3.02. Watershed Resources: Geology, Soil, Hydrology

Introduction

This section discusses the physical aspects of watershed resources: geology, soil, and hydrology. The biological and botanical aspects of watershed resources are discussed in Section 3.03 (Terrestrial and Aquatic Species) and 3.06 (Plant Communities). Several attributes of watershed resources can be impacted by management activities: soil hydrologic function and erosion rates and the amount and rate of sedimentation, stream flow (quantity, timing, and quality), and flooding; (Kattelmann and Dozier 1991). However, the relative importance of the alterations and the ability of natural and human communities to adapt to or recover from alterations in hydrologic processes in the Sierra Nevada are highly dependent upon the degree, extent, and location of change and the sensitivity of the watershed.

Forest management activities, including development of geologic resources, can result in ecosystem damage when the activity's location, construction, or implementation is not based on an understanding of geologic conditions and geomorphic processes. The protection of soil and water quantity and quality are important parts of the mission of the Forest Service (Forest Service Strategic Plan for 2007 to 2012, July 2007). Management activities on National Forest System lands must be planned and implemented to protect the health of forest soils and watersheds, including the productivity and hydrologic functions of soils and the volume, timing, and quality of streamflow. The use of roads, trails, and "Open Areas" on National Forests for the operation of motor vehicles has the potential to affect these hydrologic functions through the compaction of soils; interception of runoff; and detachment, transport, and deposition of sediment (e.g., Foltz, 2006). Management decisions to prohibit cross country travel, add new motorized trails to the National Forest Transportation System (NFTS), establish "Open Areas, and/or make changes to the existing vehicle class and season of use on the National Forest Transportation System (NFTS) must consider effects on soil and watershed functions. Information in this analysis has been summarized at a variety of scales, including: forest level, river basin, the Hydrologic Unit Code 6 (HUC6) scale (watershed approximately 10,000 to 40,000 acres in size), the Hydrologic Unit Code 7 (HUC 7) scale (watersheds approximately 2,500 to 10,000 acres in size), and site specifically by individual route. The HUC7 watershed is the scale usually used for cumulative watershed effects for projects on the Tahoe National Forest (TNF).

Land Ownership Patterns

Land ownership patterns can influence watershed effects analysis. Some HUC7 watersheds within the boundaries of the TNF are managed primarily by the Forest Service, some are mixed National Forest System lands and private ownership, and others are primarily under private ownership. It is difficult to show the direct and indirect effects of this proposal in watersheds with a high percentage of private ownership. For example, the Donner Lake HUC7 watershed is 74 percent privately owned. There are 369 native surface, motorized stream crossings in this watershed. Of these 369 crossings, only 36 are under Forest Service jurisdiction. Given that the Forest Service only owns ten percent of the crossings, any changes in this watershed associated with proposals in this document would be masked by the impacts

associated with those on private land. However, this document analyzes the cumulative effects of activities on all lands regardless of ownership.

Most National Forest System (NFS) lands have roads and motorized trails that are not under Forest Service control (federal, state and county routes). For example, Figure 3.02-1 shows road and trail density by HUC7 watershed for the No Action Alternative and two of the action alternatives. In each alternative the first set of bars is total motorized road and trail density all ownerships and the second set is National Forest Transportation System (NFTS) motorized road and trail density. In every case the percent of HUC7 watersheds with road and trail density less than 2.5 miles per square mile is highest when looking only at NFTS motorized road and trail density. NFTS motorized road and trail density in excess of 5.5 miles per square mile occurs only in Alternative 1. All action alternatives would decrease the density of motorized roads and trails on NFS lands below 5.5 miles per square mile at the HUC7 watershed scale.

