To determine how the state highway system divides the Forest into major habitat blocks (i.e., roadsheds), we utilized the GIS layers with the road system (tran), and the boundary of the WNF (wil_bnd). From these two layers, we generated a new polygon coverage that shows the roadsheds of the WNF (**Map W1a**).

Questions that were analyzed in this report
1. How does the state highway system divide the Forest into major habitat blocks, or "roadsheds" (W1)?
2. Of the total amount of spotted owl habitat on the Forest, how much is impacted by the "edg effects" of roads (TW1, TW4, TW5)?
3. Of the total amount of interior, late-successional, habitat on the Forest, how much is influenced by the "edge effects" of roads (TW1, TW4, TW5)?
4. What are the current road densities in riparian reserves (W2)?
5. What are the current road densities in connected, late-successional, habitat in no-harvest status (TW1, TW4, TW5)?
6. Where does the current density of open roads exceed Willamette Land Management Plan objectives for big game (i.e., deer and elk) (W3)?
Questions that were considered and analyzed, but not included in this report*
7. What are the current road densities in spotted owl habitat (TW1, TW4, TW5)?
8. What are the current road densities in interior, late-successional, habitat (TW1, TW4, TW5)
Questions that were considered, but not analyzed, in this report**
9. How and where do roads affect special and unique habitats (e.g., caves, cliffs, meadows) (TW7)?
10. How and where does the road system affect the removal of habitat structural components (e.g., hazard trees/tree removal along roads, woody debris for firewood) (TW10)?
11. Which late-successional related species are affected by roads and how are they affected (W
12. How and where does the road system affect direct mortality (e.g., road kill, legal and illegal hunting) (TW8, TW9)?
13. How do road maintenance chemicals (e.g., de-icers, road oils) used on all roads affect wildlife? Which chemicals have adverse effects? (W5)
14. How, when, and where does the road system affect habitat of threatened, endangered, sensitive (e.g., wolverine), and proposed (e.g., Canada lynx) species habitat due to the proximity of roads to key habitat such as nesting, roosting, denning, and foraging areas (W

Table 1. Issues and key questions pertaining to the effects of roads on wildlife and their habitats. The number-letter combinations beginning with TW refer to specific questions developed by the National Roads Team. The number-letter combinations beginning with W refer to specific questions developed by the Willamette National Forest Wildlife Department.

*These two analyses were similar in scope and approach to Question 5. Due to their similarities, these two analyses identified the same resource "hot spots" as Question 5. Therefore, we only included the results for Question 5.

**Questions 9-13 were not analyzed because the data to address them were non-existent or inadequate. Question 14 could have been analyzed for spotted owls, but concerns for this species were already addressed with Questions 2-5, and 7-8. Question 14 is more appropriately addressed with project-level analyses. Question 9 was partially analyzed by the Botany Department.

Question 2: ***Edge effects on spotted owl habitat***

We conducted this analysis at the Forest scale, including all land allocations except wilderness and roadless areas. Results were then summarized by roadshed. The main GIS layers used for this analysis were: transportation (tran), roadshed (roadshed), and spotted owl habitat (ohab). The key logical steps in this analysis were:

1. *To generate a coverage showing the "edge effects" from roads.* Published results from the WNF (Chen et al. 1993, 1995, 1996; Brosofske et al. 1997) show that microclimatic variables (e.g., temperature, wind speed, and relative humidity) in clearcuts can extend up to 240 m (787 feet) into adjacent late-successional forest, while biological variables (e.g., sun scald, windthrow, response of understory plants) can be measured up to 120 m (394 feet). Although roads *per se* are expected to generate less edge effects than clearcuts, the vehicular and human uses of roads generate effects (e.g., noise, poaching, removal of snags and trees that pose hazards, etc.) that clearcuts do not. Based on these considerations, we considered edge effects from state highways to extend 240 m (787 feet), and from all other road types to extend 120 m (394 feet). Therefore, we generated an "edge effects" coverage by buffering state highways by 240 m (787 feet) and all other roads by 120 m (394 feet) (railroads and trails were not included in this analysis). A map was created that shows the roadsheds (not including Wilderness and Roadless Areas) with the edge effects erased from it (**Map W1b**).

2. *To create a coverage showing spotted owl habitat in each roadshed.* This is a simple GIS procedure to assign a roadshed value to each polygon of spotted owl habitat. From the spotted owl habitat layer, we selected only the "typical nesting" and "typical roosting" habitats.

3. *To erase the "edge effects" coverage from the roadshed coverage.* This step generates a new coverage that shows only the spotted owl habitat that is not impacted by edge effects from roads.

Question 3: ***Edge effects on interior habitat***

We conducted this analysis at the Forest scale. This analysis was identical to the analysis for Question 2, except that interior, late-successional habitat was substituted for spotted owl habitat. An interior habitat layer was created from the seral stage data in the GIS layer, called LSR VEG, created during the Mid-Willamette LSR Assessment (USDA/USDI 1998). Because the Mid Willamette LSR Assessment did not cover watersheds north of the Little North Santiam River, the resulting interior forest habitat also does not include these areas. However, because the excluded area is currently proceeding through a process to become the Opal Creek Wilderness area, its exclusion from this analysis is not a problem (since we excluded Wilderness and Roadless areas from analyses for Questions 2-3).

Seral stages present in the LSRVEG layer are the following: (a) early; (b) early-mid; (c) mid; (d) late-mature; and (e) large-old growth. Actual assignment of each stand to a seral stage was dependent on dbh, plant association, and age. For more information on how seral stages were assigned, see the Mid-Willamette LSR Assessment (1998). To create the interior habitat layer, "late-mature" and "late-old growth" seral stages were "buffered" inward 400 feet.

Question 4: ***Road densities in riparian reserves***

We conducted this analysis at the Forest scale. We used the transportation (tran) and riparian reserve (strbuf) GIS layers for this analysis. With these two layers as starting blocks, we then ran a sequence of GIS steps to calculate the density of roads within and adjacent to riparian reserves. This sequence of steps, called a "moving window analysis" was written as an aml (Arc Macro Language). The product of this analysis is a map (**Map W2**), which highlights the stretches of riparian reserves with the highest road densities.

Question 5: ***Road densities in connected, late-successional habitat***

We conducted this analysis at the Forest scale. The Northwest Forest Plan established a system of reserves to provide connected late-successional habitat across the landscape for late-successional species. There are two basic kinds of reserves: large reserves and riparian reserves. The large reserves (e.g., Late-Successional Reserves, Administratively Withdrawn Lands, and Congressionally Reserved Lands) are often connected through the linearly shaped riparian reserves. It is not always necessary for patches of late-successional habitat to be adjacent for late-successional species to successfully disperse among patches. Many species can cross short distances of other habitat types before arriving at late-successional habitat. For this analysis, we assumed that low-mobility, small-bodied species can travel no more than about 350 m (1148 feet) through non-late-successional habitat. ***Connected late-successional habitat****, then, consists of late-successional habitat in a no harvest status (this includes all reserved lands and land with unsuitable soils for harvest) buffered by 191 m (627 feet).* With the pixel size we used in GIS (one pixel = one acre), 191 m (627 feet) is as close to half of the maximum gap distance of 350 m (1148 feet) as we could get. This is the same layer of connected, late-successional habitat that was used for the Mid-Willamette Late-Successional Reserve Assessment (USDA/USDI 1998).

With this connectivity layer, we then ran the same "moving window" analysis as we did for Question 4. The product of this analysis is a map (**Map TW4**) which highlights the areas of connected, late-successional habitat where road densities are relatively high.

Question 6: ***Road densities in BGEAs***

We conducted this simple analysis at the Forest scale. Two GIS layers were used: transportation (tran) and Big Game Emphasis Area (bgea). From the transportation layer (tran), we selected only those roads that are open. We then calculated the miles of open road per Big Game Emphasis Area. The results from this analysis are displayed on the map, **Map W3**.

Results and Interpretation

Question 1: ***Roadsheds created by state highway***

The state highway system divides the Forest into six distinct roadsheds (**Map W1a**), that vary greatly in size (**Table 2**). Because many species will not cross major highways, or suffer high mortality rates when attempting to cross them (due to collisions with vehicles), roadsheds may represent regions into which some populations are subdivided.

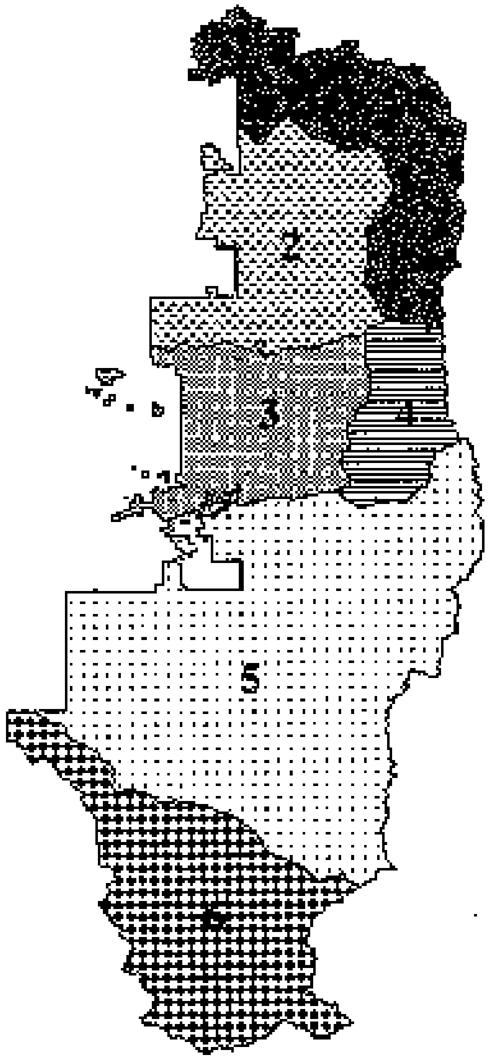
Roadshed	Area (sq. miles)
1	171
2	301
3	272
4	67
5	609
6	460

Table 2. Area of each roadshed. Wilderness and Roadless Areas not included in calculations.

Generally speaking, the smaller the roadshed, the higher the probability that highly mobile, terrestrial organisms (e.g., carnivores) will encounter a major highway. Of the six roadsheds on the Willamette, Roadshed 4 is tremendously smaller than the other five. Therefore, an individual whose home range overlaps or borders the highways will have a higher probability of encountering high density, high velocity traffic if it attempts to disperse than individuals whose home ranges do not overlap or border highways.

Map W1b offers a striking representation of how much land is impacted from the edge effects of roads. In each roadshed, over 40 % of all the land is impacted by edge effects (**Figure 1**). We consider this to be a very high percentage of land to be negatively impacted by roads. Roadshed 4 has the most land that is affected by edge effects from all road types, followed by Roadshed 2 (**Map W1b**, **Figure 1**).

Map W1a. The Six Roadsheds on the Willamette NF.



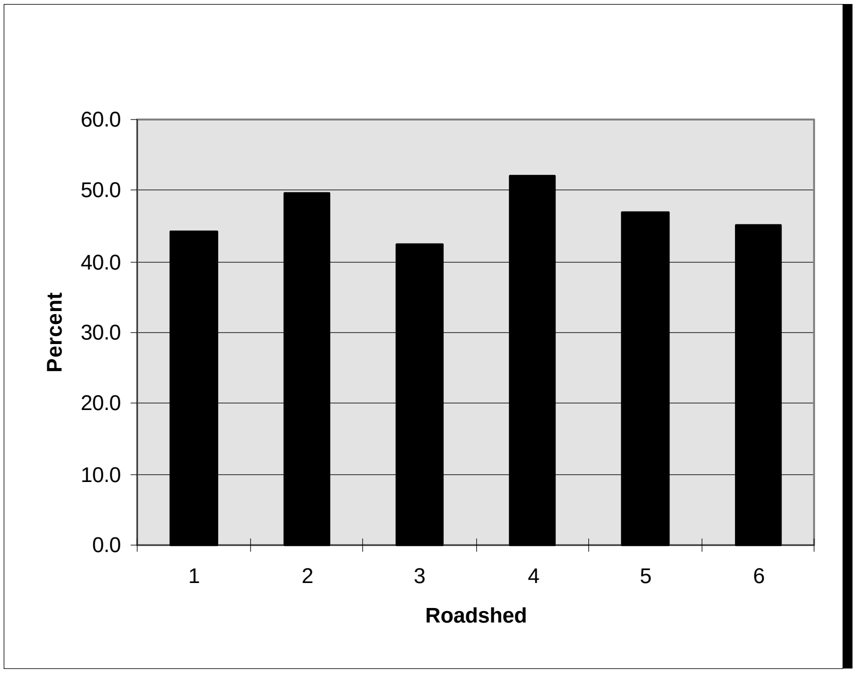


Figure 1: The percentage of each roadshed that is affected by edge effects from roads. Roadshed 4 has the highest percentage of its total area impacted by edge effects, while Roadshed 3 is least affected. Wilderness and Roadless Areas not included in calculations.

Question 2: *Edge effects on spotted owl habitat*

The amount of spotted owl habitat varies greatly among roadsheds, from a low of 26.9 square miles in Roadshed 4 to a high of 270 square miles in Roadshed 5 (**Figure 2**). Edge effects impact 31 - 49 percent of the spotted owl habitat per roadshed (**Figure 3**). Twelve percent more spotted owl habitat in Roadshed 4 is impacted by edge effects than in any other roadshed (**Figure 3**).

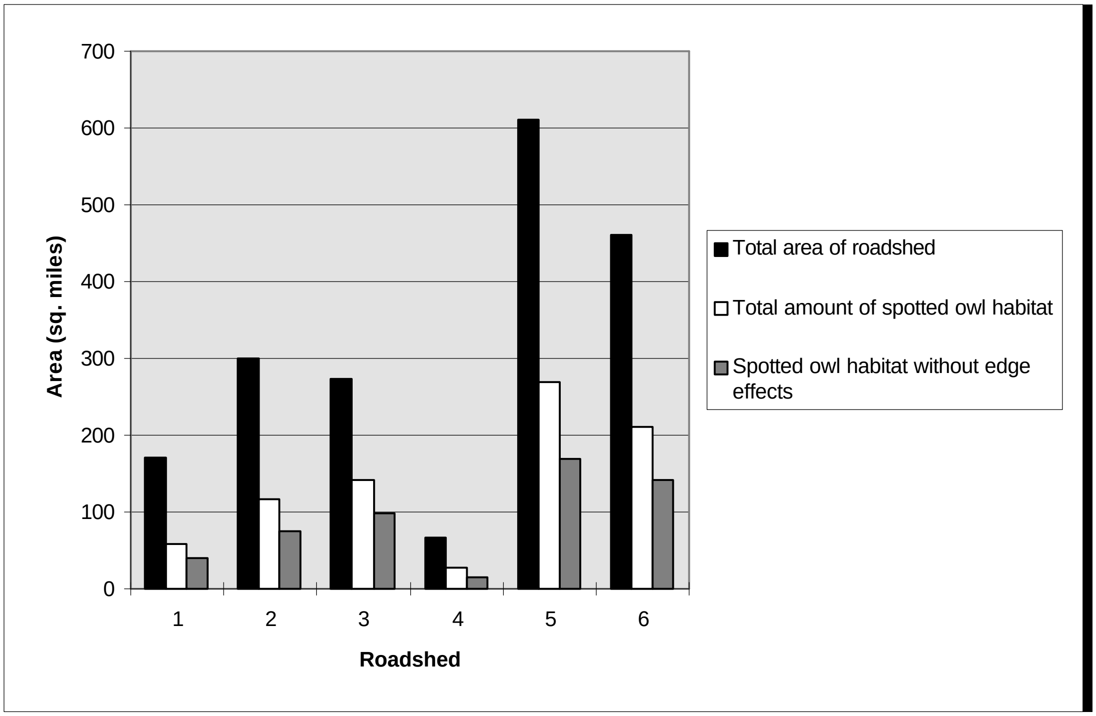


Figure 2. Comparison of roadsheds based on total area, area of spotted owl habitat, and area of spotted owl habitat that is not affected by edge effects from roads. Wilderness areas and roadless areas are not included in these calculations.

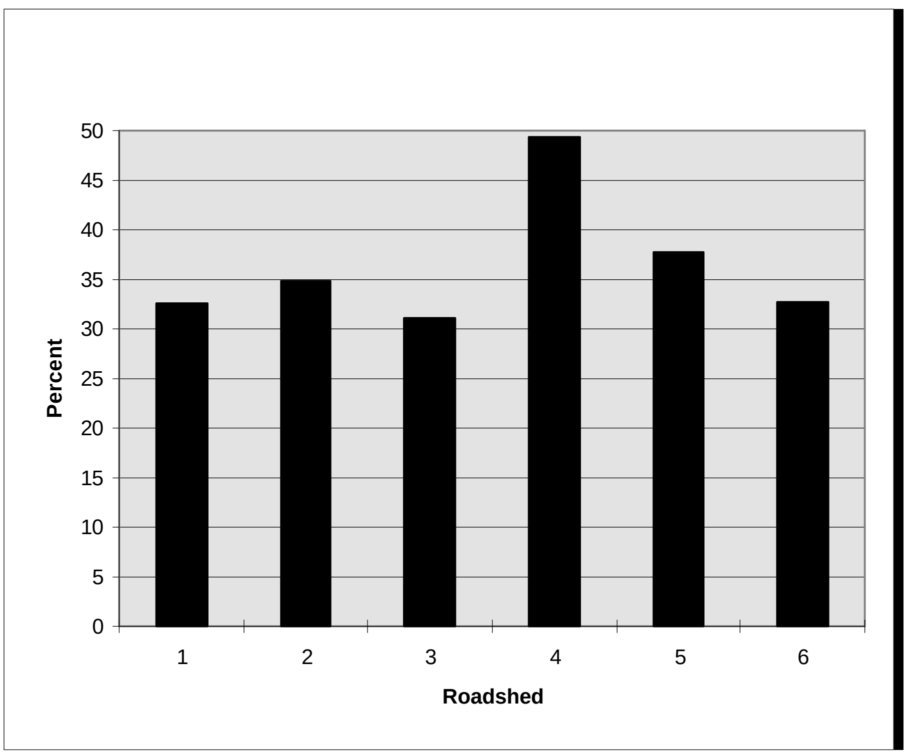


Figure 3. The percentage of spotted owl habitat that is impacted by edge effects from roads. Spotted owl habitat in Roadshed 4 is most impacted by roads, while owl habitat in Roadshed 3 is least affected by roads. Wilderness areas and roadless areas are not included in these calculations.

Question 3: ***Edge effects on interior habitat***

The amount of interior habitat varies greatly among roadsheds, from a low of 7.7 square miles in Roadshed 1 (6 percent of the roadshed) to a high of 60.1 square miles in Roadshed 6 (16 percent of the roadshed) (**Figure 4**). Of the current amount of interior habitat in each roadshed, 22 - 41 % is impacted by edge effects (**Figure 5**). Interior habitat in Roadshed 4 is impacted to a much greater extent by edge effects than the other roadsheds (**Figure 5**).

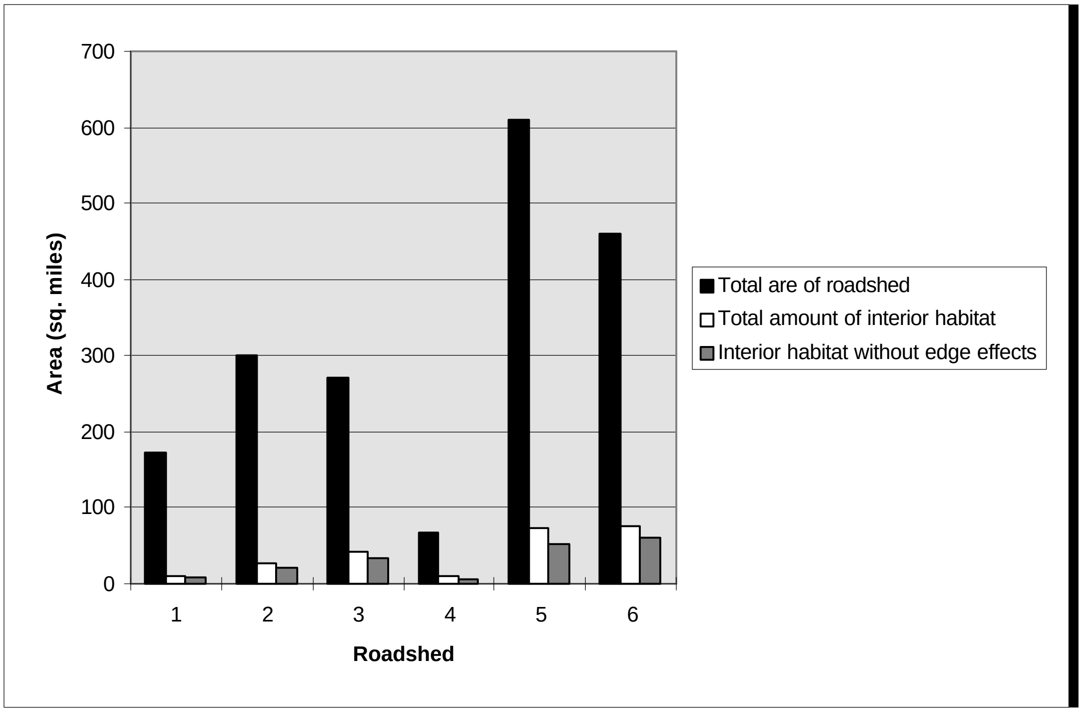


Figure 4. Comparison of roadsheds based on total area, area of interior habitat, and area of interior habitat that is not affected by edge effects from roads. Wilderness areas and roadless areas are not included in these calculations.

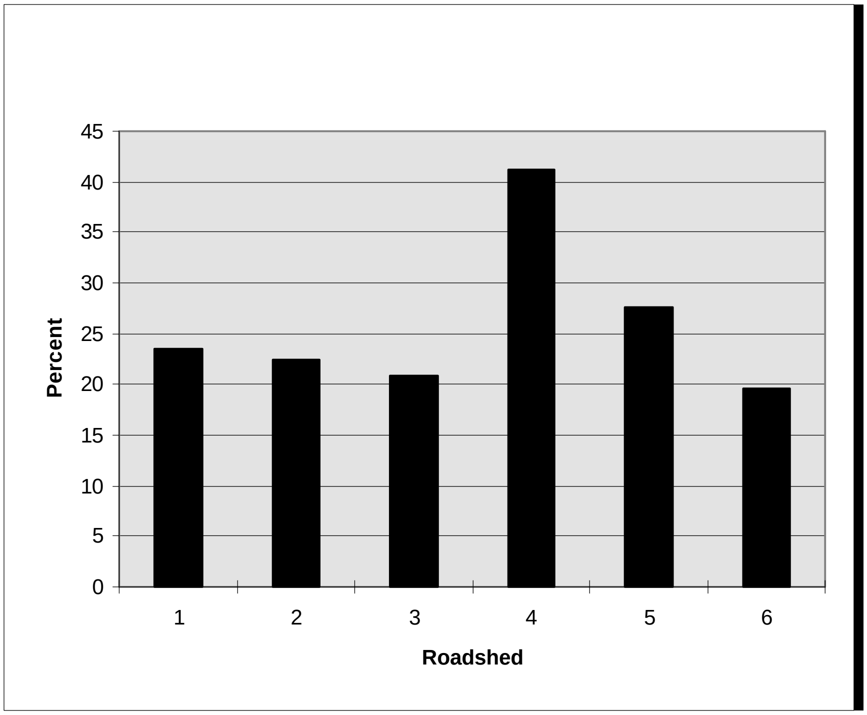


Figure 5. The percentage of interior habitat that is impacted by edge effects from roads. Interior habitat in Roadshed 4 is most impacted by roads, while interior habitat in Roadshed 6 is least affected by roads. Wilderness areas and roadless areas are not included in these calculations.

Question 4: *Road densities in riparian reserves*

Map W2 highlights the areas of concern based on road densities in riparian reserves. The highest priority areas are those that have road densities of 4-5 miles/sq. mile. In several areas on this map, the riparian reserve width appears to be much larger than in the other areas. These areas represent places where the riparian reserve intersects a primary management zone for a threatened or endangered raptor. On the south end of the Forest, there is a priority area (4-5 mi/mi2) close to Road 23 that is an important raptor management zone. This area should be considered a particularly high priority, given the conservation importance of threatened and endangered species.

Question 5: *Road densities in connected, late-successional habitat*

Map TW4 highlights areas of concern based on road densities in connected, late-successional habitat. The highest priority areas are those that have road densities of 6-8 miles/sq. mile. Note that several of the areas in the highest road density categories are in Late-successsional Reserves (LSRs). Because these areas are supposed to be managed for late-successional dependent species, it is of concern that some of the highest road densities for connected, late-successional habitat occurs in the LSRs. The Mid-Willamette Late-Successional Reserve Assessment (USDA/USDI 1998) also discusses the problem of roads within LSRs. This LSR Assessment should be consulted for a more detailed discussion of the role that roads may play in the management of the LSRs.

Question 6: *Road densities in BGEAs*

Of the 53 High Emphasis Areas for big game on the WNF, 26 (49%) have road densities that exceed WNF Land Management Plan objectives. Of the 110 Moderate Emphasis Areas for big game, 36 (33%) have road densities that exceed the objectives. On an acreage basis, 218,493 acres (43%) of the land in the High Emphasis Level exceeds the objectives, whereas 270,163 acres (29%) of the land in Moderate Emphasis Level exceeds the objectives (**Table 3**). **Map W3** displays the Big Game Emphasis Areas where WNF Land Management Plan objectives for big game are not being met.

Big Game Emphasis Level	Total # acres in Emphasis Level	# acres that exceed objectives for Big Game (% of total acreage)
High	508,533	218,493 (43%)
Moderate	930,321	270,163 (29%)
Low	352,025	0 (0 %)

Table 3. Number of acres that exceed objectives for big game, by emphasis level.

Summary of results

High road densities can pose problems for wildlife populations because of the biological and abiotic edge effects associated with roads. On the six roadsheds of Willamette National Forest, 31 - 49 percent of the current spotted owl habitat, and 22-41 percent of the interior habitat, is impacted by edge effects. These statistics indicate that a large percentage of late-successional habitat, upon which many plant and animal species depend (USDA/USDI 1994), incurs negative impacts from roads.

Non-late successional dependent species, such as elk, can also be negatively impacted from high road densities. Our analysis of road densities in Big Game Emphasis Areas shows that current road densities exceed management objectives for big game in 33% of Moderate Emphasis Areas and 49% of High Emphasis Areas.

Given the high road densities on the Forest, where should efforts be taken to close or decommission roads to benefit wildlife? We produced **three maps (Maps W2, TW4, and W3)** to help prioritize areas of the Forest where roads should be closed or decommissioned. Each map shows priority areas, or hot-spots, based on the impacts of roads to one particular species or habitat type. These maps should be used in conjunction with the maps produced by other natural resource departments (e.g., botany, fisheries, and hydrology). The highest priority sites for management action should be those where there is congruence, or overlap, among two or more maps. For example, if there is a riparian reserve with very high road densities (from Map W2), that also overlaps a stream with endangered fish species, or an area with high potential for landslides, then that would be a priority area. Areas identified as a priority by one map, but not on any others, may still be a Forest-wide priority, but the trade-offs of focusing on one site to the expense of other sites must be weighed carefully.

Process Critique

Overall, I felt the process used for the pilot roads analysis was effective and efficient. I felt the leadership team did a solid job of keeping all the participants informed of timelines and expectations. I felt the composition of the analysis team was sufficiently experienced, and encompassed a wide spectrum of expertise. From my perspective, the lack of public involvement made the analysis much easier to complete in a timely fashion. However, public involvement may have generated ideas or issues that we did not think of ourselves.

The greatest drawback to the process was the lack of updated GIS data. Most importantly, the transportation (roads) layer does not contain consistently good data across the forest. Certain Districts have been very conscientious about digitizing each road that exists on their District, while other Districts have not. Therefore, attempting to prioritize areas of concern based on road densities may be biased towards Districts that have updated their GIS layer. Districts that have not digitized all their roads may, in reality, have more roads (and therefore, more need to close or decommission roads) than the other Districts, but because they are not in GIS, our analyses would not include them.

In addition to the roads layer, several of the forest-wide layers for wildlife have not been updated recently. While each District may have updated layers for species of concern, it was not possible with the time frame of this project to gather all the data and convert it into forest-wide layers. We are currently rectifying this situation so that all of our GIS wildlife layers will be standardized across all Districts and annually updated.

Once this updating process is complete, we would be able to address the following questions:

1. *Are any peregrine falcon management areas negatively affected by roads?*
2. *Are any bald eagle management areas negatively affected by roads?*
3. *What portions of Canada lynx and wolverine habitat are most impacted by roads?*

Literature Cited

Brosofske, K.D., J. Chen, R.J. Naiman, and J.F. Franklin. 1997. Harvesting effects on microclimate gradients from small streams to uplands in western Washington. Ecological Applications **7**:1188-1200.

Chen, J., J.F. Franklin, and J.S. Lowe. 1996. Comparison of abiotic and structurally defined patch patterns in a hypothetical forest landscape. Conservation Biology **10**:854-862.

Chen, J., J.F. Franklin, and T.A. Spies. 1993. Contrasting microclimates among clearcut, edge, and interior of old-growth Douglas-fir forest. Agricultural and Forest Meteorology **63**:219-237.

Chen, J., J.F. Franklin, and T.A. Spies. 1995. Growing-season microclimate gradients from clearcut edges into old-growth Douglas-fir forests. Ecological Applications **5**:74-86.

Demaynadier, P.G., and M.L. Hunter, Jr. 1998. Effects of silvicultural edges on the distribution and abundance of amphibians in Maine. Conservation Biology **12**:340-352.

Forman, R.T., and A.M. Hersperger. 1996. Road ecology and road density in different landscapes, with international planning and mitigation solutions. Pages 1-23 in G. Evink, D. Ziegler, and J. Berry, editors. Highways and movement of wildlife: improving habitat connections and wildlife passageways across highway corridors. Proceedings of the Florida Department of Transportation/Federal Highway Administration Transportation-Related Wildlife Mortality Seminar. Orlando, Florida, April 30-May 2, 1996.

Fraver, S. 1994. Vegetation responses along edge-to-interior gradients in the mixed hardwood forests of the Roanoke River Basin, North Carolina. Conservation Biology **8**:822-832.

Hartley, M.J., and M.L. Hunter. 1998. A meta-analysis of forest cover, edge effects, and artificial nest predation rates. Conservation Biology **12**:465-469.

Keyser, A.J., G.E. Hill, and E.C. Soehren. 1998. Effects of forest fragment size, nest density, and proximity to edge on the risk of predation to ground-nesting passerine birds. Conservation Biology **12**:986-994.

Klein, M.L. 1993. Waterbird behavioral responses to human disturbances. Wildlife Society Bulletin **21**:31-39.

Lyon, L.J. 1983. Road density models describing habitat effectiveness for elk. Journal of Forestry 81:592-595.

Lyon, L.J., T.N. Lonner, J.P. Weigand, C.L. Marcum, W.D. Edge, J.D. Jones, D.W. McCleerey, and L.L. Hicks. 1985. Coordinating elk and timber management. Intermountain Forest and Range Experiment Station. USDA Forest Service, Missoula, MT.

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

Paton, P.W. 1994. The effect of edge on avian nest success: how strong is the evidence. Conservation Biology **8**:17-26.