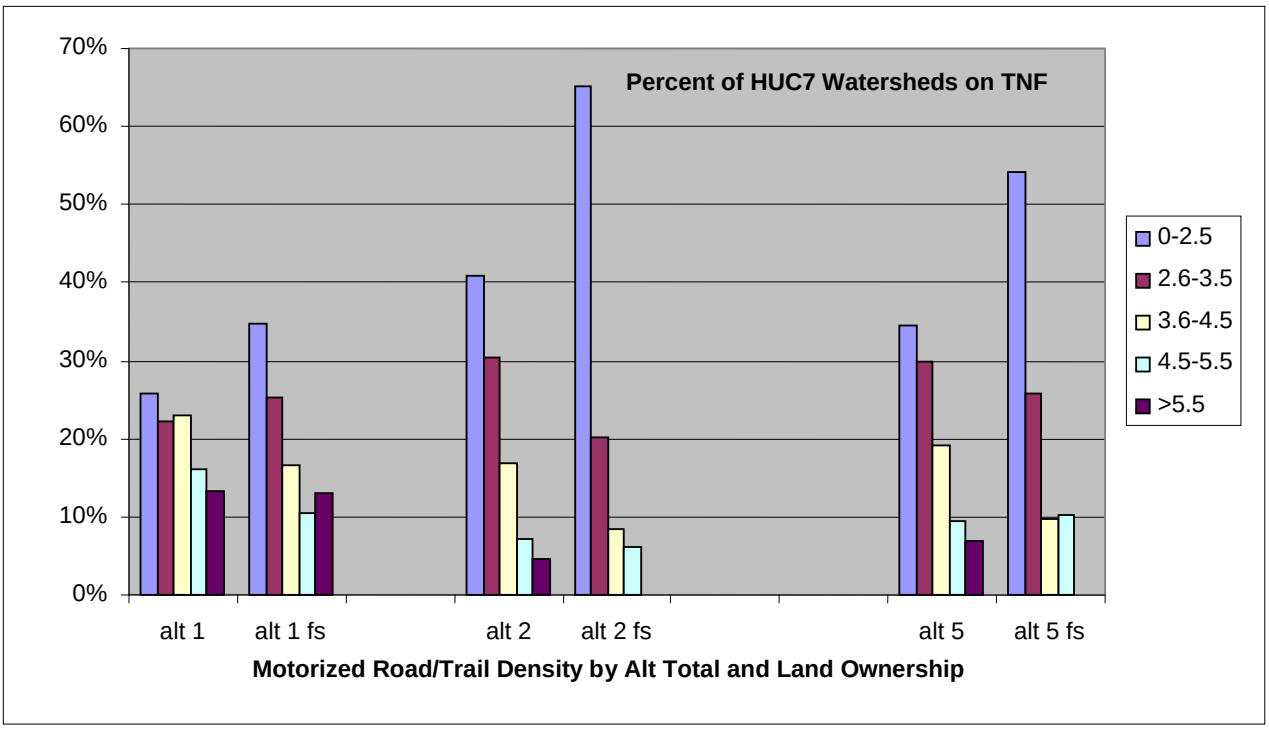

Figure 3.02-1. Total Route Density and Forest Service Route Density for Alternatives 1, 2 and 5

Geology

Introduction: Geological resources affect all aspects of National Forest System lands. Geological resources include cave resources, paleontological resources, geological special interest areas, and ground water resources. Geological hazards can impact public safety on NFS lands. Hazards can include mine shafts, rock falls, debris flows, slope stability issues, caves and public health concerns. Geology determines watershed morphology, soils types, and other essential ecosystem functions. Ground water is a valuable resource that may be affected by this project. Mining related hazards are a concern for public

safety as the National Forests could have potentially dangerous abandoned mine shafts and hazardous products in the areas of the proposed action.

Regulatory Framework

Regulatory Direction relevant to the proposed action as it affects geologic resources includes:

FSM-2880.11 - Statutory Authority

- **Organic Administrative Act of June 4, 1897, as Amended (30 Stat. 34, as Supplemented and Amended; 16 U.S.C. 473-478, 482-482(a), 551. (FSM 2501.1.)** This act authorizes the Secretary of Agriculture to issue rules and regulations for the occupancy and use of the National Forests. This is the basic authority for issuing special use permits for the collection of vertebrate paleontological resources for scientific and educational purposes on National Forest System lands.
- **Preservation of American Antiquities Act of June 8, 1906 (34 Stat. 225; 16 U.S.C. 431 et seq.). (FSM 2361.01.)** This act authorizes permits for archeological and paleontological exploration involving excavation, removal, and storage of objects of antiquity or permits necessary for investigative work requiring site disturbance or sampling which results in the collection of such objects.
- **Federal Aid Highway Act (72 Stat. 913; 23 U.S.C. 305)**. This section of the United States Code allows federal funding for mitigation of archeological and paleontological resources recovered pursuant to Federal aid highway projects.
- **Multiple Use - Sustained Yield Act of June 12, 1960 (MUSY) (74 Stat. 215; 16 U.S.C. 528-531). (FSM 2501.1.)** This act requires due consideration for the relative values of all resources and implies that the administration of nonrenewable resources must be considered.
- **Watershed Protection and Flood Prevention Act of August 4, 1954, as Amended (68 Stat. 666; 16 U.S.C. 1001). (FSM 2501.1.)** This act authorizes the Secretary of Agriculture to share costs with other agencies in recreational development, ground-water recharge, and water-quality management, as well as the conservation and proper use of land.
- **Federal Water Pollution Control Act of July 9, 1956, as Amended (33 U.S.C. 1151) (FSM 2501.1); Federal Water Pollution Control Act Amendments of 1972 (86 Stat. 816) (FSM 2501.1), and Clean Water Act of 1977 (91 Stat. 1566; 33 U.S.C. 1251). (FSM 2501.1, 7440.1.)** These acts are intended to enhance the quality and value of the water resource and to establish a national policy for the prevention, control, and abatement of water pollution. Ground water information, including that concerning recharge and discharge areas, and information on geologic conditions that affect ground water quality are needed to carry out purposes of these acts.
- **Wilderness Act of September 3, 1964 (78 Stat. 890; 16 U.S.C. 1131-1136). (FSM 2501.1.)** This act describes a wilderness as an area which may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value. These geological features are generally identified for wilderness classification purposes.

- **National Forest Roads and Trails Systems Act of October 13, 1964 (78 Stat. 1089; 16 U.S.C. 532-538). (FSM 7701.1.)** This act provides for the construction and maintenance of an adequate system of roads and trails to meet the demands for timber, recreation, and other uses. It further provides that protection, development, and management of lands will be under the principles of multiple use and sustained yield of product and services (16 U.S.C. 532). Geologic conditions influence the final selection of route locations.
- **Wild and Scenic Rivers Act of October 2, 1968 (82 Stat. 906 as Amended; 16 U.S.C. 1271-1287)**. This act states that it is the policy of the United States that certain selected rivers of the Nation which, with their immediate environments, possess outstanding scenic, recreation, geologic, fish and wildlife, cultural, or other similar values shall be preserved in free-flowing condition.
- **National Environmental Policy Act of January 1, 1970 (NEPA) (83 Stat. 852 as Amended; 42 U.S.C. 4321, 4331-4335, 4341-4347). (FSM 1950.2.)** This act directs all agencies of the Federal Government to utilize a systematic interdisciplinary approach which will ensure the integrated use of the natural and social sciences in planning and in decision making which may have an impact on man's environment. Geology is one of the applicable sciences.
- **Mining and Minerals Policy Act of December 31, 1970 (84 Stat. 1876; 30 U.S.C. 21a)**. This act provides for the study and development of methods for the disposal, control, and reclamation of mineral waste products and the reclamation of mined lands. This requires an evaluation of geology as it relates to ground water protection and geologic stability.
- **Endangered Species Act of 1973 (ESA) (87 Stat. 884, as amended; 16 U.S.C. 1531-1536, 1538-1540)**. This act provides for the conservation of endangered and threatened species and their habitats.
- **Archeological and Historical Conservation Act of 1974 (AHCA) (88 Stat. 174; 16 U.S.C. 469). (FSM 2361.01.)** This act requires all Federal agencies to notify the Secretary of the Interior when a construction project threatens to irreparably harm or destroy significant scientific, prehistoric, historic, or archeological data. The paleontological resource may have significant scientific and historic value.
- **Disaster Relief Act of 1974 (88 Stat. 143; 42 U.S.C. 5121, 5132). Section 202(b) states that the President shall direct appropriate Federal agencies to ensure timely and effective disaster warnings for such hazards as earthquakes, volcanic eruptions, landslides, and mudslides.** The Federal Register, Vol. 42, No. 70 of April 12, 1977, "Warnings and Preparedness for Geologic Related Hazards," implies coordination with the U.S. Geological Survey in such warnings.
- **Forest and Rangeland Renewable Resources Planning Act of August 17, 1974 (RPA) (88 Stat. 476; 16 U.S.C. 1600-1614) as Amended by National Forest Management Act of October 22, 1976 (90 Stat. 2949; 16 U.S.C. 1609). (FSM 1920 and FSM 2550.)** This act requires consideration of the geologic environment through the identification of hazardous conditions and the prevention of irreversible damages. The Secretary of Agriculture is required, in the