Reijnen, R., R. Foppen, C. ter Braak, and J. Thissen. 1995. The effects of car traffic on breeding bird populations in woodland. III. Reduction of density in relation to the proximity of main roads. Journal of Applied Ecology **32**:187-202.

Reijnen, R., R. Foppen, and H. Meeuwsen. 1996. The effects of traffic on the density of breeding birds in Dutch agricultural grasslands. Biological Conservation **75**:255-260.

Reudiger, B. 1996. The relationship between rare carnivores and highways. Pages 24-38 in G. Evink, D. Ziegler, and J. Berry, editors. Highways and movement of wildlife: improving habitat connections and wildlife passageways across highway corridors. Proceedings of the Florida Department of Transportation/Federal Highway Administration Transportation-Related Wildlife Mortality Seminar. Orlando, Florida, April 30-May 2, 1996.

Soule, M. 1987. Viable populations for conservation. Cambridge University Press, Cambridge, England.

Thomas, J.W., H. Black, Jr, R.J. Scherzinger, and R.J. Pederson. 1979. Deer and Elk. Pages 104-127 in J.W. Thomas, technical editor. Wildlife Habitats in Managed Forests: the blue mountains of Oregon and Washington. USDA Forest Service Agriculture Handbook No. 553.

USDA/USDI. 1998. Mid-Willamette late-successional reserve assessment. USDA Willamette National Forest, USDI Salem District BLM, USDI U.S. Fish and Wildlife Service OSO.

USDA/USDI. 1994. Record of decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the northern spotted owl and standards and guidelines for management of habitat for late-successional and old-growth related species within the range of the northern spotted owl. USDA Forest Service and USDI Bureau of Land Management.

Wisdom, M.J., L.R. Bright, C.G. Carey, W.W. Hines, R.J. Pederson, D.A. Smithey, J.W. Thomas, and G.W. Witmer. 1986. A model to evaluate elk habitat in western Oregon. USDA Forest Service, Pacific Northwest Region (R6-F&WL-216-1986).

Yahner, R.H., T.E. Morrell, and J.S. Rachael. 1989. Effects of edge contrast on depredation of artificial avian nests. Journal of Wildlife Management **53**:1135-1138.

Willamette National Forest Pilot Road Analysis

Appendix E

Botanical Species Process Paper

October 1998

Background

Botanical species diversity is dependent on the variety of habitats found throughout the National Forest matrix. Ross and Chambers (1988) estimate that 95% of the biodiversity in forests from the western Cascades are found in special and non-forested habitats. Special habitats are defined as those habitats that are not part of the dominant (coniferous) forest matrix. Examples include areas such as forested wetlands (hardwoods and swamps), springs, meadows and rock outcrops. Most of the Regional Forester's sensitive species for Region 6, Willamette National Forest, and other rare species whose distributions are tracked to ensure their viability (NFMA direction) grow in meadows, rock gardens, rock outcrops and riparian areas.

Roads have historically been built along riparian lowlands and ridgelines for both economics and feasibility. All of the major highway and many scenic byway corridors are built adjacent to major waterways: North Santiam (Highway 22), South Santiam (Highway 20), McKenzie (Highway 126), South Fork Middle Fork Willamette (21), North Fork Middle Fork Willamette and South Fork McKenzie (15) and Salt Creek (highway 58). Midslope roads intersect riparian areas as they travel upslope. Roads often intersect with special habitats along ridgelines. These areas are often rocky, with little soil development; factors which favor development of dry meadows or rock gardens rather than a forest. Not only are these habitats situated where roads are most easily built, but it is also presumably cheaper to build through a rock garden than a forest. Many of these habitats have had fill placed on top of existing habitat as roads are built through them. The resulting changes in drainage patterns, changes in soil composition, and introduction of noxious weeds from roadside shoulders may cumulatively result in significant alteration of the existing plant communities.

Other botanical species unique to the Pacific Northwest are species on the "survey and manage" list. These species were elevated in importance by their inclusion in Table C3 of the ROD (USDA and USDI, 1994a). These species are largely non-vascular plants (mosses and liverworts), lichens and fungi. The importance of these species to the health of ecosystems is just being recognized. The majority of these species are found in mature to late-successional forests. Intact forests have substrates and microclimate (temperature and humidity) preferred by these species. Several species are dependent on pristine riparian or aquatic conditions. Roads create openings to interior forest habitats, reducing the quality of the habitat. Fragmentation of habitat creates conditions which many species may not survive.

The final botanical feature affected by roads is noxious and invasive nonnative weeds. The Oregon Department of Agriculture's Weed Control program began mapping weed infestations across the Forest in the late 1980's. In 1993, the Forest wrote an Environmental Assessment for an Integrated Vegetation Management Program (LRMP standard and guideline) that directs the Forest to use all available control methods found in the EA, based on site-specific analysis. The EA is tiered to the Regional EIS for Managing Competing and Unwanted Vegetation. The preferred alternative is prevention of noxious weed movement and infestation. The second priority is control of new invaders. On this Forest, knapweeds, toadflax, giant knotweed, false brome and new infestations of evergreen and Himalayan blackberry are new invaders and are targeted for treatment.

Roads are the vectors disseminating most of our weeds throughout the Forest. Most roads are maintained, creating early seral habitat, devoid of competing vegetation, for weed establishment. Without immediate revegetation of road cutbank and shoulders following construction, weeds establish. Vehicles, animals, and machinery move noxious weeds from place to place. Weed populations are found in dispersed campsites, hunting camps, trailheads and timber harvest landings.

Maintenance of roads also contributes to movement of weed seed and propagules, especially along the crest of the Cascades. Knapweed is our largest problem and it is largely referred to as a “road runner”. It has very light seed similar to that of a dandelion, which may easily be transported on the undercarriage of vehicles in soil or debris. This species seems to be moving from population centers on the east side of the Cascades via State highways through the Forest down into the Willamette Valley. The largest concentrations of this weed are along the major highway corridors, 22, 20, 126 and 58. Populations on the 126 corridor seem to be spreading at an alarming rate off the major highway along Forest Service arterial roads. One factor we have been able to document is movement of weed seed from cinder pits (waste disposal areas) used for icy highways in the winter. This species is highly drought-tolerant and can survive in areas of minimal soil such as cinder or on road shoulders.

Process description and Documentation

1. ***How do roads change special, mostly nonforested, plant habitats?***

- ***How and where do roads affect special and unique habitats (e.g. meadows and rock gardens)?*** Forest and project scale

This question would ideally be answered using a GIS layer for special habitats and intersecting it with the roads layer. Unfortunately, a forestwide special habitat layer has yet to be consolidated from Ranger District layers (which are in various stages of completion). In the absence of this forestwide tool (which should be available summer 1999), we may look at the nonforested habitats in the forestwide vegetation layer (Vegis). Conclusions from this query will be very general as the only habitats featured in Vegis are greater than 1 acre and we know that a large percentage of habitats across the forest are smaller than this. Also, very general habitat identification (for example shrubland, wetland) is used.

To get a more detailed description of the effects previously constructed roads have had on special habitats, one may use data from the three Watershed Analyses completed on Lowell Ranger District of the Willamette National Forest: Fall Creek, Winberry and Lookout Point Reservoir (note: most Watershed Analyses on this Forest have used this process). The special habitat layer manuscripted from orthographic photos, hand digitized into GIS, and attributed as to non-forested plant association/special habitat type (see Dimling and McCain, 1996) was used to overlay roads.

- ***How do roads impact reserved lands (Late Successional Reserves and Riparian Reserves) which are habitat for rare and unique species?***

- ***What late-successional-related species are found adjacent to roads and how is their habitat affected?*** **Forest scale**

This question can be answered using the two forestwide layers for survey and manage species (survmanage and allotropa) and intersecting them with roads that are buffered by 120 m (387 ft) on each side. The reason for buffering the roads by this amount is that research has shown opening of the forest can cause changes in microclimate up to 500 feet from the opening (Chen et al, 1995). This research was conducted to determine changes induced by opening up the canopy by regeneration harvest, but effects are assumed to be similar.

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2. How do roads affect sensitive plant species and other plant species of concern?

- ***What species are located in habitats with high probability of impact from road building and quarries?***

This question may be partially answered using the analysis completed for Botany question #1 as most of the sensitive plants on the Regional Forester's Sensitive Plant List for Region 6, Willamette National Forest, are highly correlated with special habitats. The sensitive plant GIS layer was overlain with roads buffered by 50 feet to determine whether any intersections occur. And finally, we may use the results of our Willamette National Forest LRMP Monitoring question # 16.4 that asks whether any sensitive plant species have been adversely affected by management actions.

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3. How does road maintenance and construction contribute to movement of noxious and undesired non-native plant species?

- ***How and where do roads contribute to the spread of exotic species (i.e. noxious weeds)?*** Forest scale

To analyze the distribution of weeds and the contributory nature of roads to weed movement, overlay the weed infestation GIS layer with roads. There is almost a 1 to 1 correlation between movement of the new invaders and the road network.

Results and Interpretation

Special Habitats

The first part of the analysis was determining the intersection of roads with a 120 meter buffer on the forestwide special habitat layer (map ef1a). Table 1 illustrates the percentages of habitats that are affected by roads on a rough scale using polygons of one acre or larger.

A significant number of special habitats have been affected by roads. The number of affected habitats presented is deceptively low as special habitats counted include those in roadless and Wilderness areas where there are no roads to impact special habitats. Thus this analysis at the forestwide level does not accurately portray the issue.

An analysis was conducted on a forestwide scale to determine where on the landscape special habitats are most affected by roads built through them ("hot spots"). The hypothesis was that the habitats most greatly affected are often found along the ridgelines (shrub =vine maple and alder in Table 1) and in the valleys (wet meadows and ponds in Table 1). These areas are where many of the Forest roads and major highways are built. The results of this analysis showed that only 2% of affected habitats were within the top 10% of the slope and 16% of affected habitats are within the bottom 10% of the slope. This analysis disproves the hypothesis about ridgeline habitats but supports the hypothesis about riparian habitats. One would expect a random distribution to show 10% of habitats affected per 10% slope.

Table 1. Analysis of Intersection of Roads with Forestwide Special Habitat Polygons

Habitat Type	**Acres Affected By Roads**	**Total Acres Forestwide**	**Percentage of Habitats Affected by Roads**
Rock garden	25.7	1013.3	2.5
Mesic Meadow	554.3	15703.4	3.5
Dry Meadow	204.7	4344.8	4.7
Shrub	520.6	8067.8	6.4
Rock Outcrop	98	2267.5	4.3
Wet Meadow	124.6	2420.2	5.1
Talus	1151.5	43364	2.6
Pond	15.6	242.2	6.4

Hot spots were more numerous in the riparian than the ridgeline watersheds. Hot spots for ridgeline habitats affected are only in Fall Creek (27%). Hot spots for special habitats affected in riparian areas include North Santiam Downstream (53%), Willamette Middle Fork Downstream (44%), Hills Creek (33%), North Santiam Blowout-Woodpecker (29%), Willamette, Upper north Fork (23%) and McKenzie South Fork (22%), McKenzie, Minor Tributaries (14%). A forestwide analysis is the only way to portray where on the landscape these features are most affected.

Table 2 portrays the acres of special habitat impacted by roads in each sixth field watershed as a percentage of total special habitat acres. The "hot spots" are Lookout Point (85%), Hills Creek (75%), Upper North Fork, Middle Fork Willamette (58%), Quartz Creek (57%), Fall Creek (56%) , Middle Santiam (53%) , McKenzie Downstream Tribs (53%). In all these watersheds, over half of the special habitats are affected by roads.

Table 2. Special Habitats affected by Roads

Sixth Field Watershed	% Special Habitats Affected By Roads
Little North Santiam	7
Breitenbush	14
Upper Quartzville	21
Middle Santiam	54
South Santiam	32
McKenzie	27
Blue River	47
McKenzie, Downstream	53
Quartz	57
McKenzie, South Fork	27
Horse Creek	5
Fall Creek	40
Winberry	40
North Fk Mid Fk Willamette	40
Salmon Creek	20
Lookout Point	85
Salt Creek	20
Hills Creek	76
Staley	46
Upper N. Fk. Mid Fk. Willamette	58
Blowout	39
Upper N. Santiam	9

An analysis of the effects of roads on special habitats may be extrapolated from watershed analyses conducted on Lowell Ranger District. Table 3 depicts the percentage of special habitats affected by roads by habitat type. Road densities in Winberry and in Lookout Point watersheds are much higher than in Fall Creek because Fall Creek has some large unroaded areas (soils that are unsuited for timber harvest).

Table 3. Percentage of Special Habitats Intersecting Roads in Three Watersheds on Lowell Ranger District

Habitat Type	Fall Creek	Winberry	Lookout Point	Average
Rock garden	3	83	37	41
Mesic Meadow	3	20	84	36
Dry Meadow	6	26	53	28
Shrub Talus	1	0	53	18
Rock Outcrop	5	0	32	12
Hardwood	2	0	14	5
Wet Meadow	8	0	0	3
Pond	8	0	0	3

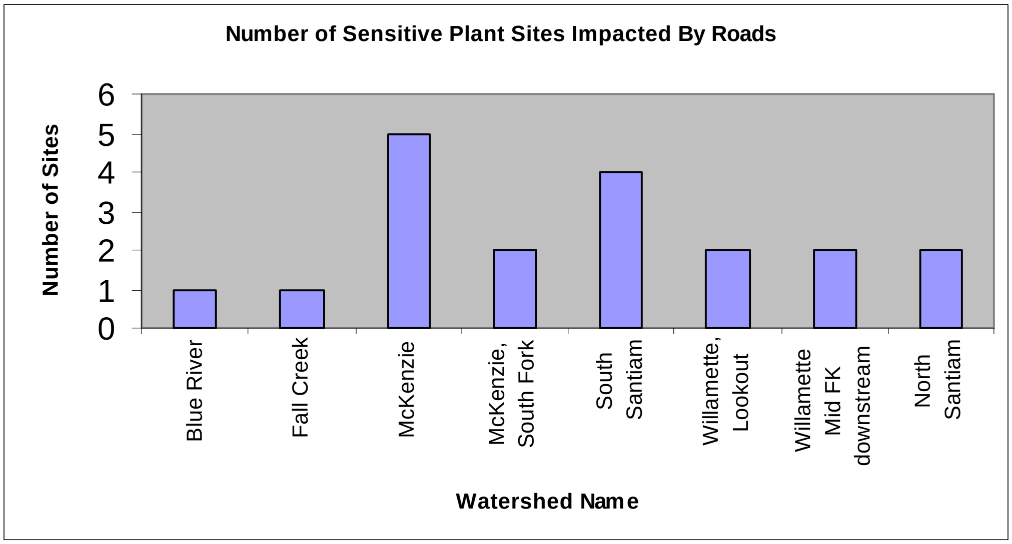
This scale of analysis shows the effect of road construction on diverse plant habitats. Habitats particularly affected by roads and associated quarries and disposal areas tend to be rock gardens and mesic to dry meadows and shrub talus found along ridgelines. This type of analysis may be used by resource specialists to determine restoration needs and priorities for special habitats at the watershed scale, to be implemented at the project scale.

Sensitive Plants

The only known population of a sensitive plant that has been directly affected by road construction in the 1980's is *Aster gormanii*, Gorman's aster (see Figure 1, North Santiam). This species grows along ridgeline scree slopes on Detroit and Sweet Home Ranger Districts. A spur road was placed through a section of one population. Results of this action are difficult to determine as the population was not monitored prior to road construction.

The most commonly affected sensitive plant is *Romanzoffia thompsonii*, Thompson's mistmaiden, in rock gardens adjacent to roads on Detroit, McKenzie, Middle Fork and Blue River Ranger Districts (see Figure 1). This species is an ephemeral annual that blooms during the spring when runoff moistens its habitat. Adverse effects to the populations probably occurred during the period of road construction. However, that construction led to the discovery of most of these populations. In all cases, roads are below the population and do not obstruct drainage; the chance of the road adversely affecting this species is minimal. In some cases (McKenzie South Fork in particular), road maintenance should take into consideration the close proximity of the population.

Figure 1. Number of TES Plant Sites Impacted By Roads/Watershed



The only other issue where road use could affect mistmaiden would be increased access to the site by having the road situated so close to the populations.

Four populations of tall bugbane, *Cimicifuga elata*, are found near roads. All of these subpopulations occur in the central core of the population, in the South Santiam watershed (Figure 1). This species occurs in mixed coniferous/deciduous forests at low to moderate elevations in the Cascades. It is tolerant of shade, but benefits from opening of the canopy (Kaye and Kirkland, 1994). One population has a skid road running through its center, providing a road for travelling deer and elk who find this rare plant a favorite food. Recommendations for these roads would be to allow them to revegetate themselves with no further disturbance.

Umpqua swertia, *Frasera umpquaensis* is found adjacent to a road at the headwaters of the Fall Creek drainage (Figure 1). A ridgeline road (1824/142) was built through the meadow community that provides habitat for this plant. It is unknown if the road decreased the population size; a subpopulation is less than 15 feet from the road (1824/142). Maintenance of this road should take into consideration affects to this species. Because this system is frequently used, restoration of the meadow is probably not realistic.

The final sensitive plant affected by roads is an odd ephemeral vernal pool species called *Montia howellii*, Howell's montia. This species grows in mud puddles in the parking lot of a very heavily used trail(Figure 1, Lookout Point). Plants are only discernable in February-April. After the rainy season ends, pools dry up and plants die. Recommendations for managing this site would include no grading activities that would fill up those pothole habitats. Other options would include not using the parking lot where the plants are located until April.

Late Successional Species

A number of survey and manage species have the potential to be affected by roads. The species are classified into four types: vascular plants, bryophytes, lichens and fungi. Life histories differ dramatically for these species, management recommendations for each species group will differ.

Table 4 shows the only vascular survey and manage species adjacent to roads is *Allotropa virgata*, candystick. This species is mycotrophic; it has no chlorophyll so it attaches itself to a host tree roots for food via a mycorrhizal fungus. Experiments in the Umpqua National Forest (Dan Luoma, pers. comm.) have shown that similar mycorrhizal species can tolerate commercial thining; a closed old growth canopy is not necessary for maintenance of the species. Changes to the microclimate created by roads should not affect this species. Only direct impacts to the mycorrhzal symbiont or host trees would adversely affect candystick.

The bryophytes featured in Table 4 are very different from one another. *Buxbaumia viridis* grows on decomposing class 3 or 4 logs. It is sensitive to changes in light level and microclimate caused by removal or thinning of the canopy and is dependent on adequate levels of coarse woody debris (Bryophyte Management Recommendations, *Buxbaumia*, p. 2) *Racomitrium aquaticum* is a bryophyte which grows on rocks on or near streams. *Racomitrium* would be vulnerable if road culverts were removed and extra sediment washed downstream. This species is also vulnerable to erosion and scouring floods that could remove the species from its substrate (Bryophyte Management Recommendations, *Racomitrium*, p. 2). If populations of this species are located in areas of potential road failures, this would represent a “hot spot” for survey and restoration (see map ef1c- aquatic bryophytes).

Table 4. Survey and Manage Species Affected By Roads

Species Group	Species	Survey Strategy	**Populations Affected by Roads**
Vascular	*Allotropa virgata*	1,2	20
Bryophyte	*Buxbaumia viridis*	Protection Buffer	1
	Racomitrium aquaticum	1,3	1
Lichen	*Bryoria subcana*	1,3	1
	Fuscopannaria leucostictoides	4	1
	Fuscopannaria saubinettii	4	2
	Hydrothyria venosa	1,3	2
	Hypogymnia oceanica	1,3	8
	Lobaria hallii	1,3	4
	Lobaria oregana	4	9
	Lobaria pulmonaria	4	11
	Lobaria scrobiculata	4	3
	Nephroma bellum	4	3
	N. helveticum	4	4
	N. occultum	1,3	3
	N. parile	4	3
	Peltigera collina	4	6
	Pseudocyphellaria anomala	4	12
	P. anthraspis	4	10
	P. crocata	4	3
	P. rainierensis	1,2,3	3
	Sticta fuliginosa	4	2
	S. limbata	4	1
	Usnea hesperina	1,3	1
	U. longissima	4	1
Fungi	*Boletus pulcherrimus*	1,3	1
	Choiromyces alveolatus	1,3	1
	Destuntzia fusca	1,3	1
	Geelatinodiscus flavidus	1,3	1
	Gymnopilus puntifolius	1,3	1
	Mycenia monticola	1,3	1
	M. quinaultensis	1,3	1
	Neournula pouchettii	1,3	3
	Pithya vulgaris	1,3	2
	Rhizopogon inquinatus	1,3	2

Most of the species in Table 4 are lichens. Most are old-growth associates which depend on maintenance of interior habitat with associated temperature and humidity regulation (USDA and USDI, 1994b, p. 231) because of their epiphytic habit. Epiphytes are species that grow in the canopy of trees without rooting in soil. They depend on the air for moisture and nutrients. When specific species have been transplanted experimentally to the edge of clearcut stands, these species reproduced poorly and viability was low (USDA and USSDI, 1994b, p. 231). A prioritization of closing and revegetating roads within late-successional reserves should benefit these species viability (see wildlife discussion on maintenance of interior habitat for late-successional species).

Other lichens are associated with riparian areas. *Hydrothyria venosa* is an aquatic lichen. As mentioned above in the *Racomitrium* discussion, care should be taken with restoration projects around populations of this species due to affects from increased sediment loads (see map ef1c- aquatic lichens). “This lichen appears to be more sensitive to stream sediment than are salmon” (USDA and USDI, 1994b Appendix J2, p.243). Populations of *Hydrothyria* located in areas with potential road failures or in areas scheduled for road reconstruction should be considered “hot spots”.

Usnea longissima is an epiphyte on hardwoods. The increased humidity within riparian zones is critical to maintenance of this species (USDA and USDI, p. 239). Restoration and closing of roads within riparian areas in late-successional reserves should aid in maintaining species viability (see wildlife section on interior habitat).

The final group of survey and manage species are the fungi (Table 4). Most are mycorrhizal species, connected underground to host tree roots that supply some nutrients while the fungus provides macronutrients from the surrounding soil (and maybe some other benefits such as disease resistance). Some are truffles (*Rhizopogon*) which fruit underground but are also mycorrhizal. Others are cup fungi (*Gelatinodiscus*, *Pithya*) which grow out of twigs or needles. Green hazard tree removal could affect some fungi in removing their hosts. Road maintenance activities outside of the road prism could compact soil and kill fungi.

Table 5 depicts the number of survey and manage species affected by roads within 6th field watersheds. The McKenzie and Willamette, Lower North Fork Middle Fork have Survey and Manage Species Impacted By Roads By Watershed the highest number of affected species and would be considered “hot spots”. However, these watersheds are both large in size and do not have a greater density of survey and manage species/area than other watersheds presented.

Table 5. Number of Sites Affected by Roads

Watershed Name	Number of Sites
Breitenbush	9
Upper North Santiam	1
Quartzville	2
Middle Santiam	4
South Santiam	10

Watershed Name	Number of Sites
McKenzie	37
Blue River	5
Horse Creek	1
South Fork McKenzie	6
Winberry	3
Willamette, Lower N Fk	34
Willamette, Upper N Fk.	1
Salmon Creek	6
Salt Creek	2
Willamette, Mid Fk Downstream	13
Willamette, Upper Mid Fk	10

Noxious Weeds

The analysis of noxious weeds using GIS layers focused on new invader weed populations. Established weed infestations would be found along most road corridors making analysis of hot spot areas impossible.

Table 6 shows the number of new invaders affected by road corridors. The majority of new invaders documented on the Forest is associated with a road. Roads are vectors for dispersal of weeds. Additional standards and guidelines for the Willamette Land and Resource Management Plan are proposed in a new Environmental Analysis for Integrated Weed Management for prevention of weed movement along road corridors:

- Immediately seed (with native species where possible) roads following construction, removal or maintenance, using a competitive cover to discourage weed movement.
- Require that vehicles used under contract (such as logging, road construction and stream restoration equipment) be steam cleaned prior to movement from one project area to another (used as a contract clause for ground-disturbing activities).
- Use only certified weed-free seed for revegetation purposes. Try to use native, non-invasive seed.
- Use only weed-free rock sources for road construction/restoration projects
- Close roads to reduce the number of weed travel corridors on the Forest.

In a Master's theses conducted on HJ Andrews Experimental Forest (Blue River watershed, Parendes (1998) found that closed roads have less or no weeds as compared to roads that remain open. A serious effort should be undertaken, via ATM, to document necessary roads and close those which do not contribute to necessary activities. Even gates provide the decrease in disturbance necessary for native species to reinvade and outcompete weedy species (Ford, pers. comm.).

Table 6 Number of New Invader Weed Sites Located Adjacent to Roads

Weed Species	Number of Sites
Spotted knapweed	76
Himalayan and Evergreen Blackberry	55
Meadow knapweed	15
Yellow toadflax	7
False brome	6
Diffuse knapweed	5
Giant knotweed	3
Dalmatian toadflax	1
Houndstongue	1

The number of new invading weeds located in watersheds throughout the Forest varies, depending on the density of roads and number of highway travel corridors found within the watershed. Blackberry sites are not included in **Table 7** because surveys are not consistent forestwide. The McKenzie, Willamette Middle Fork Dowstream Tribs and South Santiam watersheds have the highest density of weed infestations. The McKenzie corridor is highway 126. In the past 5 years we have noted significant movement of spotted knapweed from this highway corridor on to secondary Forest Service roads. As spotted knapweed continues to be spread by vehicles coming from the east side of the Cascades and as road maintenance activities continue to move weed seed around with cinder for icy roads, this trend will continue. The South Santiam watershed, through which highway 20 runs, is in a similar situation. The Willamette Middle Fork Downstream tributaries is an area accessed by highway 58, another highway corridor which crosses the Cascade crest. Expansion of populations here, along roads 21 and 23, are probably due to recreation, such as dispersed camping and hunting, as well as equipment used in timber harvest activities. These areas should be considered “hot spots” for weed infestation. Road projects should include costs associated with weed prevention in their budgets (see measures outlined above). An option to address recreational user spread of weeds would be to close dispersed campsites and hunting camps with documented weed infestations until they are “cleaned” of existing weed infestations.

Table 7. Number of New Invader Weed Populations By Watershed

Watershed Name	Number of Weed Sites
McKenzie	24
McKenzie, South Fork	12
Willamette, Mid Fk Downstream	12
South Santiam	10

Watershed Name	Number of Weed Sites
Willamette, Upper Mid Fk	8
Salt Creek	5
Willamette, Lower N Fk Mid Fk	5
McKenzie, Minor Tribs	4
N. Santiam, Upstream Tribs	4
Salmon Creek	4
Blue River	3
Fall Creek	3
N. Santiam, Blowout-Woodpecker	3
Quartzville	2
N. Santiam, Downstream	2
Willamette, Lookout	2
Hills Creek	1
Horse Creek	1

Process Critique

The timeline for this analysis was too short. Tell the story part was a very valuable step in getting ideas on analysis from other members of the Team. We had only one person doing all the GIS requests and it was too much for one person given time constraints. I received my final data requests after the integration step had taken place. Botanical issues were largely left out of this step as a result of this lack of data.

Data consistency and availability as well as questions of scale always confounds analysis. Using forest-level, generalized data to analyze special habitats did not work. Data on special habitats at the District scale is much more telling of the effects of roads on these species. Data on sensitive species is very good and an analysis of effects can be done at the forest scale. Inventory for survey and manage species is in its infancy. Data collected tends to be in areas of project activity so Late-Successional Reserves and other reserve areas may be underrepresented in distribution. Analysis is appropriate at the forest scale. Data on weeds is good for all new invaders except blackberry. Analysis at the Forest or province level might be most appropriate for weeds which move along major highway corridors although prevention measures to stop movement of the weeds needs to be local. This means Forest Service road maintenance contractors and contractors for ground-disturbing activities need to be educated as to the effect they are having on movement of weeds across the Forest and measures they can take to stop the spread.

References

Chen, J., J.F. Franklin and T. Spies. 1995. Growing-season microclimate gradients from clearcut edges into old-growth Douglas fir forest. Ecological Applications 5(1):74-86.

Dimling, J. and C. McCain. 1996. Special Habitat Management Guide, Willamette National Forest.

Ford, P. 1998, zone botanist for McKenzie watershed, personal communication.

Kaye, T. and M. Kirkland. 1994*Cimicifuga elata*: status, habitat analysis, monitoring, inventory and effects of timber management. Oregon Department of Agriculture, Salem, Oregon.

Luoma, D, 1988. Mycologist specializing in mycotrophoc species at Pacific Northwest Forest Service Lab, Corvallis, Oregon, personal communication.

Parendes, L. 1997. Dissertation: Spatial patterns of invasion by exotic plants in a forested landscape, Oregon State University, Corvallis, Oregon.

Ross, R.A. and H.L. Chambers. 1988. Wildflowers of the western Cascades. Timber Press. Portland, Oregon.

US Department of Agriculture and US Department of Interior, 1994a. Record of decision for amendments to Forest Service and Bureau of Land Mangement planning documents within the range of the northern spotted owl. Portland, Oregon.

US Department of Agriculture and US Department of Interior, 1994b. Record of decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the northern spotted owl: Appendix J Portland, Oregon.

Appendix F

Fire and Fuels Process Paper

October 1998

Background

The Willamette National Forest observes a moderate to high fire activity load during each fire season. Normally, fire seasons on the Forest occur from June 20 to October 15, each year (1). Fire occurrence for the Forest from 1970 through 1994 (25 years) indicates the Forest average fire loaded is 0.453 lightning fires per ten thousand acres and 0.42 human caused fires per ten thousand acres, annually (2). Current Federal Wildland Fire Policy states: *fires are to be suppressed at minimum cost, considering firefighter and public safety, benefits, and values to be protected, consistent with resource objectives* (3).

Roads are an important factor, both positively and negatively, in the nature of wildland fire and fuel management on the Willamette National Forest. Roads networks provide a positive benefit by allowing travel access to and from forested areas for fire suppression and fuel management activities . They provide access to and from water sources, lookouts, helispots and other fire resources. Within the Forest roaded areas, suppression response time is reduced increasing efficiency and effectiveness of firefighter suppressing both human and natural fires. Roads also provide barriers or fire breaks for fire suppression and fuels activities. From a safety standpoint, roads provide anchor points for line construction, escape routes, and in some cases safety zone for both wildland fire and prescribed fire personnel. In some cases wildland fire strategies have been developed around road networks (4).

Contrary to the positive benefits forest roads and other forms of transportation systems provide for firefighters, they also they also have negative aspects. These effects are increases in risk of ignitions of human caused fires. Human caused fires along roadways throughout most the Forest have a random distribution. However, there are geographical, public high uses, areas which have higher frequencies of fires. In some cases, data analyzed indicates, these areas have significantly higher human caused fire frequencies. The majority of these areas were identified along major State of Oregon highway corridors and a railroad transportation systems within the Willamette National Forest boundary.

Disturbances of forested areas by fire can change ecosystems and interacts with geomorphic processes. The geomorphic processes from the fire and road construction to harvest fire-killed timber can have an important effect on the overall rate of erosion (5).

Process Description and Documentation

1. ***How do roads provide for or affect protection in terms of efficiency, effectiveness and safety?***

Fire Suppression (Efficiency, effectiveness, and safety)

Historically, road systems have provided for an efficient transportation route for an appropriate fire suppression response on the Forest. Roads have normally been associated with strategies and tactics that were the most cost-effective commensurate with objectives for management areas in which the fires occur (6).

The level of fire suppression efficiency was measured for the Forest by an analytical process known as the National Fire Management Analysis System (NFMAS) in 1994. NFMAS objectively measured the net value change between the fire protection program, fire related cost, and resource losses on the Forest. This process identified the most efficient organizational needs for fire protection and proposed the most efficient funding level for the Forest fire protection organization.

Efficiency of transportation by emergency and other vehicles on Forest road systems played a key role in the NFMAS process. Vehicles were utilized, as the primary mode of transportation, in 87% to 90% of representative fires analyzed. The primary reason for the high utilization of vehicles was due to the high road density on the Forest.

Within NFMAS, fire management analysis zones were identified based on access and travel management within ranger districts boundaries and whether or not the area is designated as wilderness. Within the Forest, three nonwilderness zones were identified for each ranger district based on the primary type of initial suppression actions historically taken on wildland fires (1). The percentages of the initial suppression responses are shown below in *Table 1*. The "roaded-engine/hand" are initial attack forces going to the fire being transported in a vehicle or engine. The "remote hand" initial attack forces require walk in time, in addition to the vehicle travel time on existing Forest road systems.

Table 8. Forest Suppression Response Method

Forest Area-NonWilderness	Primary Suppression Response Method	Percent of Fires
Detroit / Sweet Home RD's	Roaded - Engine/Road - Hand	89%
	Remote - Hand	11%
Blue River / McKenzie RD's	Roaded - Engine/Road – Hand	90%
	Remote - Hand	10%
Middle Fork RD	Roaded - Engine/Road - Hand	87%
	Remote - Hand	13%

Based on the scope of the Forest Road Analysis, data, and time frames available to identified site specific changes in the road systems, quantifiable to changes to fire protection efficiency and effectiveness will not be analyzed in this process paper. The Forest Fire Managers are planning to calibrate NFMAS by March of 1999. The scope of this analysis should address travel management as a key issue or theme. If travel management is identified as an issue, base on current and future road closures, primary suppression response methods will be adjusted in the analysis. These adjustments, if made, will adjust the frequency of the distribution of the representative fires in the analysis. The change in frequency of the distribution will change the acres represented in the "roaded-engine/road-hand" and apply those acres to the "remote-hand". To apply this process road closures, future road closures and acres those road closures represent will need to be identified within the Forest's 3 non wilderness Fire Management Analysis Zones (FMAZ). This process will allow for frequency distribution changes to be utilized and will provide a detailed look at the net-value change for fires in areas where road closures occur.

The example in *Table 2* illustrates the estimated adjustment to the acreage on the Forest given a 2% frequency change in the NFMAS calibrations for suppression methods for firefighters traveling to fires. Again, this is just an example to reflect a change on Forest if road system being closed were to change suppression from "roaded-engine/road-hand to "remote-hand" in approximately 38,000 acres.

Table 9. *(Example)* Effect of Acreage Change with a 2% Change in NFMAS Frequency for Initial Attack Transportation Method

Suppression Method	**Current Acres (Forest wide)**	**Acres Change @ 2% Freq. Change in NFMAS (approx. 38,000 acres**
Roaded - Engine/Road - Hand	1,180,000	1,142,000
Remote - Hand	118,600	156,600

The example in *Table 3* illustrates the change of expected burned acres and cost plus the net-value change if a 2% frequency change (38,000 acres) was made in the NFMAS analysis on Forest.

Table 10. *(Example)* NFMAS Cost Plus Net-value Change and Burned Acres @ 2% Frequency Change

(Acres and dollar amounts are set at -30% Most Efficient Level and expressed in 1993 dollar values)

	Acreage change	**Expected Burned Acres**	**Cost + NVC** (1000 Dollars)
Current NFMAS Theme	0	1014	$8,902
NFMAS Theme @ -2%	38,000	1274	$9,645
Difference	38,000	+260	+$743

Safety in relation to road systems and travel management on Forest, along with all other safety considerations, will be the highest priority for firefighters and publics. When considering fire responses to wildland fires, fire managers along with firefighters need to identify tactics and strategies that do not compromise safety of firefighters. Issues such as road surface type and condition, road clearances, visibility of roadways on corners, maintenance levels, and traffic levels are just a few of the safety or possible safety issues emergency vehicle drivers deal with when responding to wildland fires. The scope to this analysis at a Forest level was too broad to deal with site specific and random information that requires on site data needs. In addition, the data sets are not currently available, and the time frame for this analysis was too restrictive to identify all the fire suppression safety issues as they relate to roads systems on a Forest scale. We would suggest that future analysis occur at the watershed level through water shed planning, NFMAS, and wildland fire situation analysis to answer questions relating to firefighter safety and access management travel.

When road maintenance issues are identified during fire suppression, corrective actions are taken. Many of these issues are as simple as brushing out narrow roads, grading roads, or doing other maintenance work to make road systems safe for travel by firefighter. When safety issues dealing with access and travel management on Forest cannot be mitigated, other forms of suppression transportation or methods of suppression actions will be utilized, by fire managers.

Access for Fuels Treatment and Management

It is anticipated, future fuel management and prescribed burning on the Forest will decline at the activity fuel project level and may increase on a ecological landscape scale. Activity fuel treatment projects funded by trust fund accounts on the Forest have been decreasing since the early 1990's (7). In 1996-97 a forest-wide Fire Management Plan was developed to identify the role of prescribed burning, within LSR's, at an ecological landscape level. In addition, a wilderness prescribed natural fire plan was developed for three of the wilderness areas on the Forest. It's anticipated that roads and road networks leading to and from activity fuel areas will not change significantly in the near future. This is based on the activities and access needs normally associated within watershed planning areas. In the future, if management ignited fires (MIF) are used to meet wildland fire objectives at an ecological scale, road systems maybe be utilized to provide for effective barriers during the ignition and holding stages of the prescribed burn. At this time, however, this program is still in the planning stage with no site specific prescribed burns planned that can be analyzed in regards to road access. Again, these are issues that are best analyzed and managed at the watershed level and not at a forest level. In regards to safety, fuel management would be address the same as in subsection "A. Fire suppression" portion of this process paper. Safety is recognized as the number one priority for local fire managers dealing with access travel management to and from activities, and needs addressed at a site specific or within each watershed level.

Access to Fire Resources

Fire resources are defined as lookouts, helibases, developed water sources, developed incident base camp locations, radio hill top sites, preattack fire breaks, helispots, and other related areas on the Forest. These resources were developed to support fire activities and safe factors relating to fire detection, fire prevention, Forest communications, and suppression of wildland fires.

An analysis of these resources was not done in relation to access and travel management, due to the nature and of the scope of this analysis.

Helispot, preattack fire breaks, and developed water sources need to be review at the watershed level scale and not at a Forest scale analysis. Road access to permanent lookouts and radio hill top sites or trail heads leading to those facilities need to be retained and maintained due to investments in the facilities, personnel safety factors, and communications network they provide for the Forest. At this time the only developed incident base camp within the Forest is the Hills Creek Dam site, located five miles southeast of Oakridge, Oregon. This site is located on Corp of Engineer lands under special use agreement with the Forest (see *Table 4*, below).

Table 11. Fire resources located on Forest

Type of Resource	Number of Resources on Forest
Lookouts (permanent)	4
Lookouts (other)	3
Radio Base Hill Tops	11
Heliports (not on FS lands)	2
Developed Water Sources	281
Helispots	79

2. How do roads increase the risk of fire occurrence?

Public Access in Relation to Fire Occurrence

Public access to National Forests is an important issue. Undoubtedly, the high density of roads on the Forest have contributed to a higher frequency of human ignitions in some areas (4). Also it can be assumed that public high uses areas have higher then average human ignitions. The randomness of each fire occurrence makes it very difficult to analyze.

Historical fire occurrence data on the Forest was assessed to determine if there was any correlation in human fire occurrence on the Forest to road density and high public uses areas. The historical fire occurrence data set was utilized to assess the fires that occurred on the Willamette National Forest between the years of 1970 and 1994. Also reviewed at the Forest scale were the spacial relationships between high intensity fuels models, dry southern aspects, areas where slope was greater then 50%, and human fire occurrences across the Forest.

Table 5 shows the number of human caused fires for standard road densities identified on the Forest. The statistical information is from fires occurring between 1970 though 1994.

Table 12. Human Caused Fire by Road Density

Road Density Mile/Mile^2	#'s of Human Caused Fire/ Road Density
0	270
0-2	244
2-4	618
4-6	485
6-8	69
>8	12

The road density assessment does not indicate a correlation in road mile density and human caused fires on the Forest. The frequency and distribution of human caused fires may be related to factors other then road densities. At this point more analysis is needed.

Greater access to such areas as dispersed campsites, backcountry camping and hunting may contribute to the higher incidence of human-caused fires – up to a point. Areas with the highest road densities are generally highly industrialized and therefore are less appealing to recreationists and hunters as camping sites.

The assessment at this time doesn't verify the need to alter, close, or change road systems based on just human caused fire occurrence.

Human caused fires were also reviewed from a non statistical process by identifying areas on a GIS created map with human fire occurrences. Occurrence data was overlayed and reviewed with transportation systems on the Forest, high intensity fuel within the Forest, slopes greater then 50% slopes and southern aspects. Identified were the high-risk areas based on fuel model, slope, and aspect in relation to fire occurrences. Nine areas were identified with high human caused fire occurrences for the 25 year period. None of the high occurrence sites identified had significant amounts of high-risk areas associated in them. Three of the nine areas were identified to have very high occurrences of human caused fires. The first was the Lookout Point area northeast of Oakridge, Oregon. High human fire occurrence in this area was due to a high frequency of railroad fires in the early 1970's through the early 1980's. The Forest area surrounding the Oakridge area also had a high occurrence rate due to the high amount of recreational activities outside the Oakridge City limits and occurrences along the Oregon State Highway 58 corridor. The third area was in the Upper McKenzie river area. The Upper McKenzie area is a very high recreational area during the summer.

3. How do roads affect the fire protection in the urban interface?

An assessment for road affects on Urban interface within the boundaries of the Willamette National Forest was not accomplished. This was due to short time frames of the process and quality of information available on a Forest scale. Assessment for affects on Urban interface will be recommend to be accomplish at local levels where public comments and information can be utilized to make site specific evaluations for each area of concern.

Interpretation

This assessment presents limited results due to time frames and process time. The nature of fire protection and assessment of fire protection of this scale is limited by well define information that can be utilized to identify cause and effect. Besides GIS data, studies and information sources on Forest and nationally are very limited when discussing fire management and road issues, however this is a good starting point. In this assessment there was not a determination on the values of roads in relation to fire protection and impacts to fire protection if road were closed. To assess values of roads in relation to fire protection and cost, quantifiable information, such as miles of road to close, site specific locations, and types of closures will need to be determined in advance of the analysis.

Future fire management issues dealing with road access will be a key issues on the Willamette National Forest this winter. The Washington National fire management group has request all National Forests in all Regions to calibrate NFMAS. The fire managers on the Forest have already identified that changes in road systems are forthcoming. Areas that were once accessible by roads four to five years ago are blocked or no longer in existence. Changes in current road access, availability of road access, or future access will need to be analyzed. This ultimately will influence strategies, tactics, burned acre area, and budgets on the Forest in the future.

Process Critique

Time of the year and process knowledge were key factors during the assessment. My lack of technical capabilities in GIS and not having good processing time was lacking thought the first month of the project. Lack of quality technical information relating to the effects of roads on fire management or fire on roads could not be secured. There seems to be very few reports addressing this issue. For a Forest scale assessment, background information would have been helpful. What little information I did find was helpful.

Competition for data through GIS seemed to be the one major problem. Time frames were short and not having maps and other data available in a timely manner was a key factors. Also, much of the fire data, on file, was not related to the issues of the analysis and did not really answer questions about access and travel management. The data that was relevant in some cases created more questions then answers, causing a need for more data.

Limited public involvement did not affect fire management input to the process, however, public involvement is an important factor in any Federal assessment and time will tell how critical not having public involvement in this process was.

Literature Cited, Key References, and Data Source

USDI and USDA, 1995. Federal Wildland Fire Management Policy and Program Review, Final Report, p. 5.

McNabb, D. H. and Swanson, F. J., 1990. Effects of Fire on Soil Erosion. Natural and Prescribe Fire in Pacific Northwest Forests. Chapter. 14, pp. 160-168.

USDA Forest Service and USDI Bureau of Land Management, 1997. Annual Fire Report, pp. 2 21. Willamette National Forest and Eugene District BLM.

USDA Forest Service, 1990. Land and Resource Management Plan, p. IV-82. Willamette National Forest. PNW R6.

USDA Forest Service, 1994. Willamette National Forest NFMAs Suppression Analysis Documentation, pp. 1-6.

USDA Forest Service, 1998. Forest Service Roads: A Synthesis of Scientific Informantion (Dra Part II, Fire, p.5.

USDA Forest Service, 1998. Willamette National Forest, Geographical Information System, fir data.

Appendix

GIS Data

Data Table:

1. Number of Human and Lightning Caused Fires By Road Density

Bar Chart:

2. Number of Human and Lightning Caused Fires for Each Road Density Category

Data Table:

3. Forestwide Road Density - Acres

Forest Map:

4. Human Caused Fire Cluster Count

Data Table:

5. Human Caused Fires per Fifth Field Watershed

Bar Chart:

6. Number of Human Caused Fires in Each Watershed

Data Table:

7. Results of Evaluating Overlap of Significant Hazard and Resource Concerns

Data Table:

8. Description and Count of Various Structures that Occur on Willamette National Forest Land

NFMA and F.BEHAVE Data

Data Tables:

9. Summary of Option - Theme 4
10. Summary of Option - Group 2%
11. Summary of Option - Group 4%
12. Summary of Option - Group 6%
13. Summary of Option - Group 8%
14. Summary of Option - Group 10%
15. Burn Subsystem, Fire1, Behave Run (3 pages)

Appendix G

Forest Products Process Paper

October 1998

Introduction

Roads are essential to the management of the Forest Products Program on the Willamette National Forest. For the purposes of this analysis, the Forest Products Program is meant to include both the Timber Program and the Special Forest Products Program.

Roads provide access to the forest for planning, designing and implementing a wide range of timber harvest activities. These same roads provide access for equipment that can perform the logging and harvesting activities. They also provide access to the people and equipment that complete subsequent vegetation management treatments. The roads also provide access to individuals that gather special forest products such as Christmas trees, floral greenery, mushrooms, fence posts and firewood. Without the existing network of roads on the Willamette National Forest, many of the forest products activities we now take for granted would not be possible.

Process description/documentation

To begin to understand the importance of roads to management of the Forest Products Program, a list of questions were developed.

1. ***How do roads provide for the management of forest products in Matrix and Adaptive Management Areas (AMA)?***

The structure of this question further refined the area of analysis for the Forest Products Section of the report to only Matrix and AMA land allocations. This is appropriate on the Willamette National Forest as the focus of harvest activities for both the timber and special forest products program is in the Matrix and AMA allocations. Programmed Sale Quantities are planned from AMA and Matrix land allocations.

Roads allow for access to forest products. All timber and most non-timber forest products come from within 2,000 feet of a road. Most timber comes from within 1,500 feet of a road. Non-timber products such as firewood and fence posts come primarily from within 100 feet of a road. These products are relatively heavy and most of their value is added in processing. More portable non-timber products such as Christmas trees, boughs, mushrooms, floral greenery and cones come from varying distances from the road, but their utility to the collector drops rapidly with increasing distance from roads.

Key Questions

- *How much of the area that is suited and available for timber management is accessed by the existing road system and can be logged using conventional yarding systems? Forest and watershed scale?*

To answer this question at the forest scale, a GIS analysis using existing data was performed. This analysis compared the existing system road layer with the forested lands in the Matrix and AMA land allocations. The analysis was done using the assumption that any land that was within 2,000' of an existing system road could be logged with conventional logging equipment such as yarders and tractors. Two caveats are worth discussing. The efficiency of cable logging systems falls off rapidly at yarding distances greater than 1,500 feet. Logging is usually feasible at up to 2,000 feet, but not in all circumstances. Second, harvest and transport of special forest products is facilitated by proximity to roads. Watershed and project level analysis is needed to further refine the accuracy of the forest scale analysis. It is also expected that site specific analysis will identify areas where alternative harvest methods (ie helicopter) will be needed.

There are 444,577 of suitable and available matrix lands that are within 2,000 feet of a road.

- *Which suited and available acres are not accessed by the existing road system?* Forest and watershed scale

Using the same analysis described in question “A”, the watersheds on the forest were ranked as to their accessibility. In addition, the map generated in question "A" spatially located those areas that were more than 2,000 feet from a road.

There are 15,734 acres of suitable and available matrix lands that are not within 2,000 feet of a road.

- *How does road spacing and location affect logging system feasibility?* Watershed scale

If areas that are more than 2000 feet from a road are known, project teams can assess project feasibility when they move to watershed or project level analysis. Any watershed or project area that has a significant percent of the area further than 2,000 feet from a road will need to include either road construction or alternative (helicopter or other aerial systems) logging systems in project design.

The amount of logging spur road and the spacing of spur roads is related to cutting unit size and shape. This relationship has undergone a major change with the implementation of the Northwest Forest Plan. Streams are linear features, flowing across contours (downhill) in a dendritic pattern. Under the Northwest Forest Plan, streams are surrounded by buffers of up to 680 feet, where no timber harvest is allowed. This tends to constrain timber harvest to narrow slices of land between stream buffers, usually oriented between ridge and valley bottom. Roads built to access particular timber stands for logging are by necessity constructed along ridges or across the slope of a ridge (with the contour), commonly at right angles to stream buffers. Thus, under the Forest Plan, more miles of road must be constructed to reach the ‘slices’ of land available for harvest.

- *How does existing road access affect commercial and personal collection of special (non-timber) forest products?* Watershed and project scale.

Proximity to a road increases the value of products, from the perspective of customers who gather special forest products. The heavier the product, the less valuable it is at increasing distances from open roads. Firewood may only have value at less than 100 feet from a road. Mushrooms may retain some value at 2000 feet from a road.

Results

Results from analysis showed that the majority of the Matrix and AMA land allocations in the Willamette National Forest are accessed by existing system roads.

If Matrix and AMA lands within 2,000 feet of a road are considered accessible, more than 96 percent of the forest is accessible.

Access by watershed is shown in table 1. Table 2 describes the location and size of each watershed. Figure 1 shows the location of each watershed.

Table 1

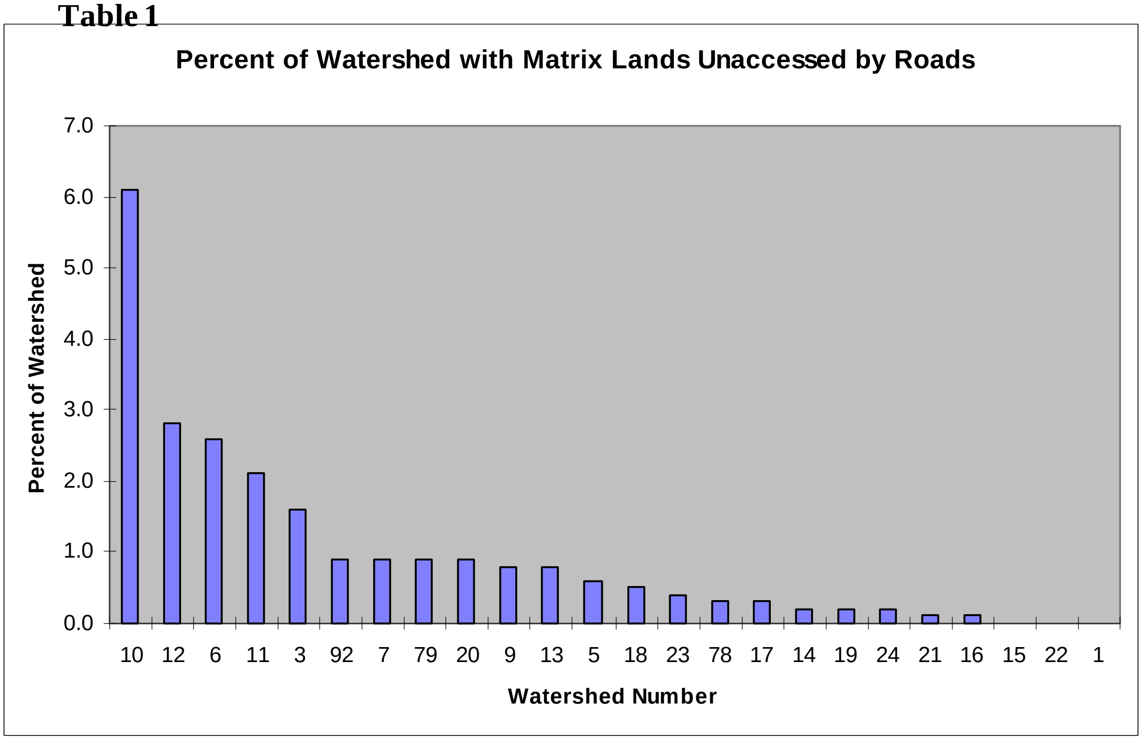


Table 2

Watershed Number	Watershed Name	Watershed Acres
1	Little North Santiam	40137.8
3	N Santiam, Downstream Tribs	39349.8
4	Quartzville Creek	39233.8
5	Middle Santiam	56038.6
6	South Santiam	92355.9
7	McKenzie	230925.5
9	Calapooia	6657.2
10	Blue River	59077.9
11	McKenzie, Minor Tribs	43525.2

Watershed Number	Watershed Name	Watershed Acres
12	Quartz Creek	27068.1
13	McKenzie, South Fork	137545.6
14	Horse Creek	101537.5
15	Fall Creek	87616.1
16	Winberry Creek	22637.3
17	Willamette, Lower NFk MFk	88427.1
18	Salmon Creek	82431.8
19	Willamette, Lookout Res	49352.4
20	Salt Creek	71769.3
21	Willamette, Mdl Fk Downstream Tribs	109916.1
22	Hills Creek	38456.5
23	Willamette, Upper Mdl Fk	113384.3
24	Willamette, Upper NFk MFk	69843.4
78	N Santiam, Blowout-Woodpecker	83122.6
79	N Santiam, Upstream Tribs	99388.3
87	Thomas Creek	546.2
91	Whitewater River	488.1
92	Breitenbush	61150.3
99	Molalla	588.7

Matrix lands that may need the development of more system roads to provide for use of conventional logging systems are quite limited on the forest. Those matrix lands appear to coincide with areas that are identified as "roadless”. Generally, it would seem to be prudent to design logging systems that do not require the construction of more roads. Of course, the specific needs of a particular project must be further analyzed at the project scale.

Process Critique

1. The short amount of time for the process required that we use existing GIS data for analysis. In some cases this data was inaccurate. Because of the short time frame the data was not ground-verified. For future projects it would be more efficient to have this GIS data ready before analysis and synthesis started.
2. Our process allows only minimal public involvement.
3. The transferability of the specifics about what a conventional logging system may not be transferable to other parts of the country where the availability of logging equipment and the topography of the ground may be significantly different.

References

Toupin, Rick. 1998. Personal communication. Region 6, Logging Systems, Engineer.

Willamette National Forest Pilot Road Analysis

Appendix H

Recreation Process Paper

October 1998

Recreation

The first section pertains to the following Key Questions in the “Recreation” part of the analysis:

1. ***Is there now or will there be excess supply or excess demand for unroaded recreation opportunity now or in the future?***
2. ***Does road access contribute to use in excess of the capacity of Wild and Scenic Rivers?***
3. ***Does road access (number of roads and road condition) contribute to overcrowding and/or resource damage at popular back-country destinations (Wild and Scenic Rivers)?***
4. ***What is the level and condition of access to Special Interest Areas and Old Growth Groves?***

The second section will deal with the questions in the context of Dispersed Recreation, Scenic Byways and Developed Recreation.

The final section will address the same questions in the context of Trails and Wilderness.

Background

Citing the Willamette NF LRMP/EIS, the Forest offers a diversity of recreation settings ranging from developed recreation to Wilderness. The primary purpose of managing recreation resources is to provide a range of opportunities from which National Forest users can obtain satisfying recreation experience. We seek to identify recreation settings of varying characteristics that range from large, remote undeveloped areas to small, easily accessed highly developed sites.

Maintaining a viable road system is the key to our ability to provide the diverse recreation settings necessary to meet our desired condition. At the same time, the existence of roads and/or the condition of roads may contribute to overuse, and ultimately a diminishment of visitors' recreation experiences. Public needs may change over time, and we should be willing to adjust and make needed changes.

Process Description/Documentation

1. ***Is there now or will there be excess supply or excess demand for unroaded recreation opportunities?***

According the Forest LRMP/EIS (III-105): "Uses which depend upon a semiprimitive setting face a decreasing supply of opportunities as lands are converted from an unroaded state. Unroaded areas which undergo intensive timer harvesting and accompanying road construction will lose those attributes that provide the solitude and undisturbed environment associated with semiprimitive recreation experiences".

"Semiprimitive non-motorized" settings are characterized by a high probability of solitude, natural appearance, low interaction between users, evidence of vegetation modification is low.

The Forest Plan goes on to predict that recreation use in the semiprimitive unroaded segment of the Forest will exceed the practical capacity for that setting sometime between 2010 and 2040.

We have no better data than this to help with the Roads Analysis. Year-to-year data from wilderness permits, trailhead registers, automatic road counters, would all contribute to our understanding of trends of use. We have no integrated methodology to do a comprehensive analysis of use trends.

2. Does road access contribute to use in excess of the capacity of Wild and Scenic Rivers?

The Forest has two congressionally designated Wild and Scenic Rivers: North Fork of the Middle Fork Willamette, and Upper McKenzie. The Forest also has one congressional Study River: South Fork McKenzie. In the Forest LRMP, we identified nine river segments that have river-related values that meet criteria to be eligible for Wild and Scenic River status: Little North Santiam, Opal Creek, Breitenbush, South Fork Breitenbush, North Santiam, Quartzville Creek, Middle Santiam, South Santiam, and Middle Fork Willamette.

For the streams that have classifications of "Recreation", roads and other developments are permitted. Most of the streams listed above have an arterial or collector road within the corridor boundary. Those roads are likely to be considered essential for recreation.

In order to answer this question, a Limits of Acceptable Change (LAC) process would have to be used to determine the current level of use for each of the streams, develop thresholds for levels of use, and ultimately develop standards for what constitutes acceptable change over time. None of the eligible or designated rivers have undertaken an LAC process for road-related recreation use. Initiation of such a process would best be done at a District level.

3. Does road access (number of roads and road condition) contribute to overcrowding and/or resource damage on Wild and Scenic Rivers.

This question is similar to #1 in that most of the designated or eligible rivers are served by arterials or collector roads. Recreation use, especially during the summer will be moderate to high in river corridors.

Local roads that disperse use into river corridors may have an effect on vegetation, soil, and may ultimately contribute to erosion. River Management Plans for the two designated Wild and Scenic Rivers identified the need to close certain local roads, and both Districts have followed through on that direction. For the eligible rivers, some local roads or non-system roads have been closed over time.

This question is best answered by Districts through Watershed Analyses or through a LAC process to determine thresholds and standards for change.

4. What is the level and condition of access to Special Interest Areas and Old Growth Groves?

The Forest identified 44 new Special Interest Areas in the Forest LRMP/EIS to preserve special cultural, historic, geologic, zoologic, botanic and scenic qualities of the Forest. Management actions are to focus on protection of the important historic, cultural and natural aspects, and where appropriate, foster public use, study and enjoyment of designated lands.

Use will be managed to the extent necessary to protect the unusual features of individual sites. Area Management Guides are to be prepared for each area.

In addition to the aforementioned SIAs, 34 Old Growth Groves were designated in the LRMP for education, use and enjoyment of the public. Area guides are to be prepared for each Grove.

Many of the SIAs and Groves are served by arterials or collectors; some are not accessed by roads at all.

There are no known use or access issues at the Forest level. The evaluation of this question is best done at the District level during the Area Plan or Watershed Analysis processes.

Results and Interpretation

In general for the questions I answered (Wild and Scenic Rivers, SIAs and Old Growth Groves), there are no "hot spots" that should be addressed at the Forest level during this analysis. There may be opportunities, however, to look at the number of local roads within Wild and Scenic River corridors and/or leading to SIAs or Old Growth Groves if they are concurrently identified as contributors to the decline of other resources (fish, wildlife, water quality, etc).

Dispersed Recreation/Scenic Byways/Developed Recreation

Process Description/Documentation

2. What is the level and condition of access to developed recreation sites?

3. How and where does the existing road system influence recreation areas?

The majority of the developed recreation sites on the Willamette National Forest are accessible via double lane asphalt paved roads. Several sites are located on double lane all weather gravel roads. Access to developed sites is not difficult. All of the Developed Recreation Sites have water and require a fee to camp. Most sites have a ROS (Recreation Opportunity Spectrum) classification of "Roaded Modified", two are classified as "Roaded Natural"., and non are classified as "Semi-Primitive Motorized. A mix of a few more sites in Roaded Natural and Semi-Primitive Natural would provide a greater breadth of recreation experiences for the public. The ROS classification is determined in a great part by the difficulty of vehicular access to the recreation site. The existing road system provides very adequate access to all recreation areas, developed and dispersed.

- ***Key Question:*** *Does road access contribute to use in excess of the capacity of recreation facilities?:*

Detroit Ranger District is located just south of Portland, Oregon, and east of Salem, Oregon. Because of the proximity of a large body of water to the greater portion of the population of the state, Detroit Reservoir is the second highest used reservoir in the State of Oregon. On summer weekends and holidays, recreationists flock to the Detroit Reservoir area, occupying all recreation sites available. When the developed campgrounds become full, use of most or all dispersed recreation sites occurs. Detroit Reservoir is located on State Highway 22, which is a major east west travel route. It is debatable as to whether the road system contributes to overuse of this area or if it is the closeness to the metropolitan population of the state that contributes the most to overuse. It is probably a combination of both.

Overuse is not a constant issue on the rest of the forest, although it does occur at some sites on major holidays and weekends. Labor Day weekend in the McKenzie River drainage, along Fall Creek, and in the Sweethome district, at Big Lake, and at Waldo Lake usually begins with recreationist arriving as early as the prior Tuesday. The road system does provide easy access to all of these areas, but does not contribute adversely to exceeded capacity.

4. How do roads contribute to the use of dispersed recreation sites?

Dispersed Recreation Sites are directly related to road access. People using dispersed recreation sites in the summer are recreationists, and in the fall are hunters. Usually the recreationists and hunters do not use the same sites. Many dispersed sites are located on user made roads or jeep trails, which on the Willamaette are usually less than 1.000 feet. Access to the user made roads is by both asphalt and gravel roads.

5. ***How and where does the current road system meet motorized, driving for pleasure recreation demands?***

- **Key Question:** *Where are Scenic Byways, Back Country Byways, and other designated recreation-related travel routes?*

Driving for pleasure is the primary uses of the main forest road system on the Willamette National Forest. Driving for pleasure also occurs on the US Highways , and the State of Oregon Highways, but is not necessarily the main use.

A National (Federal Highway Designated) Scenic Byway exists. The Mckenzie Pass-Santiam Pass Scenic Byway goes From the town of McKenzie Bridge, Oregon, to Sisters, Oregon following the historic State Route 242, and returns via US highway 20, and State Highway 126. Some visitor facilities, ie. restrooms, interpretive signs, parking, and trails have been added to this scenic byway. Since it's designation as a scenic byway , use has increased steadily. Some improvements as mentioned above are being constructed presently.