development and maintenance of land management plans, to use a systematic interdisciplinary approach to achieve integrated consideration of physical, biological, economic, and other sciences.

- **Resource Conservation and Recovery Act of 1976 (RCRA) (90 Stat. 2795; 42 U.S.C. 6901) as Amended by 92 Stat. 3081**. This act, commonly referred to as the Solid Waste Disposal Act, requires protection of ground water quality and is integrated with the Safe Drinking Water Act of December 16, 1974, and Amendments of 1977 (42 U.S.C. 300(f)). (FSM 7420.1.)
- **Surface Mining Control and Reclamation Act of August 3, 1977 (SMCRA) (30 U.S.C. 1201, 1202, 1211, 1221-43, 1251-79, 1281, 1291, 1309, 1311-16, 1321-28).** This act enables agencies to take action to prevent water pollution from current mining activities, and also promote reclamation of mined areas left without adequate reclamation prior to this act.
- **Archaeological Resource Protection Act (ARPA) October 31, 1979 (93 Stat. 721; 16 U.S.C. 470 aa)**. This act protects archeological resources, and prohibits the removal, sale, receipt, and interstate transport of archeological resources obtained illegally from public lands. Archeological resources include paleontological resources in context with archeological resources. Also, this act authorizes the Secretary of Agriculture to issue permits for archeological research, investigations, studies, and excavations.
- **Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended (CERCLA) (94 Stat. 2767; 42 U.S.C. 9601, et seq)**. This act provides authority to the Environmental Protection Agency and to other federal agencies, including the United States Department of Agriculture, to respond to release of hazardous substances, pollutants, and constituents. It also provides for joint and several liability to potentially responsible parties (PRPs) for cleanup costs of existing water contamination. See also FSM 2160.
- **Federal Cave Resources Protection Act of 1988 (102 Stat. 4546; 16 U.S.C. 4301 et seq)**. This act provides that Federal lands be managed to protect and maintain, to the extent practical, significant caves.

FSM-2880.12 - Executive Orders

The following Executive Orders provide direction for geologic resources and services activities on National Forest System lands:

- **Executive Order 11593, Protection and Enhancement of Cultural Environment, May 13, 1971 (3 CFR 559, 1971-75 Compilation)**. This Executive Order directs agencies to preserve, restore, and maintain the historic and cultural environment of the Nation.
- **Executive Order 12113, Independent Water Project Review, January 5, 1979.** This Executive Order requires an independent water project review by the Water Resources Council on preauthorization reports and preconstruction plans for Federal and federally assisted water and related land resource plans. The technical review will evaluate each plan for compliance with the Council's principles and standards, agency procedures, other Federal laws, and goals for public involvement.

Affected Environment: Geology

Physiography, Relief and Drainage

The Tahoe National Forest (TNF) is located in the central Sierra Nevada. It is roughly divided into three physiographic areas by a glacially sculpted crest zone that trends north-south. The western third of the survey area is dominated by deeply incised canyons separated by long, narrow, gently sloping ridges. The eastern third is characterized by low foothills and broad valleys.

The ascent from the Central Valley through the western third of the Forest toward the crest is gentle; with the average slope through a west-to-east transect about 3 to 5 percent. The underlying rock formations generally trend northwest by southeast. Drainages are generally toward the southwest, with main stream channels cut through and across geologic formations. The headwaters of major drainages start in the glaciated crest zone, and descend through gently sloping volcanic and granitic bedrock to deeply entrenched V-shaped canyons along the western edge of the area, where metamorphic rocks are exposed. Typically, the land surfaces of the folded and faulted metamorphic rocks are steep and angular, the land surfaces of granitic rocks rounded, smooth, and often have a basin-like appearance, and the land surfaces of volcanic rocks are flat and relatively smooth, reflecting their origin.