The West Cascades Scenic Byway, a State of Oregon designated scenic byway begins in Estacada, Oregon, near Portland, and terminates in Oakridge, Oregon. This scenic byway is located on US Highways, State Highways, and Forest Highways on the west slopes of the Cascade Mountain Range.. It provides an alternate route to Interstate 5 for recreationists. Because of the more recent designation of this Byway, a very few number of improvements have been constructed. Plans are underway for five portals to be constructed and interpretive planning documents are being prepared.

Diamond Drive follows forest road 21 from the city of Oakridge south along the Middle Fork of the Willamette River and on to Lomolo Lake and the Rogue River-Umpqua Scenic Byway. Diamond drive was intended to be a part of the West Cascades Scenic Byway, but a 16 mile portion of the road is not asphalt paved, and therefore not eligible for inclusion in the State of Oregon Scenic Byway System. If and when the 16 miles had double lanes and is paved it could be added to the state system. Then there would be a scenic byway system from Portland, Oregon to Medford, Oregon.

A BLM / US Forest Service Back Country Drive begins at State Highway 20 and the Quartsville Road at the east end of Foster Reservoir. It ends at State Highway 22 and the Straight Creek road intersection. Kiosks have been constructed near both ends of the Back Country Drive.

Trails and Wilderness

Background

As with Recreation sites, the maintenance of a viable road system is a key to providing the diverse opportunities available on the Willamette National Forest, where there are 236 trailheads servicing 1779 miles of both non wilderness and wilderness trail.

Process Description/Documentation

1. ***What is the level and condition of access to trailheads? Does road access contribute to use in excess of the capacity of recreation facilities?***

   There is a similar situation here as with other recreation sites, roading is adequate for the current needs of the public demand for access, but during the next 40 years demand will exceed ability to respond with additional miles of trail and related trailheads.

2. ***Does the number of roads and/or their condition influence use patterns and quantities to backcountry destinations: Does access contribute to overcrowding and/or resource damage at popular backcountry trailheads?***

   Use patterns and numbers of users to backcountry destinations tend to be more dispersed by increased numbers of trailheads as well as miles of trails. This will, however, have an adverse effect on wildlife and increased cost to maintain road access to the trailheads.

3. ***How and where does the existing road system influence trailheads?***

   Trailheads are for the most part served by collector roads, with a few being on main arterials and a few on secondary roads.

4. ***How and where does the current road system meet motorized, driving for pleasure recreation demands? What opportunities exist for converting closed roads to ATV trails?***

   Opportunities such as this have not been explored at this time. As this process is ongoing, all opportunities for these conversions will be reviewed .

Results and Interpretation

This process brings to point the lack of data available on use figures for trailheads, and types and needs of users. A forest wide trailhead map was generated on GIS, several trailheads fell into areas that are considered hotspots in regards to other resources. Focus should be placed on these trailhead first for analysis as to whether or not they are in the best location for visitor needs with emphasis on resource protection. A list of these trailheads, by INFRA number are as follows:

6^{th} Field Subwatershed Number	INFRA Trailhead Number
In/or access thru **236** & **234**	72109-72110, 72118-72122, 72127-72129
In **221**	72103
In **213**	72105-72107
In **191**	72551, 72548, 72557, 72560-564 72566, 72570, 72573, 72574, 72576, 72579, 72582, 72585

Trailheads affected by other concerns to a lesser degree are:

6^{th} Field Subwatershed Number	INFRA Trailhead Number
In **073**	72688 and 72687
In **061**	73907, 73921, 73916, 73927
In **067**	73908
In **054**	73910, 73906 and 73904

Willamette National Forest Pilot Road Analysis

Appendix I

Heritage Resources Process Paper

October 1998

Background

Heritage Resources by definition include many forms of archaeological, historical, and cultural properties. Such resources are found throughout Willamette National Forest lands and have been identified primarily through project level inventories conducted in compliance with the National Historic Preservation Act (NHPA). These resources are fragile and non-renewable connections to past lifeways (or extant traditional practices of native inhabitants) and human endeavors, and as such are offered a high level of protection under current federal legislation.

Archaeological sites typically exist in the form of buried deposits of stone tools and debris resulting from tool manufacture, usually these represent the remains of the native inhabitants of the area, and as such can be quite ancient. These are commonly known as lithic scatter sites due to the dominance of stone artifacts in the assemblage. Because of the inherently poor preservation qualities of the temperate forest environment, organic cultural remains are generally rare in these assemblages. Some historic era archaeological sites are also found on the forest. These represent more recent endeavors of non-native, Euro-American settlers and explorers. Archaeological sites are usually difficult to identify without intensive field surveys, except when exposed by ground disturbing activities. Road construction, maintenance, road use, and associated erosion can destroy or damage the integrity of archaeological deposits.

Historic sites, in contrast, exhibit a broader range of artifact types, materials, and features in their assemblages. They often include structures as a dominant component, though an archaeological component may also exists. However, they are more readily identified than their archaeological counterparts. Historic properties also include engineering features and travel corridors, such as early roads, trails, railroad routes, monuments, dams, bridges, etc. Often modern roads were developed over historic transportation routes.

Cultural properties are considered to be locations of traditional cultural activities of indigenous people and their descendants, and may not manifest themselves with distinguishable physical remains. Locations may only be known to the specific practitioners or traditional members of the tribe, and information kept in confidence. These places will be most reliably identified through consultation with local tribes and traditional practitioners in the community. Federally recognized Indian tribes retain sovereign status and special consideration in accordance with that status. Furthermore, some tribes have reserved certain rights (e.g., for hunting, fishing, gathering , water, etc.) which must be recognized and access accommodated in land management decisions.

Currently the Willamette National Forest works with four federally recognized tribes who have ancestral ties to the land we manage. These are the Confederated Tribes of Grand Ronde Community of Oregon, the Confederated Tribes of the Siletz Indians of Oregon, the Confederated Tribes of the Warm Springs Indians, and the Klamath Tribe. Of these, only the Warm Springs and Grand Ronde assert their claims to ceded lands within the forest's bounds: The Warm Springs in the Mt. Jefferson wilderness, near their reservation, and the Grand Ronde consider their ceded lands to include all of the Willamette Valley from the crest of the Cascades to the crest of the coast range, including the whole of the Willamette National Forest.

Process Description/Documentation:

Just as the nature of heritage resources as physical and cultural manifestations is varied, so are the potential effects of the forest roads and road system. For the purpose of this analysis, several questions have been identified which can be used to address issues related to heritage resources and the forest's roads policy. For example ***How and where does road access affect archaeological sites and historic properties?*** The answer to this question is complex and requires the assimilation of a vast database. This issue is best examined by more specific key questions, as follows.

- ***Are archaeological sites and historic properties adversely affected by the existing road system?***

It is commonly known that many archaeological sites on the forest have been directly impacted by the initial road construction, continued road maintenance and erosion, which unmitigated results in irretrievable data loss. Through continued monitoring numerous sites have been identified throughout the forest which would benefit from road closures and or rehabilitation (See annual Forest Monitoring and Evaluation Reports, 1991-1997). Remnant deposits of sites could be preserved by stabilizing eroding surfaces such as road cuts. Archaeological sites such as those found on the forest are typically not amenable to on-site interpretation that might favor public access because of their fragile nature and discreet properties.

In order to analyze the effects of the current road system on archaeological sites and historic properties it would be necessary to correlate the locations of each and examine site specific information for evidence of impacts. There have been over 2,000 archaeological sites documented on the forest. Documentation exists primarily in the form of paper records (site records and maps) and an ORACLE data base, though two districts (Detroit and Sweet Home) have site location data on GIS. The ORACLE data base, created in 1991, has been maintained at the district level to varying degrees. The database can be used to produce reports in tabular form, listing sites with documented road impacts. This is only as reliable and current as the data input, and would likely produce only a cursory indication of the actual conditions.

Using existing data to conduct an analysis of the effects of the road system on archaeological sites would require the comparison of site locations obtained from these records with the current road system. A cumbersome and time consuming process, analysis would best be accomplished at a district or watershed scale, where more site specific information is available. Assessment at a forest scale is not feasible at this time.

- ***How does the existing road system contribute to the efficiency and costs of maintaining historic properties, especially structures?***

Historic sites, especially structures, on the other hand, are more conducive to adaptive uses such as interpretation, and in some cases recreation rental opportunities, so access for interpretation as well as maintenance may be more desirable in some cases. Some historic structures are currently used as administrative facilities (e.g., fire lookouts), requiring other access considerations. Other historic structures are not being utilized or maintained by the forest, but may receive visitor use. Access is desirable for sites of this type from both the maintenance and public use perspectives.

There are 74 historic structures currently listed on the forest inventory. Records and information about these properties exist in the same form as detailed above for archaeological sites. Comprehensive specific data on maintenance efficiency and costs are not readily available, but may be obtained through records search and interviews, primarily at the district level where most maintenance and management is undertaken. The process for analysis would be similar but somewhat simpler in light of the smaller numbers of properties involved.

As a general rule, properties with road access have been more often utilized and more efficiently maintained. In exception to this are properties which are accessible by road (or roads and short trails) but are located some distance from the ranger station. Often these properties are the target of public abuse/vandalism. Costs associated with maintaining these properties is relatively high. Additionally, the kinds of archaeological sites found on this forest would not typically require maintenance unless the site has been impacted by other management or public activities. Then there would be less occurrence of such damages in areas where access is limited.

- ***How does the existing road system contribute to interpretation and public use of historic sites or other cultural resources?***

This analysis is closely related to that of the previous question in that the same sorts of properties are utilized by the public and for interpretation. *(In fact, perhaps the two questions could be combined, and addressed as one.)* Generally, such uses are associated with recreation and could be addressed as such. Interpretive efforts are generally focused in areas of high*(er)* public use. Interpretive panels are currently found along many main travel routes (e.g., Scenic Byways, Aufderheide) and in recreation sites (e.g., Bedrock, Box Canyon, Clark Creek, Clear Lake, Delta, Sacandaga, Waldo). Interpretation of more fragile archaeological sites takes the form of off-site interpretation, such as brochures or displays. (See the Region 6 publication, "Windows on the Past," for heritage interpretation locations.) Some additions have been made since its publication.

- ***Which roads are historic transportation routes? Where have historic transportation routes been identified and how does maintenance to historic levels affect other resources?***

Many historic transportation routes, such as old wagon roads, trails, and railroad routes, have been adversely affected by road development. As transportation systems evolved over time, modern roads often followed existing historic routes. In some areas this resulted in obliteration or fragmentation; however, in some places pristine segments have survived. In some cases, current roads could be closed and routes rehabilitated to a historic character. Some could be converted into interpretive trail routes.

The process for conducting the analysis of this class of heritage resources is similar to those above in that it relies on review of existing heritage resource records. Many of these routes are fairly well documented in the archives; many have been field verified and recorded. Some have evaluations and management plans in place.

When road decommissioning or other road management activities are being considered, an archaeologist should be consulted in order to assess the potential historic values of the road system under consideration. Again, historic records and maps should be consulted to identify others previously unrecognized, perhaps minor routes. The watershed or district scale is an appropriate level of analysis for the minor routes.

- ***How and where do roads provide access for traditional cultural practices for Native Americans?***

The extent to which forest lands are currently utilized by Native Americans for traditional cultural practices is not well-known to forest managers. Recently increased consultation and interactions with local tribes and native practitioners indicates that there is considerable interest in using at least some areas of the forest for cultural activities. Some areas of interest have also been identified through tribal involvement in the watershed analysis process over the last few years. Understanding of these interests and needs will be facilitated by continued interaction and relationship building with the tribes.

For the purposes of this analysis, an informational letter was sent under the Forest Supervisor's signature to the tribal chairpersons and the cultural resource coordinators for each of the four local tribes listed above (Grand Ronde, Siletz, Warm Springs, and Klamath). The letter contained an overview of the pilot roads analysis and provided names of individuals to contact for additional information: I.D. Team leader, Forest Engineer, Forest Native American Program leader, and Forest Heritage Specialist. The letters were followed by phone calls. It is important to note that in order to be successful communications of this nature require a considerable investment of time. As the relationships between the forest and the tribes become better established, information exchange will improve.

Results and Interpretation:

Results of the Heritage portion of the analysis may seem limited or general. Because of the vast body of data available, and lack of manageable data systems, more time and resources are needed to assimilate the appropriate information. GIS has not been utilized to the extent it has for many other resources on the forest. The ORACLE data base has limitations, partially based on the current conversion to IBM, as well as inconsistent data upkeep on the district. Decisions around roads should give more specific consideration to heritage resources in determining effects of specific or programmatic undertakings, as per National Historic Preservation Act requirements. Below are the preliminary results of the analysis, arranged by Issues and Key Questions, as above. Additionally “hot spots” identified by other resource area specialists could be assessed for potential heritage resource concerns or compatible opportunities.

- ***How and where does road access affect archaeological sites and historic properties?***
- ***Are archaeological sites and historic properties adversely affected by the existing road system?***

The short answer for this is "yes". However, in order to identify specific roads and sites would require more time, and should be focused at a finer scale, as described above. In the interest of testing the available data for application to this analysis, GIS and ORACLE were used to derive data about the frequencies of sites associated with roads, including records which indicate road related impacts.

One map was created from GIS (cr1) which shows the interface of roads and heritage sites on the Detroit and Sweet Home districts. (None of the data was verified, or checked for consistency.) This map displays sites as shaded polygons for one district, and "bull's eyes" for the other. According to end of year reporting for FY 97, the total number of recorded sites for Detroit is 450, and for Sweet Home is 390. Though no frequency counts were produced by GIS, one district exhibits nearly one hundred such polygons, while the other show only about a dozen "bull's eye" sites. That is, about 22% of Detroit's sites, and 3% of Sweet Home's sites, have been impacted by road related activities, according to these data sources. The road systems nor site distributions of these two adjacent districts are not so different that it would account for such a difference in the GIS representation.

Another attempt at assimilating data was made using the ORACLE (cr_site) data base. Two standard queries were run using the forest links to the data base. The queries asked for listings of sites that had documented impacts from (1) road or bridge construction, or (2) road maintenance. Originally, this data base had been created in 1991 inputting data from the 7 districts. The queries reported data from not more that four districts. These four districts that are represented by the data have a site count of approximately 1355 (FY97 year end report).

Results:

- Impacts from Road Maintenance: 86 sites (3 districts represented)
- Impacts from Road or Bridge Construction: 312 sites (4 districts represented)

A very simple analysis of these results tells us that about 29% of the sites on these districts have recorded impacts from roads. None of these data were closely scrutinized for this analysis, so it should be viewed with considerable caution.

Review of monitoring reports from 1991-1997 indicate a commonly reported cause of (continuing) impacts to sites is road maintenance or road use (97) and off-road vehicle use (95). We have had 2 important sites damaged by road maintenance activities in the past few years.

As per NHPA, eventual decisions regarding road closures, obliteration or continued use and maintenance will require the determination of effects of specific actions on known significant sites. In some cases, road closure may be adequate to ameliorate the existing effects of road use, while other sites may require some level of rehabilitation or stabilization to prevent further damage through erosion. Effects of road obliteration must be addressed at the site-specific level. Roads analysis on a more local or watershed scale should also identify adverse effects of continued use and maintenance of some roads on archaeological sites, allowing for the design of protective measures (i.e., mitigation).

- ***How does the existing road system contribute to the efficiency and costs of maintaining historic properties?***

Again, this question needs more focused analysis. “Efficiency and cost” were not addressed as such, but clearly access is an important aspect of this. The road system contributes to the use and enjoyment of many historic structures on the forest. Typically the structures that are used are better maintained. Decisions regarding continued use and access to historic structures should take into consideration other management options, such as recreation and administrative uses, as well as historic values. Usually the preservation needs can best be met by adaptive use, which is sensitive to historic values.

- ***How does the existing road system contribute to interpretation and public use of historic sites or other cultural resources?***

Recreation is probably the most common "adaptive use" of historic structures on this forest. For the purposes of this road analysis, access will be addressed through the recreations section. Often in conjunction with recreation sites, interpretation of historic sites is also common on the forest. Interpretation is an national priority for the Heritage program. At the Regional scale, we have "Windows on the Past" as the Heritage interpretive program. A publication, *Windows on the Past: Guide to Pacific Northwest Historical Sites* (1990), currently lists six visitor sites on the Willamette, though certainly more could be added. It would be desirable to maintain access to interpreted heritage sites, though not necessarily strictly road access. Trails also can provide adequate access in many cases.

Windows on the Past Site	Access Road(s)
Klovdahl Headgate & Tunnel	Forest Rd. 24, 2421, trail 3551
Oregon central Military Wagon Road	Forest Road 21
Slick Creek Cave	County Route 6220, Forest Road 18, trail out of Bedrock Campground
Fish Lake Remount Depot	Hwy 126
Dee Wright Observatory	Hwy 242
Sand Mountain Lookout	Forest Road 2690, -810

Similarly, public use through the Recreation Rental program is another important priority for the heritage program. Maintaining adequate access to existing and proposed or potential rentals is also desired.

Current Recreation Rentals	Access Road(s)
Indian Ridge Lookout (BR)	Hwy 126, Rd. 19, 1980, -247, -248
Box Canyon Guard Station (BR)	Aufderheide Road (19)
Fish Lake Guard Station (MC)	Hwy 126
Proposed or Potential Rentals	**Access Road(s)**
Gold Butte Lookout (DE)	Rd 46, 4697
Pearl Creek Guard Station (DE)	FS 2209
Little Cowhorn Lookout (LO)	Rd. 18, 1817, -388

Several more historic structures on the Forest are under Administrative use. They also have interpretive potential because of their historic values. Many of these, as well as the historic recreation facilities, are listed in the INFRA data base. Fire lookouts, guard stations and residences, are common examples. Access to these should be considered in road analysis as well.

- ***Which roads are historic transportation routes?***

A review of historic maps and references such as the Forest's Annual Reports, indicates that trails, rails and roads have long existed on the forest. Earliest evidence would be in the documentation of "Indian trails" on GLO plats and notes from before the turn of the century. Over time these were replaced by and large with wagon roads and other transportation routes. Suffice it to say that transportation routes have evolved over time, on this forest as in other areas. Some modern roads overlay portions of historic roads. Some portions of the historic roads have been obliterated in the process of modern road development, yet some retain intact segments near the new route. These are the focus of historic preservation efforts on the forest. Some of the forest's most significant historic transportation routes have management plans in place to protect, and in some cases to restore, their historic character; several have associated interpretation. These include but are not limited to the list below.

Historic Transportation Route	Associated Modern Roads
Hogg Railroad (DE/MC)	Hwys 22/126, multiple forest roads
Santiam Wagon Road (SH/MC)	Multiple roads along Hwy 22: 2032, -302, -024, -048, -060, -065,-066, 2672-305, -810, 2690, -811, and possibly others
Gold Hill Road (BR/SH)	Forest Road 1510
Clear Lake Road (MC)	Near Hwy 126, between Scott Creek and Fish Lake
Old McKenzie Highway (MC)	Hwy 242
Oregon Central Military Wagon Road (MF)	On, along and near Road 21
Box Canyon Road (MF)	Along and adjacent to Forest Road 19, 1934, 1934-747, and others, (High Prairie to Box Canyon GS)
North Fork Railroad Logging system	Various along North Fork Willamette

- ***How and where do roads provide access for traditional cultural practices for Native Americans?***

Limited specific information is available at this time. Consultation should continue throughout the analysis and decision-making process, in keeping with federal trust responsibilities to the Native American tribes. We have learned through on-going consultations that our tribal neighbors have interests in forest lands for reasons of resource procurement *such as* cedar, huckleberries and medicinal plants. There are interests in some areas for other cultural reasons, such as personal or spiritual.

In addition to the letters sent, person-to-person contact was made with representative individuals of three tribes. In summary, each expressed an interest in the roads analysis subject and process and concern over their abilities to respond in a meaningful way to project of such scope in a short time frame.

The representative of the Klamath indicated they would be interested mostly in the Oakridge area, southern area of the Forest; would like us to send maps.

The Grand Ronde representative thought it best to deal with individual projects early in the planning process, such as when we begin to look as roads by watershed, etc. Also, we agreed it we could discuss it further when we met next for our Memorandum of Understanding in progress with the CTGR.

The Siletz had a few areas of specific concern, but also thought it best to deal with local land managers and participate in a more localized scale of analysis.

There was an interest expressed in reviewing the product of this pilot road analysis so they might have an opportuntity to provide more detailed input or comment to the process as a whole.

References

McAlister, Jeff. 1993. Oracle Cultural Resource Database: User Manual. Internal publication, on file at Willamette National Forest Supervisor's Office, Eugene, Oregon.

Minor, Rick, et al. 1987. Cultural Resource Overview of the Willamette National Forest, A 10-Year Update. Heritage Resource Associates Report 60. Eugene, Oregon.

Rakestraw, Lawrence and Mary. 1991. *History of the Willamette National Forest*.

USDA Forest Service. 1998. Desk Guide to Tribal Government Relations, Second Edition. Pacific Northwest Region. Portland Oregon.

USDA Forest Service, Willamette National Forest. 1991-1997. Willamette National Forest Monitoring and Evaluation Report.

USDA Forest Service. 1998. Desk Guide to Tribal Government Relations, Second Edition. Pacific Northwest Region. Portland Oregon.

USDA Forest Service. 1990. Windows on the Past: Guide to Pacific Northwest Historical Sites (R6-REC-055-90). Oregon and Washington

Appendix J

Social Issues Process Paper

August 2001

Background and Recommendations

As a former Chief of the Forest Service noted "…just as surely as a river will find its flood plain, social values will prevail…" (Dombeck, 1999). However, while the natural and heritage resources managed by the Agency are well studied and inventoried, the social component of public land management is far less well understood.

According to Preister and Kent (1997), the extent to which federal land managers continue to drive decisions based solely on a physical ecosystem perspective, conflicts of federal land use will continue. Recognizing the social landscape, or ecosystem, as an equal partner to the physical resource base is crucial to understanding, mitigating and alleviating the issues that more and more often derail our decision-making and subsequent efforts to manage federal lands in accordance with science-based principles.

Much material exists to address some of the following issues and key questions in a general way. Some issues require further inquiry, and it is strongly recommended that the Forest **commit to and pursue** data gathering that will lend itself to better and more complete understanding of the social landscape.

A social assessment, employing James Kent's Discovery Process™ and Human Geographic Issue Mapping™ will be initiated in fiscal year 2002, covering more than half the Willamette Province. This project will result in far more detailed information to address the following questions and to inform local analyses at the appropriate scale when decisions are ripe. The project will also develop GIS layers mapping cultural descriptors and social concerns and issues addressing public land management.

Process Description and Documentation

Passive-Use or Existence Value

Background: Passive-use or existence value is based on benefits people derive from the "existence of a specific place, condition, or thing, independent of any intention, hope or expectation of active use." (USDA, 1999). Simply knowing that a certain kind of environment (such as wilderness), ecosystem (such as old growth), or resource (such as wildlife), exists constitutes passive-use value. Passive uses can include thinking, hearing or reading about a resource or place and feeling good that it exists or is being preserved.

There is also a "bequest value" component to passive-use that needs to be considered. Bequest value is the "worth one places on the assurance that a resource or place will continue to exist to be enjoyed in the future by children or grandchildren (future generations), (USDA, 1997).

When affected resources are considered to be unique or rare, outstanding or unusual, passive-use value can be greater than the value produced from the same place by active recreational use or commodity production. (Fight *et. al.* 2000).

Efforts on a national scale to protect and preserve French Pete, Opal Creek, Waldo Lake, Warner Creek, Clark Creek, roadless areas, Northern spotted owl, Canada lynx and red tree voles (among others) suggest that there is substantial cause to recognize and address passive-use values. In fact, it could be argued that, on a political level, passive-use and existence values are second only to ecological health and functioning in import with regard to public land management decisions.

Scale

When considering passive-use or existence values, history has shown that interests at the national level can play a significant part in defining the options that are available to the decision-maker. However, assessing the probability of passive-use or existence values as significant issues must be done at the local level. A forest- or province-wide social mapping exercise should help identify value and uniqueness at that scale.

Key Questions to be addressed at the Forest, District or project level

- **Do areas planned for road construction, closure, or decommissioning have unique physical or biological characteristics, such as unique natural features or threatened and endangered species? (PV 1)**
- **Do areas planned for road construction, closure, or decommissioning have unique cultural, traditional, symbolic, sacred, spiritual, or religious significance? (PV2)**
- **What, if any, groups of people (ethnic groups, subcultures, and so on) hold cultural, symbolic, spiritual, scared, traditional, or religious values for areas planned for road entry or road closure? (PV3)**
- **Will constructing, closing, or decommissioning roads substantially affect passive use value? (PV4)**

Social Issues

Background: Forest roads represent more than travel corridors for people or products to move from “here to there”. Roads certainly access forest sites, settings and viewing opportunities for an extraordinarily diverse set of users. Roads also provide a means to access forest resources of both commodity and amenity value. And roads provide staging access to remote areas, wilderness, backpacking, white-water boating and kayaking. (USDA, 2001).

But roads can also contribute sediment to streams and can act as deterrents to wildlife success and survival. The proximity of roads to certain recreational activities can also be anathema. Roads have been identified as contributing to landslides and mass failures that damaged and destroyed property. Roads can provide access to heritage and sacred sites that may be subjected to vandalism, theft and destruction.

Public response to the “Proposed Rulemaking on Administration of the Forest Development Transportation System,” revealed considerably disparate views regarding how roads are perceived and how they ought to be managed. Some people see roads as a means to access resources on which they are economically dependent and others a means to access resources on which they are culturally or spiritually dependent. Still others see roads as environmentally damaging and an edifice of greed. (USDA, 1998).

Understanding the social context, the “meaning” of forest roads generally and those specific roads being considered for change is essential for supportable decisions

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How might changes in road management affect people's dependence on, need for, and desire for roads and access? (SI 1&2*)*

Key Questions to be addressed at the Forest, District or project level

- **How and where does the road system connect to other public roads and provide the primary access to communities, rural residences and businesses?**

  There are 2,130 miles of primary/secondary Forest Development Roads providing key travel routes and linkages to local communities, State and County highways, private inholdings, and inter-forest connections to trailheads and recreation sites. Any changes in maintenance level for these miles should not be made without extensive public input.

  The 4,234 miles of local roads represent the primary targets for reduced maintenance standards, decommissioning or obliteration. When the long-term status of these roads is considered, at the watershed or project scale, early and extensive community engagement is recommended. This process can serve to provide additional data for the next two questions.

- **What “personal use'” activities are commonly associated with which forest development roads (e.g. firewood gathering, berry picking, Xmas tree cutting, etc)?**

  Collection of this information could be achieved through several techniques. Where permits are issued, specific sites are or could be identified. That data should constitute a GIS special forest products layer.

  Particular attention should focus on the “ghost” or unclassified roads, both mapped and those yet unmapped.

- **How and where would people's sense of place (and special places) be affected?**

  According to Galliano and Loeffler (1999) sense of place “focuses on the subjective and often shared experience or attachment to the landscape emotionally or symbolically.” People who have never seen a certain place for themselves may know the place by name and associate special meaning with the place.

  A special place can be very small, (i.e., a single sitting rock that provides a great view); or very large, (i.e., a nation to which one is allied).

  Content Analysis conducted during the 1990 Forest Land and Resource Management Plan identified more than 80 specific sites that received at least one comment during the review period. (Many received more than a thousand comments.) That information can provide a baseline for mapping and development of a GIS layer to be refined and maintained over time. Particular attention should focus on the “ghost” or unclassified roads, both mapped and as yet unmapped, as potential access routes to special places.

The Discovery Process™ will provide additional material to address the above questions in a more empirical manner.

How can we communicate about road management in a manner that is experienced as open, honest and reliable? (SI 6)

Key Questions to be addressed at the Forest, District or project level.

- **What forms of communication are viewed as most effective?**

  People trust and rely on informal networks of communication. Schindler found that 32% of nearly 300 subjects surveyed considered personal conversations with FS staff the most useful to them. This was the highest percentage of any of the possible sources of information from which respondents might choose (Schindler 2000). Preister's work in the McKenzie Valley (1987) determined that "Public meetings are not worth it" and "Things work informally."

  Schindler's work also identified the following in order of priority to be the most important factors affecting the survey groups judgement about FS activities:

  1) Environmental consequences.
  2) Understanding the objectives of a proposed action.
  3) Reliability of FS technical or scientific information/Understanding how the decision was made.
  4) The opinions of people I respect.

Those four factors, combined with the effectiveness of informal networking and personal contact, can combine to create a very powerful communication strategy.

- **What media do most people feel comfortable with?**

  The medium of choice should be the informal communication network. Much information to guide future projects will come from the Discovery Process™ to be initiated in fiscal 2002.

- **What public participation efforts have been effective?**

  Formal public participation activities should always be tailored to the specifics of the project, the communities of interest, and the socio-political climate surrounding the issues that need to be addressed. There is simply no "recipe" for effective and successful public participation.

  Members of the Public Affairs staff are available to discuss what works and what does not. Involving them in communication and interaction strategies at the earliest possible stage of project design is strongly recommended.

For examples of innovative and successful public participation efforts, see *An Evaluation of the Delta Showcase Projects Public Participation Process: an experiment in natural resource planning* (Dinne, 1993) and *Beyond Conflict to Consensus: Exploring and Resolving the Hot Springs Situation (Chadwick 1998).*

- **What are effective ways to solicit, elicit and gather information from interested and/or affected publics?**

  Preister (1997) suggests that an effective way to understand the interests and concerns of communities is to "enter their routines," engaging with people at places that are comfortable and familiar to them. The Discovery Process™ identifies the informal social networks through which people share information, identifying major trends and issues discussed in the community, the "issue holders" and key communicators. It also maps common cultural values, revealing scales of neighborhood, community and region.

What collaborative processes have taken place that facilitated decision-making? At what scale?

Watershed Councils and Province Advisory Committees represent broad interagency and public constituencies. How effective these bodies are in serving as key communicators and conduits of information for their represented communities of interest or place is unknown by this author.

The Forest has also employed outside facilitators to support collaborative decision-making. *See McKenzie Discovery Process, Social Ecology Associates* (Contract #53-04R4-7-1630, Fall 1997) and *Exploring and Resolving the Hot Springs Situation*, Consensus Associates (April 1998).

How and where would changes in the road system, or management thereof, affect certain groups of people (ex. minorities, ethnic, cultural, racial groups, persons with disabilities, low-income groups)? (CR 1)

Key Questions to be addressed at the Forest, District or project level.

- **What are the usage patterns of potentially affected groups?**
- **What opportunities exist to improve or better facilitate use by potentially affected groups?**
- **Has the Executive Order on Environmental Justice been considered in the decision?**

For all key questions: data does not exist on a local scale. I believe that there are processes underway and resources available that could inform us to an extent, but an integrated approach needs to be taken. This is certainly a set of questions that must be addressed during *Forest Plan revision* efforts.

How would overall community (of place) economic health be affected by changes in forest development roads? (SI 7)

Background: In the early 1980's, a number of factors combined to put the economy of Oregon on a downward trend. The need to diversify the state's economy was emphasized by the changes in federal land management that have dramatically reduced timber harvests on federal lands in Oregon.

As reported by the *2001-2002 Oregon Blue Book*, Oregon's is one of the ten most diversified state economies in the nation, at least by one measure. But rural communities continue to struggle as their reliance on natural resource industries remains high. In the past decade, serious downturns in these industries have continued and worsened. Diversification of these local communities remains a challenge. (Torgerson, ed. 2001)

Key Questions to be addressed at the District or project level.