The primary potential impacts to geologic resources resulting from the Travel Management Project are associated with cave management, geological special interest areas, paleontological resources, ground water management, and areas with a risk of mass movement (primarily debris slides).

Cave Resources, Geologic Special Interest Areas, and Paleontological Resources

The term “cave” means any naturally occurring void, cavity, recess, or system of interconnected passages which occurs beneath the surface of the earth or within a cliff or ledge (including any cave resource therein, but not including any vug, mine, tunnel, aqueduct, or other manmade excavation) and which is large enough to permit an individual to enter, whether or not the entrance is naturally formed or manmade. Such term shall include any natural pit, sinkhole, or other feature which is an extension of the entrance. There are two known caves on the TNF.

There are two Geologic Special Interest Areas on the TNF: Devil’s Postpile Geologic Area (69 acres, postpile geologic feature) and Glacier Meadow Geologic Area (84 acres, glacial geologic features).

There are six known Paleontological sites currently identified on the TNF. These sites are listed below in Table 3.02-1.

Table 3.02-1. Paleontological sites currently identified on the Tahoe National Forest

Site	Description	Potential Impacts
1	Fossilized mastodon remains	One unauthorized route
2	Petrified Wood	One existing NFTS road
3	Petrified Wood	One existing NFTS Motorized Trail
4	Petrified Wood	One unauthorized route
5	Paleo Botanical Fossils	One unauthorized route and one existing NFTS road
6	Paleo Botanical Fossils	One unauthorized route

Groundwater Resources

Groundwater is water located beneath the ground surface in soil pore spaces and in the fractures of rock formations. Groundwater is recharged from, and eventually flows to, the surface naturally. Discharge of groundwater often occurs at springs and seeps and can form wetlands. Roads and motorized trails near springs and seeps can intercept flow and channel water movement and/or can pollute groundwater resources. There are three unauthorized routes and three closed NFTS routes that have the potential to impact groundwater resources. These are shown below in Table 3.02-2.

Table 3.02-2. Ground Water Resources Potentially Impacted By Unauthorized or Closed NFTS Routes

Route ID	Ground Water Resource
ARM-13	Spring
H45-2	Spring
SV-005	Seep
TKN-J5	Seep/Spring
YRS-066	Spring
YRS-SF4	Seep/Spring

Debris Slides

Road and motorized trail networks in mountainous forest landscapes have the potential to increase the susceptibility to shallow landsliding by altering subsurface flow paths. The most common type of landslide feature found on the TNF is debris slides. Debris slides are a type of soil movement that usually occurs on steep slopes with shallow soils over bedrock. Roads and motorized trails that cross debris slides can increase debris slide activity, increasing sediment delivery to channels. The risk of debris slides is covered in the erosion model presented in the Soils Section.

Abandoned Mine Lands

Some abandoned mine land (AML) sites can be a concern for public safety (e.g., mine shafts, hazardous substances, etc). There are 74 AML sites currently identified on the TNF that are within 100 feet of roads or motorized trails. Thirty-eight sites are along existing National Forest Transportation System (NFTS) roads or NFTS motorized trails. The other 36 of these AML sites are along unauthorized or closed NFTS routes.

Environmental Consequences: Geology

Cave Resources, Geologic Special Interest Areas, and Paleontological Resources

Neither of the two known caves on the TNF is within ¼ mile of a road or motorized trail and therefore would not be affected by any of the alternatives.

No changes in management of the Geologic Special Interest Areas (GSIA) would occur under implementation of any of the alternatives. Motorized vehicle use within these GSIAs is either excluded or discouraged. Therefore, native geologic features within these GSIAs would not be impacted by motorized

vehicle activity. There are no environmental consequences associated with GSIAs in any of the alternatives.

Paleontological resources on the TNF include plant and animal fossils and petrified wood. There are six known Paleontological sites currently identified on the TNF. All six of the sites could be impacted by motorized use in Alternative 1 (no action). All of the action alternatives reduce the number of sites potentially impacted by motorized use. The number of sites potentially impacted by motorized use in each alternative is shown in Table 3.02-3.