- **What is the economic composition of community?**

  This question should be addressed at the community level. Pertinent information will be derived from the Discovery Process™ to be initiated in fiscal year 2002.

- **To what extent is community dependent on extractive, commodity forest resources (timber, mining, grazing, etc)?**

  According to McGinnis (1996):

  Lane County ranked 1st in the state for timber harvest in 1988 and 2nd in 1993.

  Linn County ranked 5th in the state for timber harvest in 1988 and 6th in 1993.

  In Marion County, while the contribution of federal timber to the harvest has declined, other owner harvest has trended up since the 1970s. Marion County ranked 22nd in the state for timber harvest in 1988 and 21st in 1993.

  Benton County ranked 14th for timber harvest in 1988 and 19th in 1993.

  Douglas County ranked 2nd for timber harvest in 1988 and 1st in 1993.

Mining and grazing do not play a substantive role in the economy of counties proximate to the Willamette National Forest.

- **To what extent is community dependent on amenity forest resources (recreation, tourism, etc)?**

  Excellent sources of information include (but are not limited to): North Santiam Canyon Economic Development Corporation; Sweet Home Economic Development Group; Blue River Community Development Corporation; McKenzie River Chamber of Commerce; Convention and Visitors Association of Lane County (CVALCO); Mike Alvage, City of Oakridge; Mike Hibbard, University of Oregon, Public Policy, Planning and Management; Bruce Shindler, Oregon State University, Forest Resources; Cascade Center for Ecosystem Management.

- **What role do roads play in the changing economics of rural communities?** (SI 17)

  Forest roads provide access to a variety of leisure time activities and recreational opportunities. According to the Task Force on Growth in Oregon "More than half of the land in Oregon is in public ownership and 90% of the public lands in Oregon are held by the U.S. Forest Service or the Bureau of Land Management" (Growth and its Impacts in Oregon, 1999). Between 1990 and 2000, the population of Oregon grew more than 20% (Toregerson, ed. 2001), with most growth occurring in the Willamette Valley where 70 % of our population lives, and increasingly into recreation and retirement areas.

  Some of the communities most proximate to the Forest find themselves becoming bedroom communities for urban economic centers (Portland, Salem, Eugene) while others find themselves experiencing significant increases in retirement in-migration or recreation demand.

  Forest roads also provide access to non-timber harvesting of products such as mushrooms, salal, beargrass or evergreen boughs. This "micro-economy" is often a substantial source of income for non-English speaking immigrants or migrant workers, or those who find themselves displaced from the timber harvest industry.

Recommended contact: Brad Leavitt, "Jobs In the Woods" coordinator. He would likely have other resources to recommend as well.

How might overall community (of place) satisfaction be affected by changes to the forest development road system? (SI 13)

Key Questions to be addressed at the District or project level, until Forest Plan revision allows for broader scale "well-being analysis":

- **How cohesive is the community? What lifestyles are represented in the community?**
- **How resilient is the community? How does the community respond to change?**

Data is not available. It is anticipated that further information will be derived from the Discovery Process™ to be initiated in fiscal year 2002.

Recommend completion of a "well-being" assessment of communities in conjunction with Forest Plan revision efforts. See *Well-being Assessment of Communities in the Klamath Region***,** (Contract 43-91W8-6-7077, Forest Community Research, 1997).

What is the perceived economic dependency of a community on a roadless area versus the value of that roadless area for its intrinsic existence and/or symbolic value(s)? (SI 8)

Key Question to be addressed at the District scale:

- **What are the significant existence and/or symbolic values of the community?**
- **What is the community lifestyle?**
- **What values are being asserted from outside the community?**

The Discover Process™ to be initiated in fiscal year 2002 will address these questions in a detailed manner.

Analysis and Interpretation

The Issues and Key Questions identified for this aspect of the analysis suggest information crucial to informed decision-making. They should be used to provide guidance and direction to projects conducted at small scales but should also be adequately addressed in forest plan revision.

A careful review of *Analysis of Public Comments: Final Scoping Report (Proposed Rulemaking o Administration of the Forest Development Transportation System)* revealed five common and important themes that have resonance locally:

- Good decisions can only come from the local level with strong involvement by the public.
- The Agency is subject to too much external influence. (What that influence was perceived to be varied widely.)
- "Wilderness" areas and "roadless" areas are one and the same in the minds of many. And these are perceived to be very, very special places.
- There is substantial opposition to closing roads (for a variety of reasons), especially the "ghost" roads.
- For any given opinion or belief expressed by anyone, there will be an opinion or belief expressed that represents the exact opposite.

(Source: USDA, 1998)

My final assessment is that, by increasing our ability to identify environmental "hotspots" through the use of social assessment and issue monitoring, we can achieve well-supported forest transportation system decisions. When decisions need to be made, early and extensive engagement of communities of both place and interest will not only inform the decision making, but can be used to ferret out more information for future uses.

Passive-use values, the identification of special places, and community wellness data should be the priorities for further investigation of the human landscape. These three arenas provide the fundamental basis for incorporating the social ecosystem with the biological ecosystem.

Process Critique

- **Data:** Consistent and integrated data is often unavailable. Data sets don't always match well with the scale of the analysis (i.e., county data sets do not overlay forest boundaries.) Time limits constrained the amount of data that could be gathered and interpreted.
- **Lack of public inclusion:** While a public "involvement" process (viz. NEPA) wasn't necessary and might not have informed the analysis directly, I believe that we missed an opportunity to begin gathering some of the missing information and to bring folks along with our endeavor. The lack of including the public also leaves us vulnerable to condemnation of the project and of the product.
- **Process:** Key Questions are certainly significant questions, and the answers would provide a rich resource base for a Forest Plan revision and would inform district-level decision-making processes. However, standing back from the analysis, it seems that the most important question, at the forest level, to be asked is "Which roads are being used, for what purpose, and by whom."

References

Dinne, J.J. 1993. *An Evaluation of the Delta Showcase Project's Public Participation Process: An Experiment in Natural Resource Planning. MS Thesis. University of Oregon, Environmental Studies, Eugene.*

Doak, S.C. and J. Kusel. 1997. *Well-Being Assessment of Communities in the Klamath Region.* Prepared for the USDA Forest Service, Klamath National Forest (43-91W8-6-7077).

Dombeck, Michael. 1999. *Protecting and Restoring a Nation's Land Health Legacy.* Speech delivered in Missoula, Montana, February 3, 1999.

Fight, R.D.; L.E. Kruger; C. Hansen-Murray; A. Holden; D. Bays. 2000. *Understanding Human Uses and Values in Watershed Analysis.* USDA Forest Service, Pacific Northwest Research Station. PNW-GTR-489.

Galliano, S.J; G.M. Loeffler. 1999. *Place Assessment: How People Define Ecosystems.* USDA Forest Service and USDI Bureau of Land Management. Portland, OR. PNW-GTR-462.

Growth and Its Impacts in Oregon: A Report from Governor Kitzhaber's Task Force on Growth in Oregon. 1999.

McGinnis, W.J., R.H. Phillips and K.P. Connaughton. 1996. *County Portraits of Oregon and Northern California.* USDA Forest Service PNW R6 GTR-377.

Preister, K. 1997. *McKenzie Discovery Process.* Prepared for the USDA Forest Service, Willamette National Forest (53-04R4-7-1630).

Preister, K; James A. Kent. 1997. *Social Ecology: An New Pathway to Watershed Restoration.* Presented to American Fisheries Society, Bethesda, MD.

Steel, B.S., P.List, B.Shindler and C.Smith. 1994. “*Survey of Forestry Issues in Lane and Linn Counties: Frequency Distributions.*”

Torgerson, Tim, ed. *2001-2002 Oregon Blue Book. 2001. (need publisher info!)*

USDA Forest Service. 1995. Willamette National Forest Access and Travel Management Guide.

USDA Forest Service. 1997. *Sense of Place Protocol.* Northern Region Human Dimensions Peer Group.

USDA Forest Service. 1998. *Proposed Rulemaking on Administration of the Forest Development Transportation System. Analysis of Public Comments: Final Scoping Report.* USDA Forest Service Content Analysis Enterprise Team.

USDA Forest Service, Washington Office. 1999. *Roads Analysis: Informing Decisions About Managing theNational Forest Transportation System.* Miscellaneous Report FS-643.

USDA Forest Service, Pacific Northwest Research Station. 2001. *Forest Roads: A Synthesis of Scientific Information.* PNW-GTR-509.

Appendix K

Lands Process Paper

October 1998

Background

The Willamette National Forest is heavily impacted by private inholdings, both large blocks of single owner "checkerboard" land ownership patterns (a legacy of the old railroad grant lands), and smaller, scattered ownerships of a residential or small woodlot nature. Over time, there have been 12 major transportation system cost-sharing areas of some kind on the Detroit, Sweet Home, Blue River, McKenzie, and former Rigdon Ranger Districts. Of these, eight areas are still in operation:

Sweet Home Ranger District

- Quartzville Road, with the Bureau of Land Management
- Lava Lake, with Timber Service Company
- Harter Mountain-Squaw Creek, with Timber Service Company
- Moose Mountain, with Timber Service Company
- Canyon Creek, with Timber Service Company and Willamette Valley Lumber Co.
- Mid-Santiam, with Timber Service Company and Giustina Resources
- Calapooia Road, with Weyerhaeuser Co.

McKenzie Ranger District

- McKenzie, with Giustina Resources

Although the cost-sharing mechanism for the remaining four areas have terminated, the reciprocally granted, perpetual easements are still in place. The Forest does not have an exact count of these easements but would *roughly* estimate 200.

Issues

Management of the Willamette's transportation system requires an understanding of and attention to the legal rights and obligations of both private parties and the United States in that system.

1. ***What is the level of road access to private inholdings (cost-share roads) and what are the physical, biological and social impacts? Which inholdings are likely to require or be the source of requests for future access? Are there alternative routes or options for access to private inholdings where current access is creating adverse impacts?***
2. ***What is the level of road access to lands managed by other federal agencies or the state.***
3. ***What is the level or road access to easements/special use permits, recreation summer homes, mining claims, administrative sites (ex. grave), etc.?***

A detailed response to these questions cannot be prepared without additional data management and interaction with the Forest's neighboring private landowners and other governmental bodies. A visual display of the eight major cost-sharing areas is being prepared. Although the source documents for right-of-way grants to private parties are kept in the

Forest's files, no compilation of these documents has been undertaken (either by computerized database or mapping). Compilation of this information could be completed at the Forest level, given adequate staffing and funding, and would be beneficial to the management of its transportation system.

Unilateral action by the Forest Service on roads in which other parties have rights is rare. In cost share areas, it requires Washington Office oversight. In almost all cases, easements granted to private parties have some sort of due process provision for the private party included in the termination clause. Consequently, closing a road under easement or terminating that easement, and thereby terminating the private party's legal rights in the road, is complicated. The same would be true for relocation or reconstruction of roads under easement. An additional factor for shared roads is the cost the private party has assumed for construction of those roads.

Appendix L

Roadless Values Process Paper

October 1998

Background

Roadless areas are those places on the Forest that are undeveloped lands within which there are no improved roads. Areas in an unroaded condition have been inventoried on the Forest at least three times; as part of the national Roadless Area Review and Evaluation (1973), the second, national Roadless Area Review and Evaluation (1979) and during the National Forest Management Act, Forest Plan development (1984 - 1989). In these progressive roadless inventories unroaded areas of the Forest were identified and mapped according to certain criteria based on size and adjacency to existing wilderness. In the RARE II inventory in 1984, 210,207 acres were identified as roadless and with potential for inclusion in the National Wilderness Preservation System. By the time the Forest Plan analysis was completed in 1989, 172,007 acres remained in this inventory.

Two wilderness designations by Congress since the RARE I inventory have also affected the amount of roadless lands on the Forest. The Oregon Wilderness Act in 1984 added approximately 84,930 acres to the Forest wilderness. The Opal Creek Wilderness and Scenic Recreation Act in 1996 will add approximately 12,800 acres to the Forest wilderness when all the procedural actions are finalized.

In recent years, the issue of unroaded lands on the National Forests has taken on different views and aspects than just the potential for inclusion in the National Wilderness Preservation System. In the broad sense, there is still a diversity of values regarding roadless areas and these values often are conflicting. The values associated with roadless can be associated with recreation, symbolism of people's value for wild places, the lifestyle of a community and a variety of ecological values. Many of these values can be met in roadless areas that do not meet the minimum size criteria (5,000 acres) of the RARE I and RARE II inventories. As the total amount of roadless area, not included in the wilderness system continues to decline on the Forest, there is increased interest on the values of smaller unroaded areas.

Key Questions and Process Description

The primary issue of the unroaded areas in this Forest Roads Analysis is the amount and location of unroaded areas on the Forest stratified by size of area and Forest Plan land allocation. The key question is, where are there significant aquatic, terrestrial wildlife or ecological values associated with unroaded areas?

The analysis process to address this issue was:

Inventoried roadless areas (RARE II and exclusions since 1984) were digitized. This map was overlaid with current Forest Plan land allocations to determine the amount of inventoried roadless in land allocations with a emphasis on the land in allocations that allowed timber harvest and allocations that precluded timber harvest.

To address the issue of other unroaded areas that might not have been identified in the RARE I or RARE II inventories because they were less than 5,000 acres (or not adjacent to existing wilderness), a moving windows analysis was done using the Forest transportation layer. The analysis identified those areas on the Forest where the existing road density is zero. This is similar to the analysis done to determine road density with one notable difference. The size of the "window" used to determine road density was one mile which means that the road density for any single spot was based on roads within a one mile radius. For the unroaded analysis, the size of the "window" was reduced to .25 mile. The effect this has on the analysis is that the areas of zero road density in the unroaded analysis were significantly larger than those in the road density analysis. The rationale behind the .25 mile window was that the both the ecological values and the social values associated with roadless are impacted minimally once the distance from a road is over .25 mile. This is a generalization of course, but it supported by the wildlife analysis of how interior forest is impacted by road openings and the determination of different management levels within designated wilderness.

The unroaded map resulting from the procedure described above was further screen using information from the Forest vegetation data base (VEGIS). Stands with information indicating they had been harvested within the past 40 years were also excluded from the unroaded areas. In the majority of cases, these stands are old clear cuts and regeneration harvest units with roads and/or landings along one edge. Although these areas might recover over time to the point where they could provide social and ecological values similar to those in unroaded and unharvested areas, at the current time, the recent harvest activity is the dominant characteristic of these areas.

The last step was screening the resulting unroaded polygons by size. The original intent was to not simply screen, but to stratify the unroaded polygons by size (1,000 acre increments) beginning at 1,000 and proceeding upward until all areas were accounted for. Due to time limitations for the analysis, however, the screening was simplified to just identifying all areas greater than 1,000 acres. One thousand was selected as the minimum size based on a subjective assessment of public comments on roadless areas from a variety of sources and general wildlife input. Another screen that was considered, but not done due to a lack of time was the size to perimeter ratio of each area. This would potentially eliminate narrow areas between parallel roads.

The question about significant ecological values in the inventoried roadless areas and in the unroaded areas was not directly addressed in this analysis. An indirect answer to this question is the determination of how many acres of roadless or unroaded are within land allocations that preclude timber harvest. The assumption being that the issue is not a high priority to address in those areas where current direction or policy preclude any further road access. For the areas that are roadless or unroaded and do remain in land allocations that allow timber harvest and presumably road construction, this question was addressed based on a qualitative evaluation of the areas. It should be noted that inventoried roadless areas in Key Watersheds can not be roaded under current Forest Plan direction.

Results and Interpretation

(Note - The following results and acreages do not include designated wilderness on the Forest.)

Inventoried Roadless Areas - As previously mentioned the inventoried roadless areas mapped in in 1984 total 210,509 acres (this figure is about 300 acres greater than previously reported in RARE II and the Forest Plan FEIS due to differences in mapping systems used to calculate the area). The area that is still roadless in these areas as of 1998 is 112,166 acres.

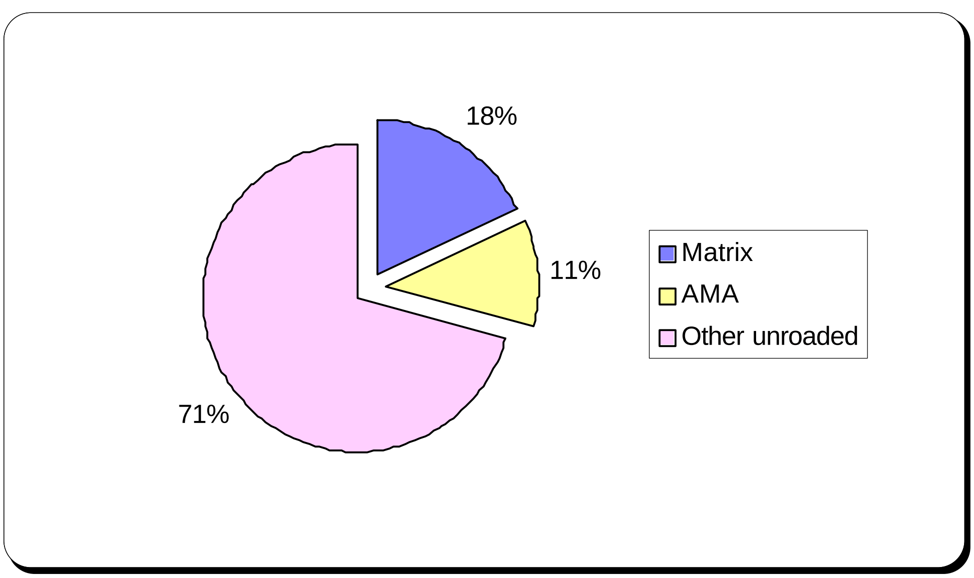
When the original area of 210,509 acres was overlaid with current Forest Plan land allocations, 45,164 acres or about 21% were in land allocations that allowed timber harvest (matrix and adaptive management area categories). The remaining 165,345 acres or about 79% are in land allocations that do not allow programmed timber harvest (late successional reserves, administratively withdrawn categories). Based on recent experience with site-specific riparian reserve mapping, it is likely that the 45,164 acres would be reduced further once all riparian reserves are identified.

Unroaded Areas - The moving window analysis of the unroaded areas resulted in a total of 303,579 acres that were identified as unroaded and not harvested within the past 40 years and were greater than 1,000 acres. A visual evaluation of the unroaded polygons shows that there are several of the polygons have elongated, narrow necks and peninsulas that might have limited ecological value (connectivity) but would probably not satisfy many other ecological or social roadless values that are generally associated with blocks of land where road influences are less noticeable in the interior.

Of the total acres of unroaded after the screening, 55,062 acres or about 18% are in the matrix category of land allocations or those that allow timber harvest (see Figure 1). When Adaptive Management Area acres are considered, the total acres of unroaded increases to 88,299 or about 29% of the total unroaded. The AMA land allocation does allow for timber, however, several of the large unroaded blocks are in the HJ Andrews Research Forest where limited harvesting is anticipated. The remaining unroaded areas greater than 1,000 acres, totals 215,280 acres or 71% of the total and is in land allocations that preclude programmed timber harvest and where there is no identified future needs for additional road access.

. Total Unroaded Lands on the Forest

Figure 1



The most immediate issue for both the inventoried roadless areas and the unroaded areas identified through the GIS analysis are for the 45,164 acres and 88,299 acres in allocations where road access is currently allowed under current Forest Plan direction. A quick check of the larger blocks that are identified revealed that many of the areas have large areas of younger aged stands or noncommercial stands and/or are on landforms that are very difficult to road (steep ground, areas with slumps, etc.). A notable exception is the Moose Creek area in the South Santiam watershed.

Our recommendation is that the unroaded map continue to be refined and used at the watershed level, to identify areas of significant ecological values and where they overlap with the unroaded areas.

References

Rakestraw, Lawrence and Mary. 1991. *History of the Willamette National Forest.*

USDA Forest Service. 1990. *Land and Resource Management Plan, Willamette National Forest.*

Willamette National Forest Pilot Road Analysis

Appendix M

Current Road Status Process Paper

October 1998

Current Road Status

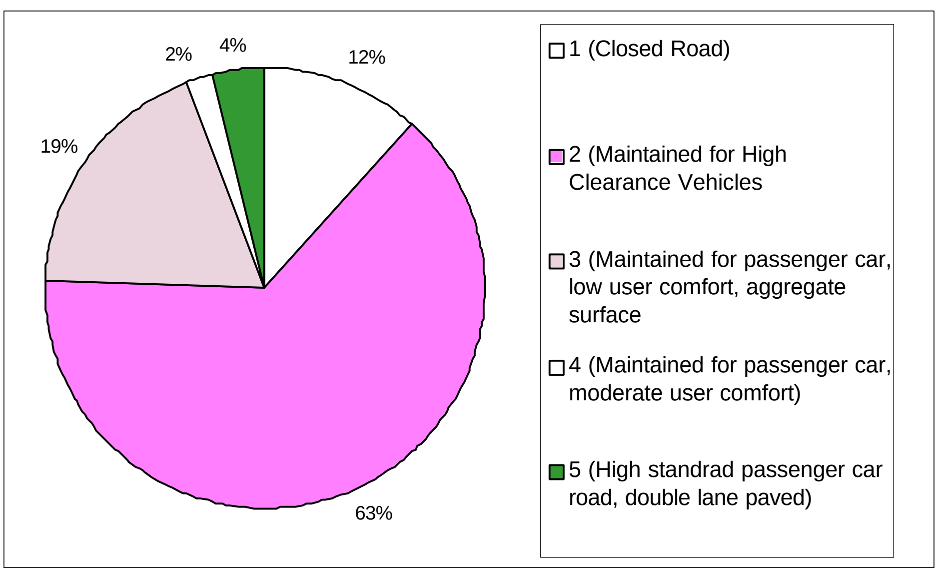
Miles by Maintenance Level

There are 6,364 miles of Forest Development Roads (FDR) in the Willamette National Forest transportation inventory. Twenty five percent (25%) of the road system is in the Maintenance Level 3, 4, and 5 categories (maintained for standard passenger cars). The Maintenance Level 2 category (maintained for high clearance vehicles) accounts for 64%, and 11% are intermittent use roads closed to vehicular traffic.

Table 3. Miles of Forest Development Roads by Maintenance Level

Maintenance Level	Miles	Error (+ or -)
1 Closed Road	736	15%
2 Maintained for High Clearance Vehicles	4067	10%
3 Maintained for passenger car, low user comfort, aggregate surfa	1191	5%
4 Maintained for passenger car, moderate user comfort	124	2%
5 High standard passenger car road, double lane paved	246	2%
Total	**6364**	

Figure 2



. Miles of Road by Maintenance Level

Unclassified Roads

There are 360 miles of unclassified wheel tracks documented as GIS line segments on the TRAN Layer. It is thought that the actual miles of undocumented wheel tracks on the forest are probably double that amount. In general, it is thought that unclassified roads have a low impact in terms of erosion and sedimentation. A recent road survey of Coffeepot Head BGEA supports this assumption *(see Table 4 and Table 5).*

Unclassified roads typically result from low-standard temporary roads built within the scope of timber sale contracts. Temporary roads are not recorded or mapped in the Forest database. After intended use, such roads are typically decommissioned but are often visible as primitive wheel tracks or show up as features in aerial photos. Unclassified roads also result from unauthorized off-road vehicle use to access dispersed recreation sites.

Table 4. Summary of Coffeepot Head BGEA Road Inventory

Location	Miles FDR	Miles of Unclassified Roads *(Ghost)*	Total Miles of Road	Percent increase in road miles
Coffeepot Head BGEA	85.19	5.91	91.11	+6.9%
Mean Length of Unclassified Road: 0.145 mile			Total area covered: 15,200 acres	

Table 5. Condition of Unclassified Roads in Coffeepot Head BGEA

Unclassified Road	Length	Closure Priority	Comments
2118-479/ O.S.	0.043	low	no culverts
2118-479/ O.S.	0.08	low	no culverts/ old cross trenches
2118-479/ O.S.	0.048	medium	no culverts/ landing is failing/stream crossing problem
2118-479/ O.S.	0.066	medium	no culverts/tension cracks present/sag near jct with 479
2118-479/ O.S.	0.151	low	no culverts/ no berm
2118-481/ O.S.	0.161	low	no culverts/ ridge road /landing stable
2118-478/ O.S.	0.114	low	no culverts
2119-O.S.	0.057	low	no culverts
2119-O.S.	0.095	low	no culverts/ entrance being used as a waste area
2119-O.S.	0.092	low	no culverts/ used as waste area/650ft O.S. found on road
2119-O.S.	0.114	low	no culverts
2119-O.S.	0.142	low	no culverts
2119-452/462/O.S.	0.165	low	no culverts/passes quarry
2119-452/466/O.S.	0.104	low	no culverts/ crossed bermed

Unclassified Road	Length	Closure Priority	Comments
2119-452/O.S	0.066	low	no culverts
2119-452/O.S.	0.095	low	no culverts/ripped
2119-452/O.S.	0.18	low	no culverts
2119-452/O.S.	0.047	low	no culverts/ bermed entrance
2119-452/O.S.	0.152	low	no culverts/ bermed entrance/ roadcut sloughing
2119-478/O.S.	0.246	low	no culverts/ trenched/
2119-478/O.S	0.088	low	no culverts/road closed
2119-478/O.S.	0.138	low	no culverts/road closed
2119-478/O.S.	0.15	low	no culverts
2119-478/O.S.	0.208	low	no culverts/entrance bermed/ripped & cross trenched
2307-O.S.	0.019	low	no culverts/ old road
2307-O.S.	0.068	low	no culvert/ road recovering
2307-O.S.	0.057	low	no culverts/ road recovering
2307-O.S.	0.114	low	no culverts/ road recovering
2307-O.S.	0.455	medium	culvert stream crossing removed at .379 miles.Check i
2307-O.S.	0.157	low	no culverts/ road recovering
2307-475/ O.S.	0.038	low	no culverts/ road recovering
2307-475/ O.S.	0.131	medium	no culverts/ road goes to old quarry/ stone mountain
2307-484/ O.S.	0.044	low	no culverts/ campfire ring
2307-484/ O.S.	0.19	low	no culverts
2307-484/ O.S.	0.25	low	no culverts
2307-483/ O.S.	0.131	low	no culverts/ large bare soil area needs machine fert
2307-473/ O.S.	0.115	low	no culverts
2307-476/ O.S.	0.063	low	no culverts/ steep road cut

Data Accuracy

Numerous corrections and revisions have been made to the Transportation database since 1992. However, mapping and database errors do exist. Table 3 gives an estimate of the current status of errors in transportation data (i.e. where GIS map locations, mile totals, open or closed status, or road existence differs from actual field conditions).

About 100 miles of road in the transportation database (TMS) do not have corresponding line segments on the GIS transportation map. Many of these roads are no longer apparent on the ground.

Key Forest Travel Routes

The primary/secondary road system was identified in a Forest-wide Access and Travel Management analysis in 1995. These consist of 2,130 miles providing the key travel-routes needed for long-term management of the National Forest. They provide vital linkages to local communities, State and County Highways, private land ownerships as well as furnishing inter-forest connections to trailheads and major recreation sites.

Table 6. Forest ATM Route Designation

ATM Designation	Miles
Primary (High standard through-routes, arterial linkages, Scenic Byways)	430
Secondary (Key inter-forest connections to interior recreation, forest management, fire response)	1,700
Local (Candidates for reduction of maintenance standards, decommissioning or obliteration)	4,234

The remaining roads not designated as primary/secondary (4,234 miles) are generally local routes whose long-term status will be analyzed at the watershed or project scale. These routes are considered candidates for reduction of maintenance standards, decommissioning or obliteration.

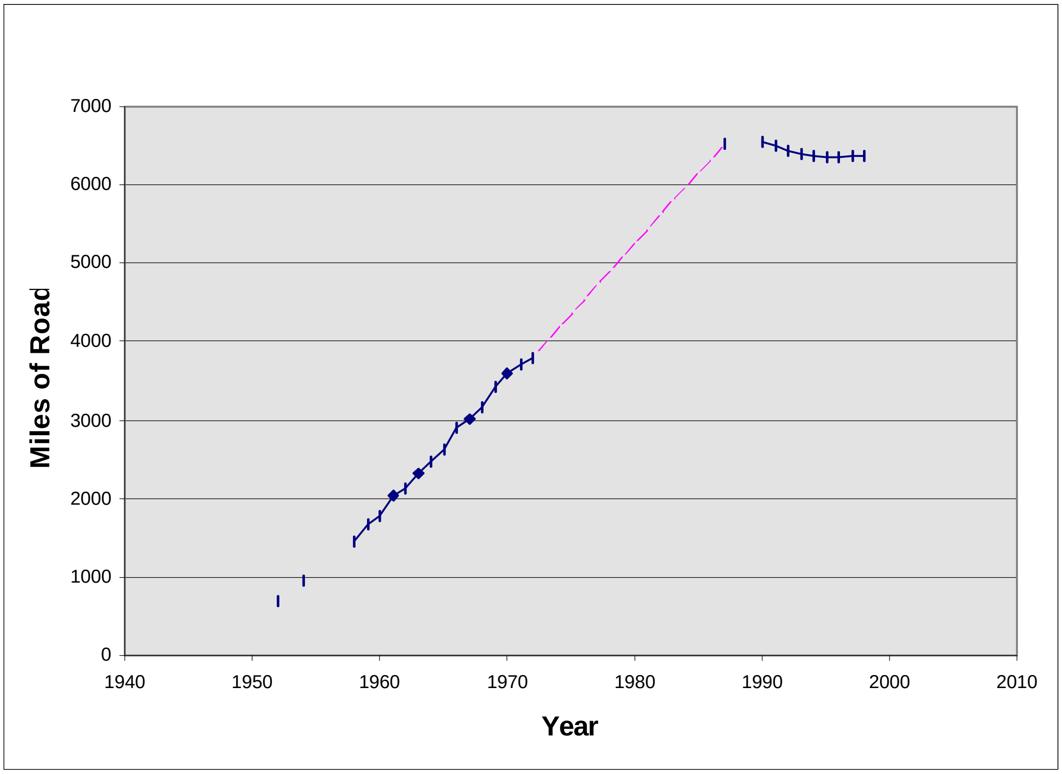
Economic Situation

Economics Question # 3. *What are the maintenance costs of the existing road system? How does that compare to recent forest road budgets and projections of future forest road budgets?*

Direct costs for roads such as maintenance, repair, closing, etc. are given in large ranges because actual costs are directly dependent on unique characteristics of that road or road system such as topography and soil type.

Background

Figure 3 shows the road building trend on the Willamette National Forest from 1953 to 1998.



New road construction averaged over 100 miles per year between 1953 and 1989. These roads were primarily constructed for the accomplishment of the timber related land management objectives prior to the 1990 Willamette Forest Plan as amended by the NW Forest Plan. Each mile of constructed road is dependent on the performance of annual maintenance to keep the road safe, to keep environmental risks to an acceptable level, and to protect the investment in the road. These roads were constructed with the idea that the timber based land allocations would generate funding for annual road maintenance on a long term basis. However lands suitable for timber harvest declined by 75% when the 1990 Willamette Forest Plan was amended by the NW Forest Plan. As a result, along with the timber program, the road maintenance budget declined substantially within a short time frame. Figure 4 shows funding declined from $7.25MM in 1989 to $3.25MM in 1992, or $4MM in three years. This was largely due to the rapid decline of the CWFS trust fund which was funded by deposits generated from log haul. Even though traffic volumes related to log haul have decreased substantially, non traffic generated road maintenance associated with erosion, sedimentation, brushing, and public safety still remain.

Figure 3. Miles of Forest Development Road from 1953 to 1998

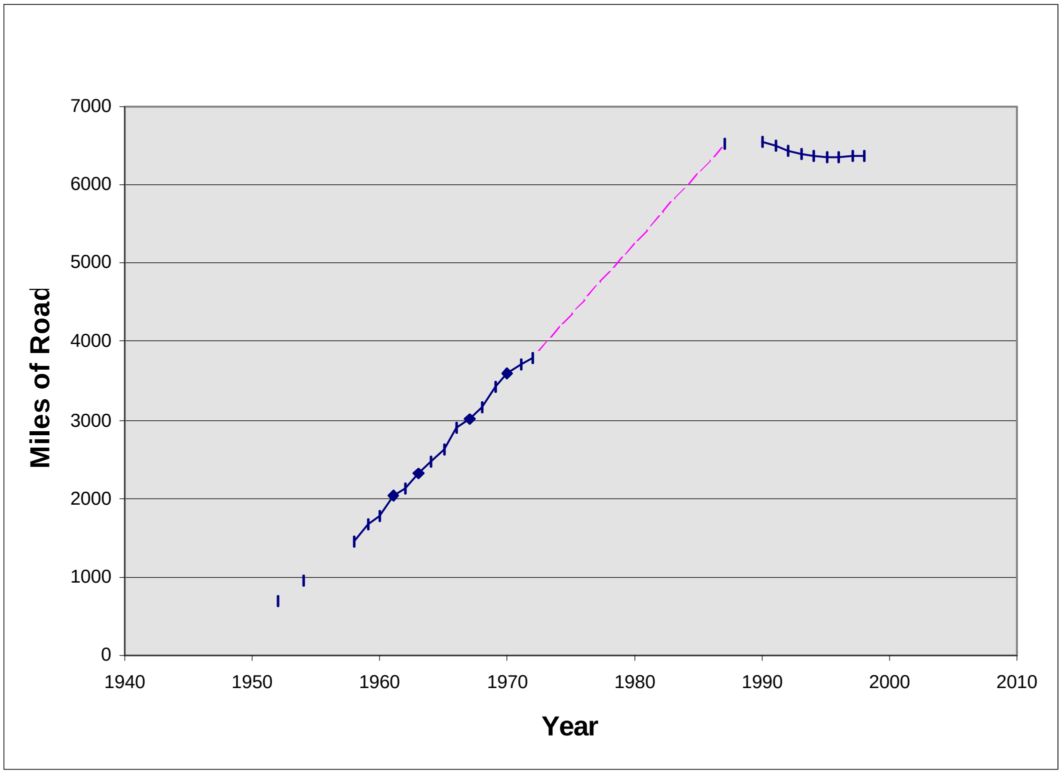
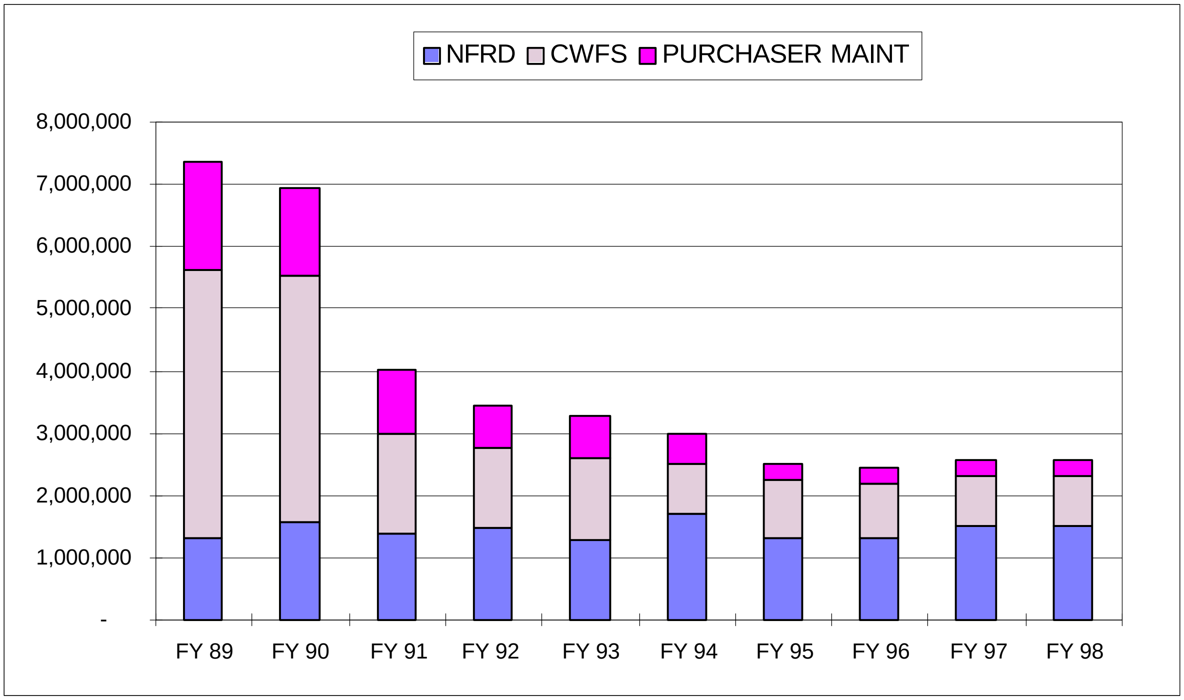


Figure 4. Road Maintenance Funding Levels


NFRD
CWFS
PURCHASER MAINT
8,000,000
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
-
FY 89
FY 90
FY 91
FY 92
FY 93
FY 94
FY 95
FY 96
FY 97
FY 98

The current annual road maintenance budget is about $2.4MM Figure 4. The $2.4MM budget amount is reduced by a near 40% for overhead costs. Thus $1.4MM is available to perform annual road maintenance. .

Estimated Annual Maintenance Costs to Maintain Existing Road System to Programed Maintenance Levels

Because of the substantial costs associated with downsizing the Forest road system, the miles of Forest Development Roads have not decreased significantly since 1989 (*see*

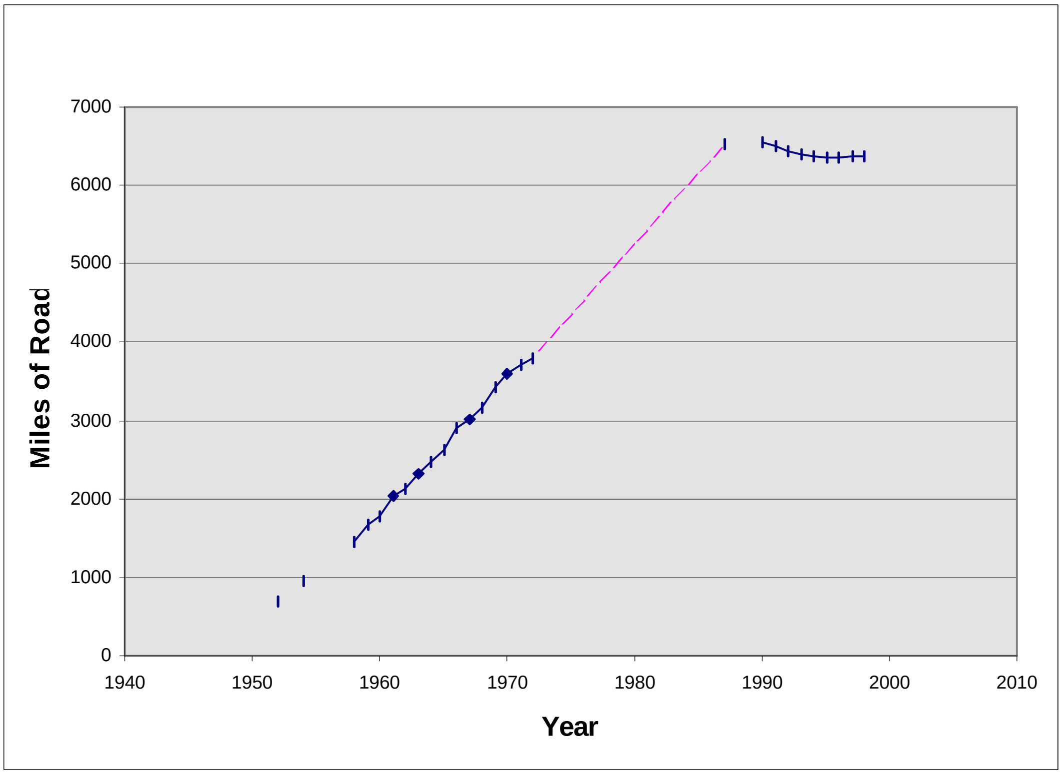


Figure 3). With the decline of the maintenance budget (but not a corresponding reduction of miles of roads needing annual maintenance) today there are insufficient funds to maintained the road system in a safe and environmentally sound condition.

Table 7 shows that an estimated $3.4MM per year is needed "on the ground" to perform the necessary annual maintenance. The total funding to the Districts is $1.4MM per year. There is thus an estimated "on-the-ground" budget shortfall of $2MM per year.

Table 7. Estimated Annual Maintenance Costs for Road Maintenance to Standard

Maintenance Level	Low Cost/mile	High Cost/mile	Average Cost/mile	Total Funding Needs	Total Funding to Districts	Funding Shortfall

1 (736 miles)	$25	$75	$50	$36,800	$1,400,000 to perform maintenance for all roads	Distribution to Districts
2 (4,067 miles)	$100	$400	$250	$1,016,750		
3 (1,191 miles)	$500	$1,500	$1,000	$1,191,000		
4 (124 miles)	$800	$3,000	$1,900	$235,600		
5 (246 miles)	$2,500	$5,000	$3,750	$922,500		
Total Annual Maintenance Costs				**$3,402,650/yr**	**$1,400,000/yr**	**-$2,000,000/yr**

The estimated funding to fully maintain the Primary/Secondary road network (those key travel routes the

Forest identified to remain open for the long term) is $2.4MM. The network of key travel routes is thus underfunded by $1.0 million if no funding was directed towards the remaining roads.

(Note: Note that this estimate does not include overhead costs, deferred maintenance or capital improvement needs. It is based on current contract costs and district force account costs for annual maintenance.)

Road Decommissioning Costs Scenario

Preliminary estimates indicate that the Forest is under-funded by more than 50% to maintain the road network to full standard. Over 3,000 miles of the Forest road network would have to be reduced to a near self-maintaining condition (or zero maintenance cost) to be in line with current funding levels. Typical costs for decommissioning (based on contract estimates) for the average road range from $5,000 to $15,000 per mile. Thus on-the-ground costs to decommission 3,000miles of forest development roads could be in the $30,000,000 range. This cost does not include planning, public involvement, or NEPA related analysis.

Appendix

Back-up Costs

A. Decommissioning Unit Costs :

Environmental Risk	Type of decommissioning	Cost per mile
Low Risk	ML 1 or 2 roads, flat slope, waterbars, no live stream culvert removal, no large fills	$2,000/mile to $5,000/mi
Moderate Risk	Removal of some small culverts, minor to moderate live stream channel restoration, waterbars, some moderate fill restoration	$5,000 to $15,000/mi
Severe Risk	large fills, Large culvert removal, some sidecast pullback, major stream channel restoration	$15,000 to $30,000 mile

Note: Site specific conditions can lead to decommissioning costs much higher than indicated above.

B. New Road Construction and Reconstruction Unit Costs

Estimated Unit Road Construction Costs *(on-the-ground contract costs, does not include FS planning, contract prep. administration)*

Type of Road	Cost per mile
Unsurfaced single lane, minimum standard road built on abandoned spur or skid trail, flat to gentle slope	$9,000/mile

Single lane maintenance level 2, Traffic Service Level D, turnout spacing 1,000 feet	
✧ Flat to gentle slope, no drill and shoot,	$15,000 to $20,000/mi
✧ Moderate slope, generally balanced section	$25,000 to $40,000/mi (rocky ground)
✧ Full Bench, rocky ground, some drill and shoot	$100,000/mi *Add $10,000/mile for crushed rock surfacing*

C. Road Construction, Reconstruction, and Decommissioning Trends 1991 - 1996

New road construction has averaged about 7 miles per year and road reconstruction 123 miles for the past 3 years. Planned activities levels in Forest Plan were 40 miles of new construction and 174 miles of reconstruction per year.

Table 1. Road Construction, Reconstruction, Decommissioning.

Year	**Constructed**	**Reconstructed**	**Decommissioned**(obliterated)
1997	7.0	203.4	18.9(non-system)
1996	6.9	95.7	2.7
1995	7.7	69.6	4.5
1994	0.2	2.7	44
1993	8.9	37.6	40
1992	2.3	20.7	52
1991	23.1	101.8	51.8
Totals	56.10	531.5	213.9

References

USDA Forest Service, Forest Service Handbook 7709. 1991a. Transportation Systems Operations Handbook, Travel Management. 7709.59-91-1.

USDA Forest Service, Forest Service Handbook 7709. 1988. Transportation Handbook, Process for Access Management, 7709.55.

USDA Forest Service, Forest Service Handbook 7709. 1992. Transportation System Maintenance Handbook, Maintenance Level Descriptions, Maintenance Activities and Maintenance Standards, and Maintenance Sharing. WO Amendment 7709.58-92-1.

USDA Forest Service, Forest Service Manual 7700. 1994a. Transportation System. WO Amendment 7700-92-6.

Willamette National Forest Pilot Road Analysis

Appendix N

Time and Cost Estimate

October 1998

Time and Cost Estimate

The first Pilot Roads Analysis meeting took place on August 12, 1998. The first meeting with the majority of resource specialists that would form the Roads Analysis Team occurred on August 25, 1998. The Roads Analysis Report was published on October 30, 1998. Approximately ten weeks of Roads Analysis Team time was spent performing the required analyses and documenting them in the published report.

A total of 16 people were identified as core and consultation team members in the Project Initiation letter. In addition, two to three additional people not identified in the Project Initiation letter helped during the course of the analysis.

Team members were asked at the first team meeting to keep track of the amount of time spent on the analysis. The team members (plus others) (18 total) reported spending a total of approximately 307 days on the pilot roads analysis or an average of about 17 days per person. The actual time spend by each person varied greatly, however from a high of 50 days to a low of 5 days. It should be noted that the most time spent on the project was by the persons doing the basic GIS analysis and queries and the writer-editor indicating that even though the average time spent on the analysis was significantly less than ten weeks, the critical path of the project from a resource scheduling and utilization standpoint was a full ten weeks.

The average pay schedule grade of team was about GS-11. Using a approximate cost to government of $220/day, the approximate personnel cost for the roads analysis was $67,540. Miscellaneous costs for supplies (map plotting materials) and reproducing and mailing copies of the report are estimated at $150. Total cost estimate is $67,690.

Appendix O

List of Key Forest Roads

January 2003

List of Key Forest Roads

ID	NAME	BEGIN_TERMINI	OBJECTIVE_MAINT_LEVEL
1000000	BLOWOUT	JCT HWY 22	3 - SUITABLE FOR PASSENGER CARS
1000000	BLOWOUT	JCT HWY 22	4 - MODERATE DEGREE OF USER COMFORT
1000035			2 - HIGH CLEARANCE VEHICLES
1000048		JCT 050 MP 0.60	3 - SUITABLE FOR PASSENGER CARS
1000049	DETROIT SUMMER HOMES EAST	JCT 050 MP 0.60	3 - SUITABLE FOR PASSENGER CARS
1000050	DETROIT SUMMER HOMES	JCT 10 MP 2.75	3 - SUITABLE FOR PASSENGER CARS
1000052	STAHLMAN SUMMER HOMES	JCT 10 MP 2.15	3 - SUITABLE FOR PASSENGER CARS
1000053	STAHLMAN SUMMER HOMES EAST	JCT 10 MP 0.06	3 - SUITABLE FOR PASSENGER CARS
1000055	SOUTH SHORE CAMPGROUND *	JCT 10 MP 4.22	3 - SUITABLE FOR PASSENGER CARS
1000055J		JCT 1000055	3 - SUITABLE FOR PASSENGER CARS
1000105	HOOVER CAMPGROUND	JCT 10 MP 0.86	4 - MODERATE DEGREE OF USER COMFORT
1000106	HOOVER CAMPGROUND LOOP	JCT 1000019	3 - SUITABLE FOR PASSENGER CARS
1000107	HOOVER CAMPGROUND	JCT 1000106	3 - SUITABLE FOR PASSENGER CARS
1000108	HOOVER BOAT RAMP	JCT 1000109	3 - SUITABLE FOR PASSENGER CARS
1000109	HOOVER CAMPGROUND LOOP	JCT 1000019	3 - SUITABLE FOR PASSENGER CARS
1003000	TOM CREEK	JCT 10 MP 0.8	3 - SUITABLE FOR PASSENGER CARS
1011000	DIVIDE CREEK	JCT 10 MP 11.07	3 - SUITABLE FOR PASSENGER CARS
1012000	IVY CREEK	JCT 10 MP 12.02	3 - SUITABLE FOR PASSENGER CARS
1013000	HAWKINS CREEK	JCT 1011 MP 1.34	2 - HIGH CLEARANCE VEHICLES
1013190		JCT 1013 MP 5.20	2 - HIGH CLEARANCE VEHICLES
1014000	PINNACLE PEAK	JCT 10 MP 13.35	3 - SUITABLE FOR PASSENGER CARS
1100000	STRAIGHT CREEK ROAD	CANAL CREEK BRIDGE	4 - MODERATE DEGREE OF USER COMFORT
1131000	CANAL CREEK RD	11	2 - HIGH CLEARANCE VEHICLES
1131000	CANAL CREEK RD	11	3 - SUITABLE FOR PASSENGER CARS
1131101	ELK CREEK RD	1131	2 - HIGH CLEARANCE VEHICLES
1131101	ELK CREEK RD	1131	3 - SUITABLE FOR PASSENGER CARS
1133000	LITTLE MEADOWS RD	11	3 - SUITABLE FOR PASSENGER CARS
1142000	MCQUADE CREEK RD	11	2 - HIGH CLEARANCE VEHICLES
1152000	KNOB ROCK RD	11	3 - SUITABLE FOR PASSENGER CARS
1152640		1152	2 - HIGH CLEARANCE VEHICLES
1161000	TRAPPERS BUTTE	JCT 1164 MP 8.27	3 - SUITABLE FOR PASSENGER CARS
1162000	STRAIGHT CREEK ROAD	JCT 1100 MP 18.52	3 - SUITABLE FOR PASSENGER CARS
1164000	FISHER POINT	JCT 1100 MP 3.14	3 - SUITABLE FOR PASSENGER CARS
1168000	PARKETT LOOP	JCT 1100 MP 1.42	2 - HIGH CLEARANCE VEHICLES
1168000	PARKETT LOOP	JCT 1100 MP 1.42	3 - SUITABLE FOR PASSENGER CARS
1168430	COFFIN MOUNTAIN ROAD	JCT 1168 MP 5.24	2 - HIGH CLEARANCE VEHICLES
1500000		HWY 126	3 - SUITABLE FOR PASSENGER CARS
1500000		HWY 126	4 - MODERATE DEGREE OF USER COMFORT
1500000		HWY 126	5 - HIGH DEGREE OF USER COMFORT
1500080	BROWDER RIDGE RD	15	2 - HIGH CLEARANCE VEHICLES
1500080	BROWDER RIDGE RD	15	3 - SUITABLE FOR PASSENGER CARS
1500105		1500000	2 - HIGH CLEARANCE VEHICLES
1500120		1500000	2 - HIGH CLEARANCE VEHICLES
1500120		1500000	4 - MODERATE DEGREE OF USER COMFORT
1500121		1500000	2 - HIGH CLEARANCE VEHICLES
1500130		1500000	2 - HIGH CLEARANCE VEHICLES
1500132		1500130	2 - HIGH CLEARANCE VEHICLES
1500690		RD 15	2 - HIGH CLEARANCE VEHICLES

List of Key Forest Roads

1500700		RD 1500	2 - HIGH CLEARANCE VEHICLES
1500705		MP 2.2 1500700	2 - HIGH CLEARANCE VEHICLES
1500720		MP 1500700	2 - HIGH CLEARANCE VEHICLES
1500731		15	2 - HIGH CLEARANCE VEHICLES
1501000		1500	2 - HIGH CLEARANCE VEHICLES
1501000		1500	3 - SUITABLE FOR PASSENGER CARS
1506000		1500000	2 - HIGH CLEARANCE VEHICLES
1506000		1500000	4 - MODERATE DEGREE OF USER COMFORT
1506320	MCRAE CREEK	1506000	2 - HIGH CLEARANCE VEHICLES
1506350	CARPENTER PASS	1506000	2 - HIGH CLEARANCE VEHICLES
1506359		1506350	2 - HIGH CLEARANCE VEHICLES
1506360		1506000	2 - HIGH CLEARANCE VEHICLES
1506365		1506360	2 - HIGH CLEARANCE VEHICLES
1506410		1506320	2 - HIGH CLEARANCE VEHICLES
1507000	LOOKOUT RIDGE	1506000	2 - HIGH CLEARANCE VEHICLES
1508000		1506000	2 - HIGH CLEARANCE VEHICLES
1509000	BEAR PASS RD	1500000	2 - HIGH CLEARANCE VEHICLES
1509000	BEAR PASS RD	1500000	3 - SUITABLE FOR PASSENGER CARS
1509877		1509000	2 - HIGH CLEARANCE VEHICLES
1510000		1509000	2 - HIGH CLEARANCE VEHICLES
1513000	QUENTIN CREEK	1500000	2 - HIGH CLEARANCE VEHICLES
1516000		1500000	2 - HIGH CLEARANCE VEHICLES
1517000		1516000	2 - HIGH CLEARANCE VEHICLES
1517563		1517000	2 - HIGH CLEARANCE VEHICLES
1598000	BROWDER CREEK RD	15	3 - SUITABLE FOR PASSENGER CARS
1800000	FALL CREEK	COUNTY RD 6240 MP 9.8	3 - SUITABLE FOR PASSENGER CARS
1800000	FALL CREEK	COUNTY RD 6240 MP 9.8	5 - HIGH DEGREE OF USER COMFORT
1800406	PUMA C.G.	FH 18 @ MP 16.21	4 - MODERATE DEGREE OF USER COMFORT
1800408		FH 18 @ MP 13.22	3 - SUITABLE FOR PASSENGER CARS
1800409	DOLLY VARDEN C.G.	FH 18 @ MP 10.33	4 - MODERATE DEGREE OF USER COMFORT
1800414	CLARK CR. C.G.	FH 18 @ MP 12.62	4 - MODERATE DEGREE OF USER COMFORT
1800417	BROKEN BOWL C.G.	FH 18 @ MP 10.90	4 - MODERATE DEGREE OF USER COMFORT
1800418	BEDROCK C.G.	FH 18 @ MP 14.59	4 - MODERATE DEGREE OF USER COMFORT
1800440		FH 18 @ MP 24.60	2 - HIGH CLEARANCE VEHICLES
1802000	WINBERRY	COUNTY RD 6245 MP 8.5	3 - SUITABLE FOR PASSENGER CARS
1802000	WINBERRY	COUNTY RD 6245 MP 8.5	5 - HIGH DEGREE OF USER COMFORT
1802115		1802-150 @ MP 5.03	2 - HIGH CLEARANCE VEHICLES
1802150	SOUTH WINBERRY	1802 MP 8.84	2 - HIGH CLEARANCE VEHICLES
1802150	SOUTH WINBERRY	1802 MP 8.84	5 - HIGH DEGREE OF USER COMFORT
1802151		1802-150 @ MP 8.16	3 - SUITABLE FOR PASSENGER CARS
1802160	BRUSH CREEK	1802 @ MP 8.84	2 - HIGH CLEARANCE VEHICLES
1802162		1802-160 @ MP 1.01	2 - HIGH CLEARANCE VEHICLES
1806000	LITTLE FALL CR.	END OF PVT ROAD OFF OF CO.RD 6230	3 - SUITABLE FOR PASSENGER CARS
1816000	TIMBER BUTTE	FH 18 @ MP 10.02	3 - SUITABLE FOR PASSENGER CARS
1816170		1816 @ MP 3.95	3 - SUITABLE FOR PASSENGER CARS
1816175		1816-170 @ MP 0.19	2 - HIGH CLEARANCE VEHICLES
1817000	COWHORN	FH 18 @ MP 10.71	3 - SUITABLE FOR PASSENGER CARS
1818000	FOUR HILLS	1817 @ MP 4.80	3 - SUITABLE FOR PASSENGER CARS
1818424		1818 @ MP 1.48	3 - SUITABLE FOR PASSENGER CARS
1818426		1818424 @ MP 2.19	2 - HIGH CLEARANCE VEHICLES

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1821000	ANDY CR.	FH 18 @ MP 13.25	3 - SUITABLE FOR PASSENGER CARS
1821100	JOHNNY CR. TRAILHEAD	1821 @ MP 0.08	3 - SUITABLE FOR PASSENGER CARS
1821168		1821 @ MP 4.82	2 - HIGH CLEARANCE VEHICLES
1821196		1821 @ MP 3.70	3 - SUITABLE FOR PASSENGER CARS
1821199		1821 @ MP 5.03	3 - SUITABLE FOR PASSENGER CARS
1824000	RUBBLE CR.	FH 18 @ MP 15.08	3 - SUITABLE FOR PASSENGER CARS
1824140		1824 @ MP 9.12	2 - HIGH CLEARANCE VEHICLES
1824140		1824 @ MP 9.12	3 - SUITABLE FOR PASSENGER CARS
1824142		1824 @ MP 6.30	3 - SUITABLE FOR PASSENGER CARS
1824143		1824-142 @ MP 3.95	2 - HIGH CLEARANCE VEHICLES
1824144		1824-142 @ MP 1.10	2 - HIGH CLEARANCE VEHICLES
1824210		1824 @ MP 4.53	3 - SUITABLE FOR PASSENGER CARS
1825000	PORTLAND CR.	FH 18 @ MP 15.69	3 - SUITABLE FOR PASSENGER CARS
1825000	PORTLAND CR.	FH 18 @ MP 15.69	4 - MODERATE DEGREE OF USER COMFORT
1830000	GIBRALTER	FH 18 @ MP 18.36	3 - SUITABLE FOR PASSENGER CARS
1831000	HE HE CR.	FH 18 @ MP 18.88	2 - HIGH CLEARANCE VEHICLES
1831000	HE HE CR.	FH 18 @ MP 18.88	3 - SUITABLE FOR PASSENGER CARS
1832000	TILLER RIDGE	FH 18 @ MP 18.97	3 - SUITABLE FOR PASSENGER CARS
1833000	PACIFIC CR.	FH 18 @ MP 20.66	2 - HIGH CLEARANCE VEHICLES
1833000	PACIFIC CR.	FH 18 @ MP 20.66	3 - SUITABLE FOR PASSENGER CARS
1835000	GOLD CR.	FH 18 @ MP 22.21	3 - SUITABLE FOR PASSENGER CARS
1835102		1835 @ MP 13.44	2 - HIGH CLEARANCE VEHICLES
1835365		1835 @ MP 6.17	2 - HIGH CLEARANCE VEHICLES
1839000	DELP CR.	FH 18 @ MP 23.98	3 - SUITABLE FOR PASSENGER CARS
1839000	DELP CR.	FH 18 @ MP 23.98	4 - MODERATE DEGREE OF USER COMFORT
1844000	EAST DELP CR.	FH 18 @ MP 26.89	2 - HIGH CLEARANCE VEHICLES
1846000	MAY YU	FH 18 @ MP 29.13	2 - HIGH CLEARANCE VEHICLES
1846000	MAY YU	FH 18 @ MP 29.13	3 - SUITABLE FOR PASSENGER CARS
1900000	AUFDERHEIDE DRIVE	WESTFIR COUNTY ROAD	5 - HIGH DEGREE OF USER COMFORT
1900400	DELTA CAMPGROUND	1900000	4 - MODERATE DEGREE OF USER COMFORT
1900410	POWERHOUSE RD	1900000	5 - HIGH DEGREE OF USER COMFORT
1900411		1900410	2 - HIGH CLEARANCE VEHICLES
1900415	RUSH CREEK	1900000	2 - HIGH CLEARANCE VEHICLES
1900415	RUSH CREEK	1900000	4 - MODERATE DEGREE OF USER COMFORT
1900416		1900415	2 - HIGH CLEARANCE VEHICLES
1900421	FRENCH PETE CAMPGROUND	1900000	4 - MODERATE DEGREE OF USER COMFORT
1900440	FRISSELL XING CAMPGROUND	1900000	3 - SUITABLE FOR PASSENGER CARS
1900441		1900000	2 - HIGH CLEARANCE VEHICLES
1900500		1900000	2 - HIGH CLEARANCE VEHICLES
1900500		1900000	3 - SUITABLE FOR PASSENGER CARS
1900509		1900500	2 - HIGH CLEARANCE VEHICLES
1900570		1900000	3 - SUITABLE FOR PASSENGER CARS
1900750		1900	4 - MODERATE DEGREE OF USER COMFORT
1910000		1900	2 - HIGH CLEARANCE VEHICLES
1910670		1910	2 - HIGH CLEARANCE VEHICLES
1910683		1910	2 - HIGH CLEARANCE VEHICLES
1911000		1910	2 - HIGH CLEARANCE VEHICLES
1912000		1900	3 - SUITABLE FOR PASSENGER CARS
1919000		1900	2 - HIGH CLEARANCE VEHICLES
1920000		1900	2 - HIGH CLEARANCE VEHICLES

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1920660		1920	2 - HIGH CLEARANCE VEHICLES
1925000		1900	3 - SUITABLE FOR PASSENGER CARS
1925642		1925	2 - HIGH CLEARANCE VEHICLES
1925646		1925	2 - HIGH CLEARANCE VEHICLES
1926000		1900	3 - SUITABLE FOR PASSENGER CARS
1926000		1900	5 - HIGH DEGREE OF USER COMFORT
1926573		1926	2 - HIGH CLEARANCE VEHICLES
1926576		1926	3 - SUITABLE FOR PASSENGER CARS
1927000		1926	2 - HIGH CLEARANCE VEHICLES
1927000		1926	3 - SUITABLE FOR PASSENGER CARS
1927000		1926	5 - HIGH DEGREE OF USER COMFORT
1927100		1927000	2 - HIGH CLEARANCE VEHICLES
1927120		1927240	2 - HIGH CLEARANCE VEHICLES
1927150		1927100	2 - HIGH CLEARANCE VEHICLES
1927240		1927000	2 - HIGH CLEARANCE VEHICLES
1927280		1927000	2 - HIGH CLEARANCE VEHICLES
1928000		1900	3 - SUITABLE FOR PASSENGER CARS
1928190		1928210	2 - HIGH CLEARANCE VEHICLES
1928210		1928	2 - HIGH CLEARANCE VEHICLES
1928700		1928	2 - HIGH CLEARANCE VEHICLES
1928706		1928700	2 - HIGH CLEARANCE VEHICLES
1929000		1927	2 - HIGH CLEARANCE VEHICLES
1929626		1929	2 - HIGH CLEARANCE VEHICLES
1930000		1928	2 - HIGH CLEARANCE VEHICLES
1931000		1928	3 - SUITABLE FOR PASSENGER CARS
1931720	HUCKLEBERRY MTN.	1931	3 - SUITABLE FOR PASSENGER CARS
1931725		1931720	3 - SUITABLE FOR PASSENGER CARS
1933000		1927	2 - HIGH CLEARANCE VEHICLES
1934000		1900	2 - HIGH CLEARANCE VEHICLES
1934000		1900	3 - SUITABLE FOR PASSENGER CARS
1934730		1934	3 - SUITABLE FOR PASSENGER CARS
1934733		1934	3 - SUITABLE FOR PASSENGER CARS
1934734		1934	2 - HIGH CLEARANCE VEHICLES
1934736		1934	2 - HIGH CLEARANCE VEHICLES
1934741		1934733	2 - HIGH CLEARANCE VEHICLES
1934810			2 - HIGH CLEARANCE VEHICLES
1940000		1900	3 - SUITABLE FOR PASSENGER CARS
1944000		1900	3 - SUITABLE FOR PASSENGER CARS
1944750		1944	3 - SUITABLE FOR PASSENGER CARS
1957000		1900	3 - SUITABLE FOR PASSENGER CARS
1958000		1900000	2 - HIGH CLEARANCE VEHICLES
1958380		1958000	2 - HIGH CLEARANCE VEHICLES
1964000		1900000	2 - HIGH CLEARANCE VEHICLES
1964406		1964000	2 - HIGH CLEARANCE VEHICLES
1964456		1964000	2 - HIGH CLEARANCE VEHICLES
1980000		1900000	3 - SUITABLE FOR PASSENGER CARS
1980204		1980000	2 - HIGH CLEARANCE VEHICLES
1980208		1980000	2 - HIGH CLEARANCE VEHICLES
1980225		1980000	2 - HIGH CLEARANCE VEHICLES
1980230		1980000	2 - HIGH CLEARANCE VEHICLES