Table 3.02-3. Paleontological resources on the TNF potentially impacted by motorized vehicles by alternative

Site	Description	Potential Impacts	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
1	Fossilized mastodon remains	Motorized trail added to NFTS	X				X		
2	Petrified Wood	One existing NFTS road	X	X	X	X	X	X	X
3	Petrified Wood	One existing NFTS Motorized Trail	X	X	X	X	X	X	X
4	Petrified Wood	Motorized trail added to NFTS	X	X			X	X	X
5	Paleo Botanical Fossils	Motorized trail added to NFTS One existing NFTS road	X	X	X	X	X	X	X
6	Paleo Botanical Fossils	One motorized trail un-authorized for motorized use	X						
		Total Number	**6**	**4**	**3**	**3**	**5**	**4**	**4**

Groundwater Resources

The potential effects of routes on aquatic species are covered in Section 3.03 (Terrestrial and Aquatic Species). The potential effects of groundwater on erosion rates are covered in the Soil Resource section and in the Appendix A (Site Specific Road, Trail and Open Area Information). Given the scale of this project, there would be little measurable effect of this project to water quality of groundwater resources. All additions to the NFTS which could impact groundwater resources have mitigation measures specified in Appendix A to reduce or eliminate any potential adverse effects. These mitigation measures for ground water resources are summarized by alternative in Table 3.02-4.

Table 3.02-4. Mitigation measures to protect groundwater resources by alternative

Route ID	Ground Water Resource	Mitigation Measure Required	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
ARM-13	Spring	None, no impact to spring							
H45-2	Spring	Place barriers					X		
SV-005	Seep	None, no impact to seep							
TKN-J5	Seep/Spring	Redirect water flow		X			X	X	X
YRS-066	Spring	Install drainage structures		X			X	X	
YRS-SF4	Seep/Spring	Install waterbars to control road drainage					X	X	
		Total Number of Mitigations	**0**	**2**	**0**	**0**	**4**	**3**	**1**

Abandoned Mine Lands (AML)

To assess the potential health and safety risks from abandoned mine lands effects, the alternatives are compared by the number of known, mapped AML sites within 100 feet of roads and motorized trails. There are currently 74 AML sites within 100 feet of existing NFTS and unauthorized motorized routes. Those alternatives with the greatest number of AML sites within 100 feet of roads and motorized trails are expected to have the highest risk to public safety. There is no way of knowing how many people using the roads and motorized trails may be accessing the mine sites. Table 3.02-5 shows the number of AML sites which could have potential public safety concerns related to motorized public access. The No Action Alternative (Alternative 1) would have the highest risk to public safety. Alternative 3 would have the lowest risk to public safety because it does not add any unauthorized routes to the NFTS and it therefore has the lowest number of AML sites. All other action alternatives would add between two and four unauthorized routes to the NFTS near AML sites. Mitigation measures to assure public safety is included in Appendix A (Site Specific Road, Trail and Open Area Information) for these sites. Mitigation measures typically are to seal off any hazardous openings such as mine adits.

Table 3.02-5. Number of Abandoned Mine Land (AML) Sites within 100 Feet of NFTS Roads and Motorized Trails by Alternative

Alternative	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Number of AML Sites within 100 feet	74	42	38	40	42	41	41

Prohibition of Cross Country Travel: All of the action alternatives prohibit cross country travel. This prohibition would reduce the public risk caused by the presence of AML features across the forest. It would also prevent the proliferation of any new motorized trails unauthorized for motorized use which could increase the public safety risk. Prohibition of cross country travel would decrease the number AML sites within 100 feet of roads and motorized trails by 38 sites. The changes in the number of AML sites within 100 feet of roads and motorized trails resulting from the prohibition of cross country travel are displayed in Table 3.02-6.