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1980231		1980230	2 - HIGH CLEARANCE VEHICLES
1980247		1980000	2 - HIGH CLEARANCE VEHICLES
1980350		1980000	2 - HIGH CLEARANCE VEHICLES
1985000		1900000	3 - SUITABLE FOR PASSENGER CARS
1985113		1985000	2 - HIGH CLEARANCE VEHICLES
1985115		1985000	2 - HIGH CLEARANCE VEHICLES
1985131		1985000	2 - HIGH CLEARANCE VEHICLES
1986000		1985000	2 - HIGH CLEARANCE VEHICLES
1993000		1900000	3 - SUITABLE FOR PASSENGER CARS
1993000		1900000	4 - MODERATE DEGREE OF USER COMFORT
1993000		1900000	5 - HIGH DEGREE OF USER COMFORT
1993555		1993000	2 - HIGH CLEARANCE VEHICLES
2000015	TROUT CREEK CAMPGROUND *	HWY 20	4 - MODERATE DEGREE OF USER COMFORT
2000026		2000024	2 - HIGH CLEARANCE VEHICLES
2000035	IRON MTN RD	HWY 20	3 - SUITABLE FOR PASSENGER CARS
2000060	HEART LAKE RD	HWY 20	2 - HIGH CLEARANCE VEHICLES
2000068	LOST PRAIRIE CAMPGROUND	HWY 20	4 - MODERATE DEGREE OF USER COMFORT
2000600	STEWART RD	HWY 20	2 - HIGH CLEARANCE VEHICLES
2000600	STEWART RD	HWY 20	3 - SUITABLE FOR PASSENGER CARS
2000601	YUKWAH CAMPGROUND RD	2000600	4 - MODERATE DEGREE OF USER COMFORT
2022000	CANYON CREEK RD	HWY 20	3 - SUITABLE FOR PASSENGER CARS
2024000	TWO GIRLS RD	2022	3 - SUITABLE FOR PASSENGER CARS
2025000	MOOSE CREEK RD	2027	2 - HIGH CLEARANCE VEHICLES
2025000	MOOSE CREEK RD	2027	3 - SUITABLE FOR PASSENGER CARS
2025500	LOW DECK RD	2025	2 - HIGH CLEARANCE VEHICLES
2025500	LOW DECK RD	2025	3 - SUITABLE FOR PASSENGER CARS
2025505	MILL ROAD	2025500	3 - SUITABLE FOR PASSENGER CARS
2026000	OWL CREEK ROAD	2022	3 - SUITABLE FOR PASSENGER CARS
2026335	TIDBITS RD	2026	2 - HIGH CLEARANCE VEHICLES
2027000	MOOSE MOUNTAIN RD	HWY 20	2 - HIGH CLEARANCE VEHICLES
2027000	MOOSE MOUNTAIN RD	HWY 20	3 - SUITABLE FOR PASSENGER CARS
2027752		2027	2 - HIGH CLEARANCE VEHICLES
2027755	COUGAR ROCK RD	2027752	2 - HIGH CLEARANCE VEHICLES
2032000	GORDON RD	HWY 20	3 - SUITABLE FOR PASSENGER CARS
2032300	LONGBOW CAMPGROUND RD	2032302	3 - SUITABLE FOR PASSENGER CARS
2032302	LONG RANCH ROAD	2032	2 - HIGH CLEARANCE VEHICLES
2032302	LONG RANCH ROAD	2032	3 - SUITABLE FOR PASSENGER CARS
2032345	SOAPGRASS RIDGE	2032	3 - SUITABLE FOR PASSENGER CARS
2032417	FALLS CREEK RD	2032	2 - HIGH CLEARANCE VEHICLES
2041000	SODA FORK RD	HWY 20	3 - SUITABLE FOR PASSENGER CARS
2041645		2041	2 - HIGH CLEARANCE VEHICLES
2041646		2041	3 - SUITABLE FOR PASSENGER CARS
2043000	SODA FORK MAINLINE RD	2041	2 - HIGH CLEARANCE VEHICLES
2043320		2043	2 - HIGH CLEARANCE VEHICLES
2043450		2043	2 - HIGH CLEARANCE VEHICLES
2044000	SQUAW CREEK RD	HWY 20	3 - SUITABLE FOR PASSENGER CARS
2044202	HOUSE ROCK CG RD	2044	3 - SUITABLE FOR PASSENGER CARS
2044230	GORDON LAKES RD	2044	3 - SUITABLE FOR PASSENGER CARS
2045000	HOLMAN CREEK RD	2043	2 - HIGH CLEARANCE VEHICLES
2045140		2045	2 - HIGH CLEARANCE VEHICLES

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2045240		2045	2 - HIGH CLEARANCE VEHICLES
2047000	SHEEP CREEK RD	HWY 20	3 - SUITABLE FOR PASSENGER CARS
2047747		2047	2 - HIGH CLEARANCE VEHICLES
2047840	TOMMY TIE	2047	3 - SUITABLE FOR PASSENGER CARS
2067000	LAVA LAKE RD	HWY 20	3 - SUITABLE FOR PASSENGER CARS
2067508	MAUDE CREEK RD	2067	2 - HIGH CLEARANCE VEHICLES
2067508	MAUDE CREEK RD	2067	3 - SUITABLE FOR PASSENGER CARS
2067560	PARKS CREEK RD	2067	2 - HIGH CLEARANCE VEHICLES
2067560	PARKS CREEK RD	2067	3 - SUITABLE FOR PASSENGER CARS
2100000		CO RD 0736-1299	5 - HIGH DEGREE OF USER COMFORT
2100112		RD 21	5 - HIGH DEGREE OF USER COMFORT
2100134		RD 21	5 - HIGH DEGREE OF USER COMFORT
2100197		RD 21	3 - SUITABLE FOR PASSENGER CARS
2100199		RD 21	3 - SUITABLE FOR PASSENGER CARS
2100276		RD 21	2 - HIGH CLEARANCE VEHICLES
2100279		RD 21	3 - SUITABLE FOR PASSENGER CARS
2102000		RD 21	5 - HIGH DEGREE OF USER COMFORT
2102101		RD 2102	2 - HIGH CLEARANCE VEHICLES
2106000		RD 21	2 - HIGH CLEARANCE VEHICLES
2106000		RD 21	3 - SUITABLE FOR PASSENGER CARS
2110000		RD 21	3 - SUITABLE FOR PASSENGER CARS
2117000		RD 21	2 - HIGH CLEARANCE VEHICLES
2117000		RD 21	5 - HIGH DEGREE OF USER COMFORT
2118000		RD 21	3 - SUITABLE FOR PASSENGER CARS
2118000		RD 21	5 - HIGH DEGREE OF USER COMFORT
2118479		RD 2118	2 - HIGH CLEARANCE VEHICLES
2119000		RD 2120	2 - HIGH CLEARANCE VEHICLES
2119473		RD 2119	2 - HIGH CLEARANCE VEHICLES
2120000		RD 21	2 - HIGH CLEARANCE VEHICLES
2120000		RD 21	3 - SUITABLE FOR PASSENGER CARS
2124000		RD 21	2 - HIGH CLEARANCE VEHICLES
2125000		RD 2127	2 - HIGH CLEARANCE VEHICLES
2127000		RD 21	3 - SUITABLE FOR PASSENGER CARS
2127000		RD 21	5 - HIGH DEGREE OF USER COMFORT
2129000		RD 21	2 - HIGH CLEARANCE VEHICLES
2129000		RD 21	3 - SUITABLE FOR PASSENGER CARS
2129342		RD 2129439	2 - HIGH CLEARANCE VEHICLES
2129439		RD 2129	3 - SUITABLE FOR PASSENGER CARS
2133000		RD 2134	2 - HIGH CLEARANCE VEHICLES
2133000		RD 2134	3 - SUITABLE FOR PASSENGER CARS
2134000	STALEY RIDGE ROAD	RD 21	3 - SUITABLE FOR PASSENGER CARS
2134000	STALEY RIDGE ROAD	RD 21	5 - HIGH DEGREE OF USER COMFORT
2134248		RD 2134	2 - HIGH CLEARANCE VEHICLES
2134250		RD 2134	2 - HIGH CLEARANCE VEHICLES
2134251		RD 2134250	2 - HIGH CLEARANCE VEHICLES
2135000		RD 21	3 - SUITABLE FOR PASSENGER CARS
2136000		RD 2134	3 - SUITABLE FOR PASSENGER CARS
2136000		RD 2134	5 - HIGH DEGREE OF USER COMFORT
2137000		RD 2136	2 - HIGH CLEARANCE VEHICLES
2143000		RD 21	2 - HIGH CLEARANCE VEHICLES

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2144000		RD 2143	2 - HIGH CLEARANCE VEHICLES
2144305		RD 2144	2 - HIGH CLEARANCE VEHICLES
2149000		RD 21	3 - SUITABLE FOR PASSENGER CARS
2153000	BIG SWAMP ROAD	RD 21	3 - SUITABLE FOR PASSENGER CARS
2153000	BIG SWAMP ROAD	RD 21	5 - HIGH DEGREE OF USER COMFORT
2153370		RD 2153	2 - HIGH CLEARANCE VEHICLES
2153375		RD 2153	2 - HIGH CLEARANCE VEHICLES
2154000	TIMPANOGAS RROAD	RD 21	2 - HIGH CLEARANCE VEHICLES
2154000	TIMPANOGAS RROAD	RD 21	3 - SUITABLE FOR PASSENGER CARS
2154000	TIMPANOGAS RROAD	RD 21	5 - HIGH DEGREE OF USER COMFORT
2154270		RD 2154	2 - HIGH CLEARANCE VEHICLES
2154399		RD 2154	3 - SUITABLE FOR PASSENGER CARS
2160000		RD 2149	3 - SUITABLE FOR PASSENGER CARS
2160380		RD 2160	2 - HIGH CLEARANCE VEHICLES
2200023	WHISPERING FALLS CAMPGROUND	JCT HWY 22 MP 10.15	3 - SUITABLE FOR PASSENGER CARS
2200040	WOODPECKER RIDGE ROAD	JCT HWY 22 MP 13.54	3 - SUITABLE FOR PASSENGER CARS
2200067	RIVERSIDE CAMPGROUND	JCT HWY 22	3 - SUITABLE FOR PASSENGER CARS
2200080	MAXWELL BUTTE TRAIL ROAD	JCT HWY 22	3 - SUITABLE FOR PASSENGER CARS
2200106	WORK CENTER ROAD	JCT HWY 22	3 - SUITABLE FOR PASSENGER CARS
2200107	DETROIT WORK CENTER ROAD	JCT HWY 22	3 - SUITABLE FOR PASSENGER CARS
2200108	WATER TOWER ROAD	JCT 107	3 - SUITABLE FOR PASSENGER CARS
2200109	DETROIT RANGER STATION	JCT HWY 22	3 - SUITABLE FOR PASSENGER CARS
2200116		2200107	3 - SUITABLE FOR PASSENGER CARS
2200117		2200107	3 - SUITABLE FOR PASSENGER CARS
2200118		2200109	3 - SUITABLE FOR PASSENGER CARS
2200118J		JCT 2200109	3 - SUITABLE FOR PASSENGER CARS
2200119		2200109	3 - SUITABLE FOR PASSENGER CARS
2200122		JCT 2200118	3 - SUITABLE FOR PASSENGER CARS
2202000	MONUMENT PEAK	ACCESS RD	2 - HIGH CLEARANCE VEHICLES
2207000	CEDAR CREEK ROAD	JCT 2223	2 - HIGH CLEARANCE VEHICLES
2207000	CEDAR CREEK ROAD	JCT 2223	3 - SUITABLE FOR PASSENGER CARS
2207125	STONY RIDGE ROAD	JCT 2207 MP 10.22	2 - HIGH CLEARANCE VEHICLES
2207214		JCT 2207 MP 15.39	2 - HIGH CLEARANCE VEHICLES
2207215	SHADY COVE CAMPGROUND	JCT 2207 MP 14.29	2 - HIGH CLEARANCE VEHICLES
2209000	ELKHORN ROAD	JCT 2207 MP 16.26	3 - SUITABLE FOR PASSENGER CARS
2209201	ELKHORN RIDGE ROAD	JCT #CR 960	2 - HIGH CLEARANCE VEHICLES
2209301	DRY CREEK ROAD	JCT 2209 MP 1.53	2 - HIGH CLEARANCE VEHICLES
2212000	KINNEY CREEK ROAD	JCT HWY 22 MP 5.87	3 - SUITABLE FOR PASSENGER CARS
2212638		JCT 2212 MP 10.66	2 - HIGH CLEARANCE VEHICLES
2212640	SLATE ROCK ROAD	JCT 2212 MP 11.61	2 - HIGH CLEARANCE VEHICLES
2223000	FRENCH CREEK ROAD	JCT HWY 22 MP 1.25	2 - HIGH CLEARANCE VEHICLES
2223000	FRENCH CREEK ROAD	JCT HWY 22 MP 1.25	3 - SUITABLE FOR PASSENGER CARS
2223501	MARGIE DUNHAM ROAD	JCT 2223	2 - HIGH CLEARANCE VEHICLES
2223520	HALL'S RIDGE ROAD	JCT 2223 MP 8.23	2 - HIGH CLEARANCE VEHICLES
2223525		JCT 520 MP 2.62	2 - HIGH CLEARANCE VEHICLES
2223526		JCT 2223525	2 - HIGH CLEARANCE VEHICLES
2225000	MARTEN BUTTE ROAD	JCT 2223 MP 1.67	2 - HIGH CLEARANCE VEHICLES
2225450	CANYON CREEK ROAD	JCT 2225 MP 0.17	2 - HIGH CLEARANCE VEHICLES
2225458	BYARS PEAK ROAD	JCT 2225 MP 5.49	2 - HIGH CLEARANCE VEHICLES
2231000	BOULDER RIDGE	JCT HWY 22 MP 5.23	3 - SUITABLE FOR PASSENGER CARS

List of Key Forest Roads

2231810	PIGEON PRAIRIE	JCT 2231 MP 4.49	2 - HIGH CLEARANCE VEHICLES
2231840	GALE HILL ROAD	JCT 2231 MP 7.48	2 - HIGH CLEARANCE VEHICLES
2231890	BREITENBUSH SUMMER HOMES	JCT 2231 MP 12.92	3 - SUITABLE FOR PASSENGER CARS
2231893	BREITENBUSH SUMMER HOMES	JCT 890 MP 0.82	3 - SUITABLE FOR PASSENGER CARS
2231896	BREITENBUSH SUMMER HOMES	JCT 890 MP 1.01	3 - SUITABLE FOR PASSENGER CARS
2233000	MCCOY_CREEK ROAD	JCT HWY 22 MP 7.82	2 - HIGH CLEARANCE VEHICLES
2233000	MCCOY_CREEK ROAD	JCT HWY 22 MP 7.82	3 - SUITABLE FOR PASSENGER CARS
2233515	BULL FROG	JCT 2233 MP 5.36	2 - HIGH CLEARANCE VEHICLES
2234000	BRUNO MEADOWS-COOPER-BU*	HWY 22 AT MP 7.80	3 - SUITABLE FOR PASSENGER CARS
2234100	COLD DECK	JCT 2234 MP 0.10	3 - SUITABLE FOR PASSENGER CARS
2236000	UPPER HAWKINS	JCT 1003 MP 9.48	3 - SUITABLE FOR PASSENGER CARS
2243000	WHITEWATER ROAD	JCT HWY 22	3 - SUITABLE FOR PASSENGER CARS
2246000	PAMELIA CREEK ROAD	JCT HWY 22 MP 13.98	4 - MODERATE DEGREE OF USER COMFORT
2253000	BINGHAM RIDGE ROAD	JCT HWY 22	2 - HIGH CLEARANCE VEHICLES
2255000	MARION CREEK ROAD	JCT HWY 22 MP 18.11	3 - SUITABLE FOR PASSENGER CARS
2257000	HORN CREEK ROAD	JCT HWY 22	2 - HIGH CLEARANCE VEHICLES
2257000	HORN CREEK ROAD	JCT HWY 22	3 - SUITABLE FOR PASSENGER CARS
2261000	TWIN MEADOWS ROAD	JCT HWY 22 MP 21.80	2 - HIGH CLEARANCE VEHICLES
2261000	TWIN MEADOWS ROAD	JCT HWY 22 MP 21.80	3 - SUITABLE FOR PASSENGER CARS
2261405	EAST OFAY	JCT 2261 MP 1.81	3 - SUITABLE FOR PASSENGER CARS
2266000		HWY 22	2 - HIGH CLEARANCE VEHICLES
2266000		HWY 22	3 - SUITABLE FOR PASSENGER CARS
2266000		HWY 22	4 - MODERATE DEGREE OF USER COMFORT
2266310		2266	3 - SUITABLE FOR PASSENGER CARS
2266450	DALY LAKE RD	2266	2 - HIGH CLEARANCE VEHICLES
2266450	DALY LAKE RD	2266	3 - SUITABLE FOR PASSENGER CARS
2267000	BIG MEADOWS ROAD	JCT HWY 22	3 - SUITABLE FOR PASSENGER CARS
2300000		CO RD LA6178 MP 4.8	3 - SUITABLE FOR PASSENGER CARS
2300000		CO RD LA6178 MP 4.8	5 - HIGH DEGREE OF USER COMFORT
2300415		RD 23	2 - HIGH CLEARANCE VEHICLES
2300428		RD 23	2 - HIGH CLEARANCE VEHICLES
2302000		RD 2118	2 - HIGH CLEARANCE VEHICLES
2303000		RD 23	2 - HIGH CLEARANCE VEHICLES
2307000	LITTLE WILLOW CREEK ROAD	RD 2308	3 - SUITABLE FOR PASSENGER CARS
2308000	MOSS MOUNTAIN	RD 23	2 - HIGH CLEARANCE VEHICLES
2308000	MOSS MOUNTAIN	RD 23	5 - HIGH DEGREE OF USER COMFORT
2309000	GROUNDHOG ROAD	RD 2307	2 - HIGH CLEARANCE VEHICLES
2309000	GROUNDHOG ROAD	RD 2307	3 - SUITABLE FOR PASSENGER CARS
2316000		RD 23	2 - HIGH CLEARANCE VEHICLES
2316000		RD 23	3 - SUITABLE FOR PASSENGER CARS
2316510		RD 2316	3 - SUITABLE FOR PASSENGER CARS
2316526		RD 2316	3 - SUITABLE FOR PASSENGER CARS
2400000		FISH HATCHERY RD.	5 - HIGH DEGREE OF USER COMFORT
2400201		2400	4 - MODERATE DEGREE OF USER COMFORT
2400207		2400	2 - HIGH CLEARANCE VEHICLES
2400207		2400	3 - SUITABLE FOR PASSENGER CARS
2404000		2400	2 - HIGH CLEARANCE VEHICLES
2408000		2400	2 - HIGH CLEARANCE VEHICLES
2408000		2400	3 - SUITABLE FOR PASSENGER CARS
2408042		2408280	2 - HIGH CLEARANCE VEHICLES

List of Key Forest Roads

2408280		2408	2 - HIGH CLEARANCE VEHICLES
2408286		2408	2 - HIGH CLEARANCE VEHICLES
2409000		2400	2 - HIGH CLEARANCE VEHICLES
2417000		2400	3 - SUITABLE FOR PASSENGER CARS
2417000		2400	4 - MODERATE DEGREE OF USER COMFORT
2417253		2417	2 - HIGH CLEARANCE VEHICLES
2417254		2417	3 - SUITABLE FOR PASSENGER CARS
2418000		2400	2 - HIGH CLEARANCE VEHICLES
2419000	LONG PRAIRIE	2417	2 - HIGH CLEARANCE VEHICLES
2419000	LONG PRAIRIE	2417	3 - SUITABLE FOR PASSENGER CARS
2419370		2419	2 - HIGH CLEARANCE VEHICLES
2421000		24 & 2422	3 - SUITABLE FOR PASSENGER CARS
2422000		2400	3 - SUITABLE FOR PASSENGER CARS
2422264		2422	2 - HIGH CLEARANCE VEHICLES
2423000		2422	2 - HIGH CLEARANCE VEHICLES
2424000		2417	3 - SUITABLE FOR PASSENGER CARS
2600220		126	4 - MODERATE DEGREE OF USER COMFORT
2600250		RD 2600705	3 - SUITABLE FOR PASSENGER CARS
2600280		126	2 - HIGH CLEARANCE VEHICLES
2600280		126	4 - MODERATE DEGREE OF USER COMFORT
2600290		HWY 126	2 - HIGH CLEARANCE VEHICLES
2600293		2600294	3 - SUITABLE FOR PASSENGER CARS
2600300		126	4 - MODERATE DEGREE OF USER COMFORT
2600302		2600	2 - HIGH CLEARANCE VEHICLES
2600302		2600	4 - MODERATE DEGREE OF USER COMFORT
2600320		126	2 - HIGH CLEARANCE VEHICLES
2600560		RD 2600	2 - HIGH CLEARANCE VEHICLES
2600700		126	3 - SUITABLE FOR PASSENGER CARS
2600701		HWY 126	3 - SUITABLE FOR PASSENGER CARS
2600703			3 - SUITABLE FOR PASSENGER CARS
2600705	MCKENZIE DUMP RD	126	3 - SUITABLE FOR PASSENGER CARS
2600713		RD 2600	2 - HIGH CLEARANCE VEHICLES
2600730		126	3 - SUITABLE FOR PASSENGER CARS
2600730		126	4 - MODERATE DEGREE OF USER COMFORT
2600750		126	3 - SUITABLE FOR PASSENGER CARS
2600759		126	4 - MODERATE DEGREE OF USER COMFORT
2600760		2600759	4 - MODERATE DEGREE OF USER COMFORT
2600761		RD 2600759	4 - MODERATE DEGREE OF USER COMFORT
2600762		126	4 - MODERATE DEGREE OF USER COMFORT
2600763		2600759	2 - HIGH CLEARANCE VEHICLES
2600770		126	4 - MODERATE DEGREE OF USER COMFORT
2600775		126	4 - MODERATE DEGREE OF USER COMFORT
2600776		2600770	3 - SUITABLE FOR PASSENGER CARS
2600780		126	3 - SUITABLE FOR PASSENGER CARS
2600820		126	2 - HIGH CLEARANCE VEHICLES
2600821		RD 2600820	2 - HIGH CLEARANCE VEHICLES
2600830		RD 2600000	2 - HIGH CLEARANCE VEHICLES
2600835		126	3 - SUITABLE FOR PASSENGER CARS
2600840		2600	3 - SUITABLE FOR PASSENGER CARS
2600840		2600	4 - MODERATE DEGREE OF USER COMFORT

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2600845		RD 2600	5 - HIGH DEGREE OF USER COMFORT
2600890		2600830	2 - HIGH CLEARANCE VEHICLES
2600893		126	3 - SUITABLE FOR PASSENGER CARS
2611000		HWY 126	2 - HIGH CLEARANCE VEHICLES
2618000		1927000	2 - HIGH CLEARANCE VEHICLES
2618000		1927000	3 - SUITABLE FOR PASSENGER CARS
2619000		2618000	2 - HIGH CLEARANCE VEHICLES
2633000		126	2 - HIGH CLEARANCE VEHICLES
2633000		126	3 - SUITABLE FOR PASSENGER CARS
2633700		RD 2633	2 - HIGH CLEARANCE VEHICLES
2633700		RD 2633	3 - SUITABLE FOR PASSENGER CARS
2633704		2633700	3 - SUITABLE FOR PASSENGER CARS
2633719		RD 2633000	2 - HIGH CLEARANCE VEHICLES
2638000	HORSE CREEK ROAD	126	2 - HIGH CLEARANCE VEHICLES
2638000	HORSE CREEK ROAD	126	3 - SUITABLE FOR PASSENGER CARS
2638000	HORSE CREEK ROAD	126	4 - MODERATE DEGREE OF USER COMFORT
2638340		2638	4 - MODERATE DEGREE OF USER COMFORT
2638350		2638	3 - SUITABLE FOR PASSENGER CARS
2638356		2638	2 - HIGH CLEARANCE VEHICLES
2639480		RD 2639000	2 - HIGH CLEARANCE VEHICLES
2643000		126	3 - SUITABLE FOR PASSENGER CARS
2643000		126	4 - MODERATE DEGREE OF USER COMFORT
2643480		2643 MP8.2 SEC 32 NW	2 - HIGH CLEARANCE VEHICLES
2643480		2643 MP8.2 SEC 32 NW	3 - SUITABLE FOR PASSENGER CARS
2647000		126	2 - HIGH CLEARANCE VEHICLES
2647000		126	3 - SUITABLE FOR PASSENGER CARS
2647521		2647	3 - SUITABLE FOR PASSENGER CARS
2649000		2600	3 - SUITABLE FOR PASSENGER CARS
2649620		2649 MP 3.2	3 - SUITABLE FOR PASSENGER CARS
2649640		2649	2 - HIGH CLEARANCE VEHICLES
2649676		2649	3 - SUITABLE FOR PASSENGER CARS
2649770		2649690	2 - HIGH CLEARANCE VEHICLES
2650000		126	2 - HIGH CLEARANCE VEHICLES
2653000		RD 2600000	3 - SUITABLE FOR PASSENGER CARS
2653720		2653	2 - HIGH CLEARANCE VEHICLES
2653735		2653	2 - HIGH CLEARANCE VEHICLES
2653760		2653	2 - HIGH CLEARANCE VEHICLES
2654000		2600	2 - HIGH CLEARANCE VEHICLES
2654000		2600	3 - SUITABLE FOR PASSENGER CARS
2654000		2600	5 - HIGH DEGREE OF USER COMFORT
2655000		RD 2654	3 - SUITABLE FOR PASSENGER CARS
2655503		2655	2 - HIGH CLEARANCE VEHICLES
2655507		2655503	2 - HIGH CLEARANCE VEHICLES
2657000		HWY 126	3 - SUITABLE FOR PASSENGER CARS
2657830		RD 2657000	2 - HIGH CLEARANCE VEHICLES
2657835		2657830	2 - HIGH CLEARANCE VEHICLES
2657840		2657	2 - HIGH CLEARANCE VEHICLES
2657850		RD 2657	2 - HIGH CLEARANCE VEHICLES
2657859		RD 2657850	2 - HIGH CLEARANCE VEHICLES
2657865		RD 2657	2 - HIGH CLEARANCE VEHICLES

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2657901		RD 2657	2 - HIGH CLEARANCE VEHICLES
2664000		HWY 126	3 - SUITABLE FOR PASSENGER CARS
2664515		RD 2664000	2 - HIGH CLEARANCE VEHICLES
2672000		HWY 126	3 - SUITABLE FOR PASSENGER CARS
2672655		2672	2 - HIGH CLEARANCE VEHICLES
2672655		2672	3 - SUITABLE FOR PASSENGER CARS
2672690		2672655	2 - HIGH CLEARANCE VEHICLES
2676000		HWY 126	2 - HIGH CLEARANCE VEHICLES
2676000		HWY 126	3 - SUITABLE FOR PASSENGER CARS
2676866		2676	2 - HIGH CLEARANCE VEHICLES
2690000		HWY 20	5 - HIGH DEGREE OF USER COMFORT
2690801		2690	2 - HIGH CLEARANCE VEHICLES
2690805		2690	5 - HIGH DEGREE OF USER COMFORT
2690806		2690805	2 - HIGH CLEARANCE VEHICLES
2690808		2690806	2 - HIGH CLEARANCE VEHICLES
2690810		2690	2 - HIGH CLEARANCE VEHICLES
2690811		2690	2 - HIGH CLEARANCE VEHICLES
2690811		2690	3 - SUITABLE FOR PASSENGER CARS
2690815	BIG LAKE CAMPGROUND	2690	5 - HIGH DEGREE OF USER COMFORT
2690892		2690890	2 - HIGH CLEARANCE VEHICLES
2690902		2690	3 - SUITABLE FOR PASSENGER CARS
2690904		2690	2 - HIGH CLEARANCE VEHICLES
2690960		2690811	3 - SUITABLE FOR PASSENGER CARS
2820000	CALAPOOIA RD	CO RD #759	2 - HIGH CLEARANCE VEHICLES
2820000	CALAPOOIA RD	CO RD #759	3 - SUITABLE FOR PASSENGER CARS
2820520	HIGH RD	2820	2 - HIGH CLEARANCE VEHICLES
4200210		242	3 - SUITABLE FOR PASSENGER CARS
4200240		HWY 242	3 - SUITABLE FOR PASSENGER CARS
4200246		HWY 242	3 - SUITABLE FOR PASSENGER CARS
4200250		HWY 242	3 - SUITABLE FOR PASSENGER CARS
4200251		4200250	3 - SUITABLE FOR PASSENGER CARS
4200260		HWY 242	3 - SUITABLE FOR PASSENGER CARS
4600000	BREITENBUSH ROAD	JCT HWY 22 MP 1.53	5 - HIGH DEGREE OF USER COMFORT
4600030	MANSFIELD MTN ROAD	JCT 46 MP 10.39	2 - HIGH CLEARANCE VEHICLES
4600033		JCT 030 MP 1.72	2 - HIGH CLEARANCE VEHICLES
4600040	SHORT MOUNTAIN ROAD	JCT 46 MP 9.81	2 - HIGH CLEARANCE VEHICLES
4600050	HOT SPRINGS	JCT 46 MP 9.75	2 - HIGH CLEARANCE VEHICLES
4600063	BREITENBUSH CAMPGROUND	JCT 46 MP 9.63	3 - SUITABLE FOR PASSENGER CARS
4600064	BREITENBUSH CAMPGROUND	JCT 063 MP 0.08	3 - SUITABLE FOR PASSENGER CARS
4600075	HUMBUG CAMPGROUND	JCT 46 MP 4.65	3 - SUITABLE FOR PASSENGER CARS
4685000	SOUTH BREITENBUSH ROAD	JCT 46 MP 11.8	3 - SUITABLE FOR PASSENGER CARS
4685330		JCT 4685	3 - SUITABLE FOR PASSENGER CARS
4688000	MANSFIELD CREEK ROAD	JCT 46 MP 10.83	2 - HIGH CLEARANCE VEHICLES
4688240		JCT 4688 MP 4.50	2 - HIGH CLEARANCE VEHICLES
4695000	WIND CREEK	JCT 46 MP 3.16	2 - HIGH CLEARANCE VEHICLES
4695130	HOOVERS RIDGE	JCT 4695 MP 3.56	2 - HIGH CLEARANCE VEHICLES
4696000	EAST HUMBUG	JCT 4600 MP 4.46	3 - SUITABLE FOR PASSENGER CARS
4696701		JCT 4696 MP 0.17	2 - HIGH CLEARANCE VEHICLES
4696850		JCT 4696 MP 6.83	3 - SUITABLE FOR PASSENGER CARS
4697000	ELK LAKE ROAD	JCT 4696 MP 0.79	2 - HIGH CLEARANCE VEHICLES

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4697390		JCT 4697 MP 6.69	2 - HIGH CLEARANCE VEHICLES
4697451	GOLD BUTTE	JCT 4697 MP 4.62	2 - HIGH CLEARANCE VEHICLES
4697453	GOLD BUTTE LOOK-OUT ROAD	JCT 451 MP 0.14	2 - HIGH CLEARANCE VEHICLES
4698000	FOX CREEK RIDGE	JCT 4696 MP 2.20	3 - SUITABLE FOR PASSENGER CARS
5800050	HAMPTON BOAT RAMP	HWY 58	3 - SUITABLE FOR PASSENGER CARS
5800129	BLACK CANYON C.G.	HWY 58	4 - MODERATE DEGREE OF USER COMFORT
5800150		5800-050	3 - SUITABLE FOR PASSENGER CARS
5800500	GOLD LAKE ROAD	HWY 58	3 - SUITABLE FOR PASSENGER CARS
5800500	ROAD TO GOLD LAKE	5800	3 - SUITABLE FOR PASSENGER CARS
5821000	NORTH SHORE	CO. RD. #6270 MP 9.0	3 - SUITABLE FOR PASSENGER CARS
5821000	NORTH SHORE	CO. RD. #6270 MP 9.0	4 - MODERATE DEGREE OF USER COMFORT
5821000	NORTH SHORE	CO. RD. #6270 MP 9.0	5 - HIGH DEGREE OF USER COMFORT
5823000	SCHOOL CR.	5821 @ MP 12.08	2 - HIGH CLEARANCE VEHICLES
5823000	SCHOOL CR.	5821 @ MP 12.08	3 - SUITABLE FOR PASSENGER CARS
5823104		5823 @ MP 3.13	3 - SUITABLE FOR PASSENGER CARS
5824000	CARPET HILL	5821 @ MP 12.97	3 - SUITABLE FOR PASSENGER CARS
5824120		5824 @ MP 3.64	2 - HIGH CLEARANCE VEHICLES
5824124		5824 @ MP 4.38	3 - SUITABLE FOR PASSENGER CARS
5826000	TIRE CR.	5821 @ MP 18.02	2 - HIGH CLEARANCE VEHICLES
5826000	TIRE CR.	5821 @ MP 18.02	3 - SUITABLE FOR PASSENGER CARS
5828000	BUCKHEAD	5821 @ MP 20.83	2 - HIGH CLEARANCE VEHICLES
5833000	GOODMAN CR.	HWY 58	2 - HIGH CLEARANCE VEHICLES
5833000	GOODMAN CR.	HWY 58	3 - SUITABLE FOR PASSENGER CARS
5833500		5833 @ MP 2.61	2 - HIGH CLEARANCE VEHICLES
5833509		5833 @ MP 4.80	3 - SUITABLE FOR PASSENGER CARS
5833509		5833 @ MP 4.80	4 - MODERATE DEGREE OF USER COMFORT
5833514		5833 @ MP 6.23	2 - HIGH CLEARANCE VEHICLES
5835000	CRALE CR.	HWY 58	2 - HIGH CLEARANCE VEHICLES
5840000	PATTERSON MTN.	HWY 58	4 - MODERATE DEGREE OF USER COMFORT
5840531		5840 @ MP 0.55	2 - HIGH CLEARANCE VEHICLES
5840535		5840-531 @ MP 2.03	2 - HIGH CLEARANCE VEHICLES
5840550		5840 @ MP 5.04	3 - SUITABLE FOR PASSENGER CARS
5847000	SHADY DELL	HWY 58	3 - SUITABLE FOR PASSENGER CARS
5847216		5847 @ MP 5.87	2 - HIGH CLEARANCE VEHICLES
5847530	SHADY DELL C.G.	5847 @ MP 0.01	4 - MODERATE DEGREE OF USER COMFORT
5847549		5847 @ MP 4.47	3 - SUITABLE FOR PASSENGER CARS
5847551		5847-549 @ MP 3.16	2 - HIGH CLEARANCE VEHICLES
5847555		5847 @ MP 7.95	2 - HIGH CLEARANCE VEHICLES
5850000	HIGH DIVIDE	HWY 58	2 - HIGH CLEARANCE VEHICLES
5850000	HIGH DIVIDE	HWY 58	3 - SUITABLE FOR PASSENGER CARS
5850000	HIGH DIVIDE	HWY 58	5 - HIGH DEGREE OF USER COMFORT
5850012		RD 5850	2 - HIGH CLEARANCE VEHICLES
5851000		RD 5850	2 - HIGH CLEARANCE VEHICLES
5852000		GRAY CREEK BRIDGE	3 - SUITABLE FOR PASSENGER CARS
5871000		58	3 - SUITABLE FOR PASSENGER CARS
5875000		58	3 - SUITABLE FOR PASSENGER CARS
5875565		RD 5875	2 - HIGH CLEARANCE VEHICLES
5876000		5875	2 - HIGH CLEARANCE VEHICLES
5877000		58	2 - HIGH CLEARANCE VEHICLES
5883000	EAGLE CREEK ROAD	5800	2 - HIGH CLEARANCE VEHICLES

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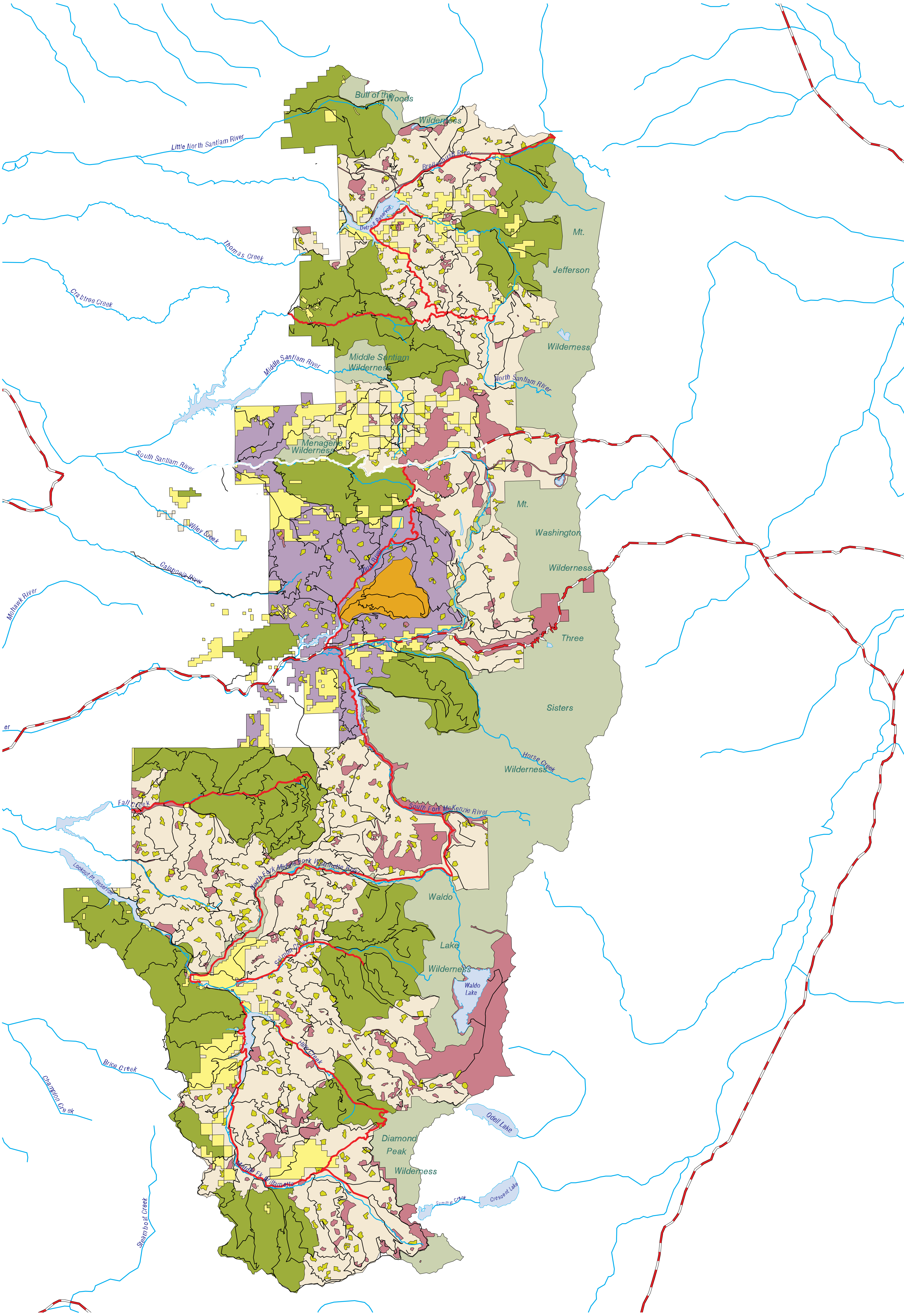
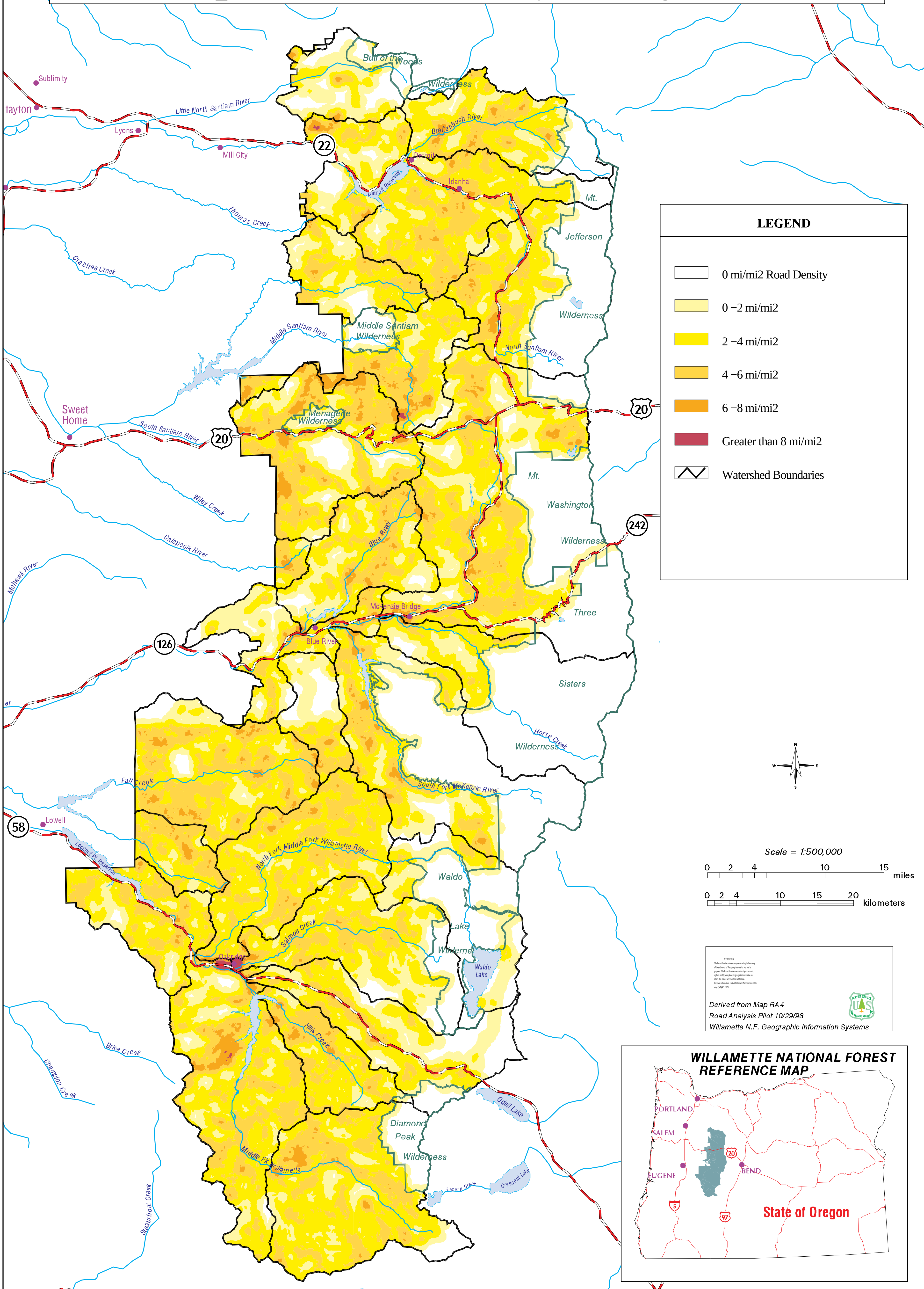
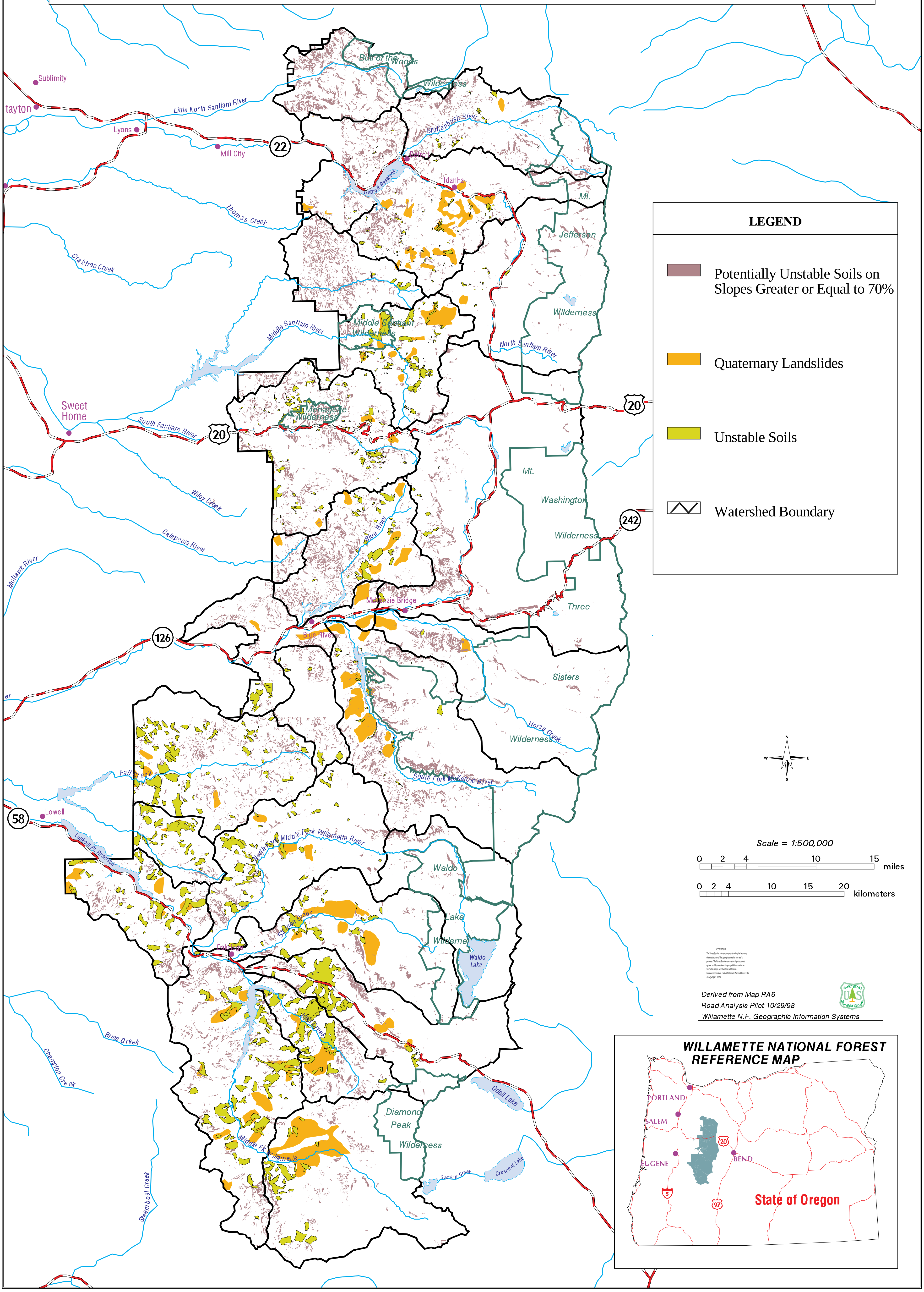
5883000	EAGLE CREEK ROAD	5800	3 - SUITABLE FOR PASSENGER CARS
5883379		5883	2 - HIGH CLEARANCE VEHICLES
5883381		5883	2 - HIGH CLEARANCE VEHICLES
5884000	BEAMER RANCH ROAD	5800	3 - SUITABLE FOR PASSENGER CARS
5884408		5884408	2 - HIGH CLEARANCE VEHICLES
5884409		5884	2 - HIGH CLEARANCE VEHICLES
5893000		5800	2 - HIGH CLEARANCE VEHICLES
5893010	SALT CREEK FALLS	5893	4 - MODERATE DEGREE OF USER COMFORT
5893062		5893	2 - HIGH CLEARANCE VEHICLES
5893420		5893062	2 - HIGH CLEARANCE VEHICLES
5894000	FUJI CREEK ROAD	5800	3 - SUITABLE FOR PASSENGER CARS
5896000	SHADOW BAY ACCESS	5897	5 - HIGH DEGREE OF USER COMFORT
5896504		5896	2 - HIGH CLEARANCE VEHICLES
5896545	SHADOW BAY CG	5896	5 - HIGH DEGREE OF USER COMFORT
5897000	WALDO ROAD	5800	2 - HIGH CLEARANCE VEHICLES
5897000	WALDO ROAD	5800	5 - HIGH DEGREE OF USER COMFORT
5898000	ISLET CG ROAD	5897	5 - HIGH DEGREE OF USER COMFORT
5898511		5898	2 - HIGH CLEARANCE VEHICLES
5898514		5898515	2 - HIGH CLEARANCE VEHICLES
5898515	N WALDO ACCESS	5898	5 - HIGH DEGREE OF USER COMFORT
5898516	N WALDO CG	5898515	4 - MODERATE DEGREE OF USER COMFORT
5898519	ISLET CG LOOP	5898	3 - SUITABLE FOR PASSENGER CARS
5899000	PENGRA PASS	5800	3 - SUITABLE FOR PASSENGER CARS


Bull of the Woods
Wilderness
Little North Santiam River
Breitenbush River
Detroit Reservoir
Mt.
Jefferson
Wilderness
Thomas Creek
Crabtree Creek
Middle Santiam River
Middle Santiam
Wilderness
North Santiam River
Menagerie
Wilderness
South Santiam River
Mt.
Washington
Wilderness
Wiley Creek
Calapooia River
Mohawk River
Three
Sisters
Wilderness
Horse Creek
Fall Creek
South Fork McKenzie River
Lookout Pt. Reservoir
Waldo
Lake
Wilderness
Waldo
Lake
Salmon Creek
Brice Creek
Champion Creek
Odell Lake
Diamond
Peak
Wilderness
Middle Fk. Willamette
Summit Creek
Crescent Lake
Steamboat Creek

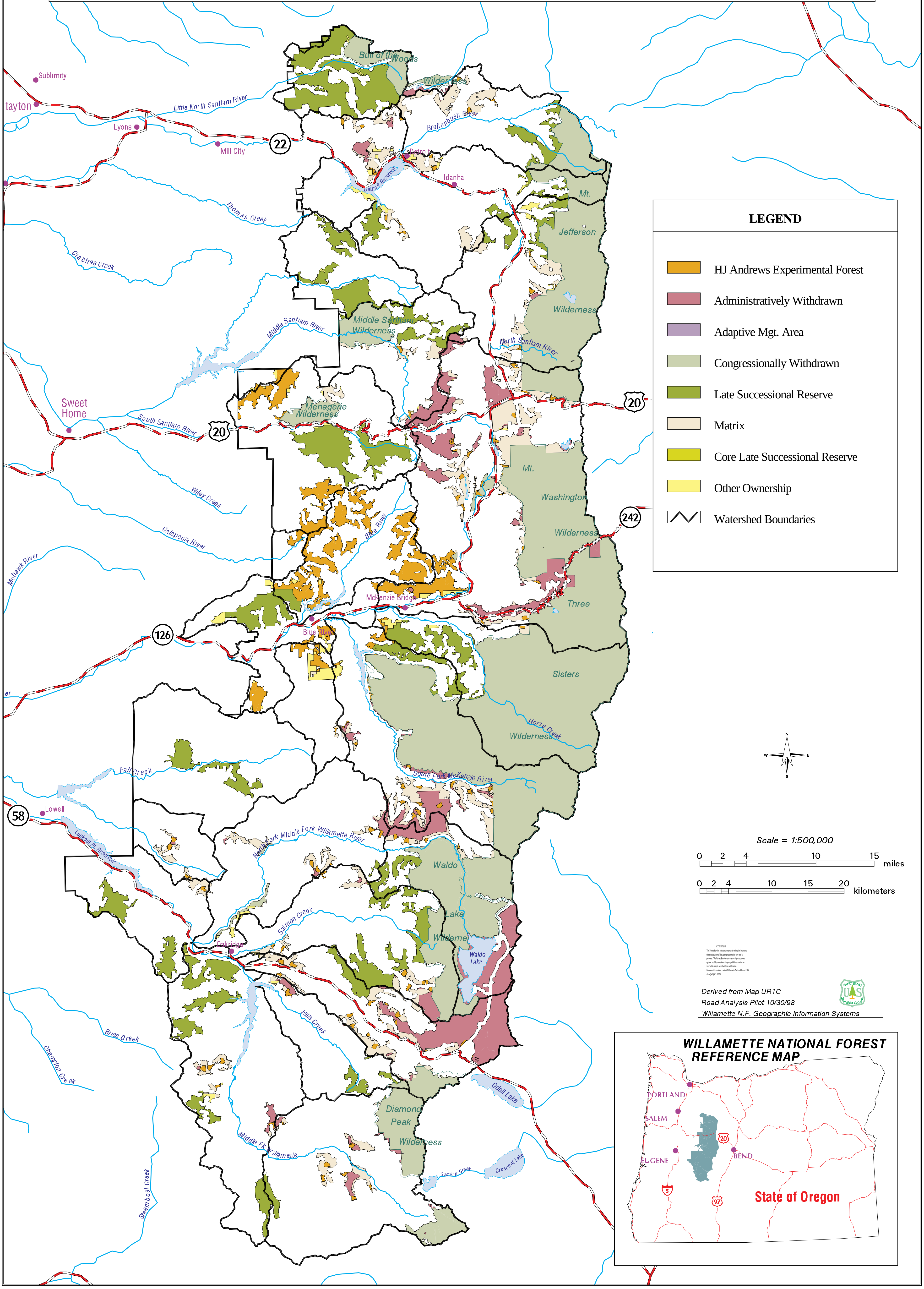
Map 2: Road Density Categories



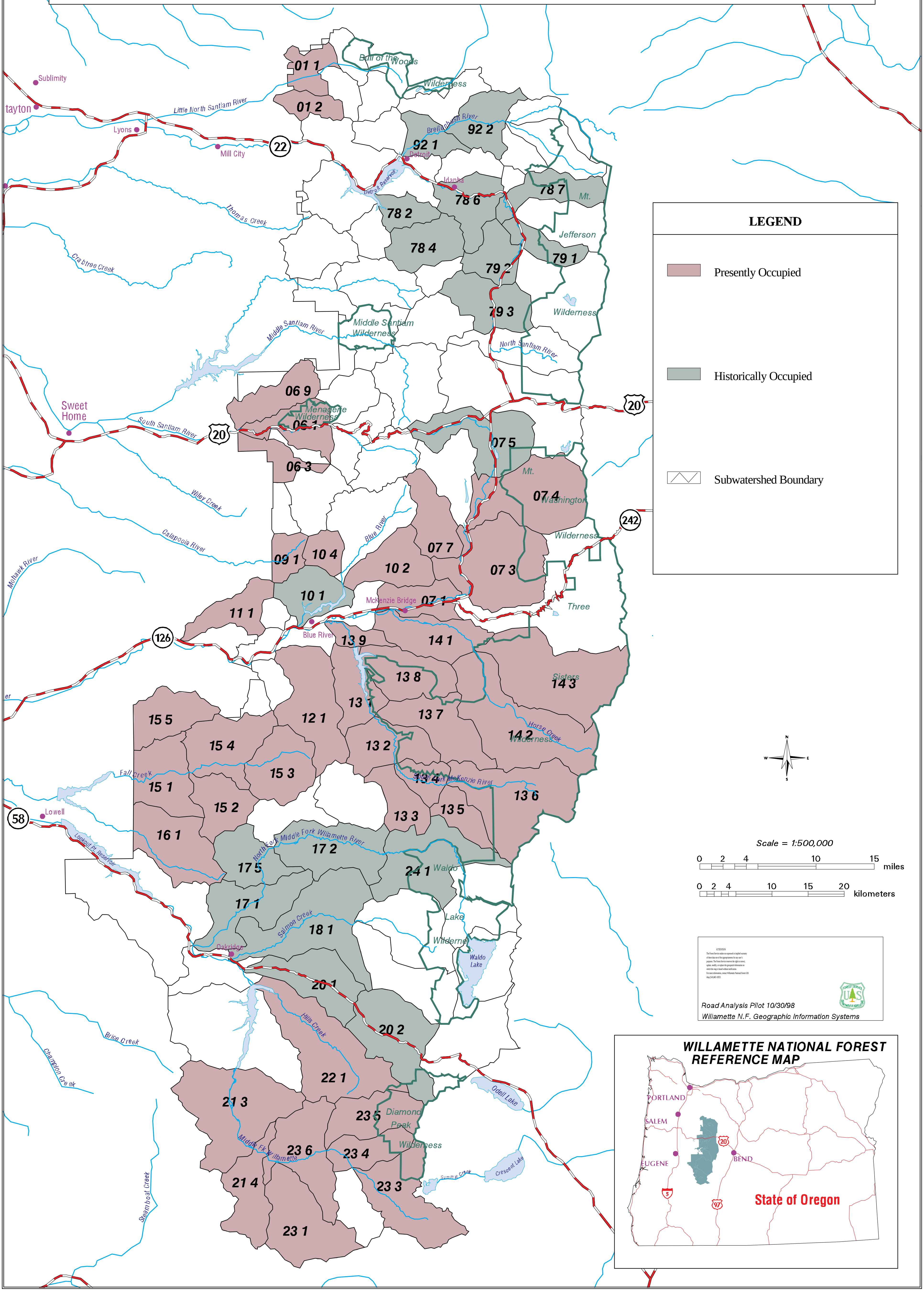
Map 3: Unstable Soils and Quaternary Landslides



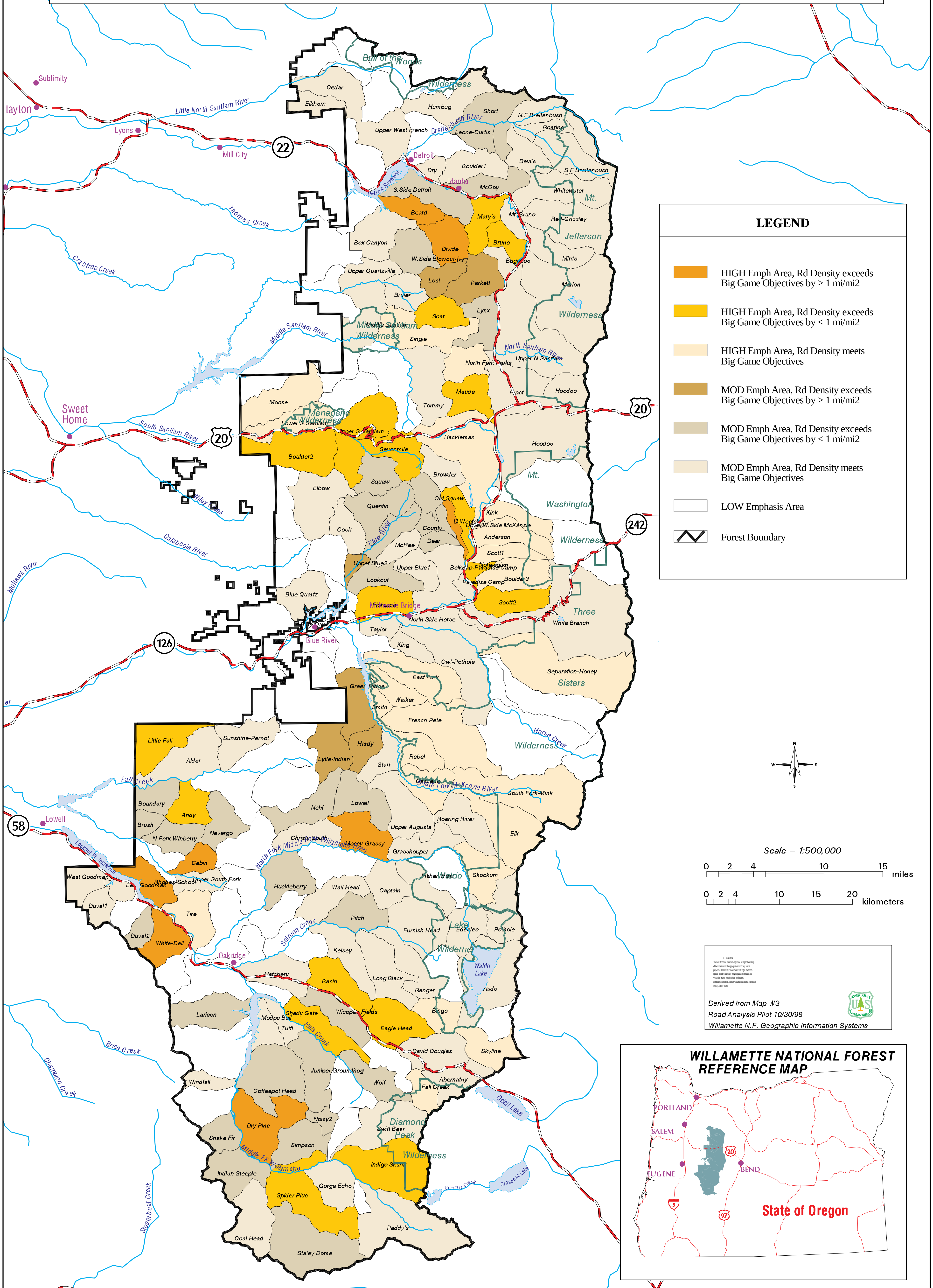
Map 4: Unroaded Areas Over 1,000 Acres in Size



Map 5: Threatened, Endangered and Sensitive Fish Status



Map 6: Road Densities in Big Game Emphasis Areas



Map 7: Subwatersheds with Multiple Resource Concerns