Table 3.02-6. Changes in the number AML sites within 100 feet of motorized vehicle access due to the prohibition of cross country travel

Alternative	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Changes in number of AML Sites within 100 ft.	0	-36	-36	-36	-36	-36	-36

Additions to the National Forest Transportation System (NFTS): There are no additions to the NFTS under Alternative 1. Adding motorized trails to the NFTS within 100 feet of abandoned mine land (AML) sites would have minimal new effects to public safety. Appendix A (Site Specific Road, Trail and Open Area Information), has mitigations needed to add the routes to the NFTS with minimal impacts to user safety. The changes in AML sites within 100 feet resulting from the additions to the NFTS are displayed in Table 3.02-7.

Table 3.02-7. Changes in AML sites within 100 feet of roads and motorized trails due to additions to the NFTS

Alternative	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Number of AML Sites within 100’	0	+4	0	+2	+4	+3	+3

Establishing motorized “Open Areas”: There are no “Open Areas” being established within 100 feet of AML sites in any of the action alternatives.

Changes to NFTS: Changing the class of vehicle allowed to use a particular NFTS road or motorized trail or the season of use does not change the impacts to and from AML sites. There are no Maintenance Level 1 roads being reopened within 100 feet of AML sites in any of the action alternatives.

Cumulative Effects: All action alternatives would result in a decrease in public health and safety risks associated with motorized access to abandoned mine land sites. Alternative 3 would decrease the number of AML sites within 100 feet of roads and motorized trails by 36 sites. The rest of the action alternatives would decrease the number of AML sites adjacent to roads and motorized trails by 32 to 34 sites. The cumulative effects to public health and safety from AMLs are the same as displayed in Table 3.02-5.

Soil Resources

Introduction

The soil resource provides many essential functions for National Forest System (NFS) lands. It sustains plant growth that provides forages, fiber, wildlife habitat, and watershed protection. It absorbs precipitation, stores water for plant growth, and gradually releases surplus water which attenuates runoff rates. It sustains microorganisms which recycle nutrients for continued plant growth. The National Forest Management Act of 1976 and other acts recognized the fundamental need to protect, and where appropriate improve, the quality of soil. The proposed action could potentially impact soil productivity and its other ecosystem functions and is therefore addressed.

The primary concern or effect of this project on the soil resource is the potential for soil erosion and subsequent effects on soil productivity or the ability of the soil to produce vegetation. Secondary effects from erosion are a reduction in the soil hydrologic function (e.g., the loss of soil depth, infiltration capacity and permeability).

The erosion that may occur from the trail or road surface is a concern regarding loss or degradation of the facility, but not a particular concern for the soil resource, because the travel-way surface is a dedicated use and no longer dedicated to growing vegetation. The effects analysis for the soil resource will focus on the risk of soil erosion from trail/road runoff water to the soil adjacent to or down slope from the route. Erosion and sediment generated by the trail or road surface may be a concern to water quality if there is the potential for its delivery to a drainage feature. (Refer to the Hydrology section).

Analysis Framework: Statute, Regulation, Forest Plan, and Other Direction

Direction specifically relevant to the proposed action as it affects soil resource includes:

- **National Forest Management Act of 1976**. Renewable Resource Program. "(C) recognize the fundamental need to protect and where appropriate, improve the quality of soil, water, and air resources."
- **National Soil Management Handbook**. The Soil Management Handbook (USDA 1991) is a national soils handbook that defines soil productivity and components of soil productivity, establishes guidance for measuring soil productivity, and establishes thresholds to assist in forest planning.

  Management activities cause varying degrees of soil disturbances, which may or may not cause a significant change in productivity. Soil quality standards (threshold values where soil disturbances become detrimental, that is, result in significant change) are intended for areas where management prescriptions are being applied, such as timber harvest areas and range allotments. They are not intended to apply to administrative sites or other areas with dedicated uses.
- **Region 5 Soil Management Handbook Supplement**. The Forest Service Region 5 Soil Management Handbook Supplement establishes regional soil quality analysis standards (SQS, USDA 1995). The Region 5 soil quality analysis standards address three basic elements for the Soil Resource: 1) soil productivity (including soil loss, porosity; and organic matter), 2) soil hydrologic function, and 3) soil buffering capacity. The analysis standards apply only to those areas dedicated to growing vegetation. They are not applied to lands with other dedicated uses, such as developed campgrounds, administrative facilities or in this case, the actual land surface authorized for travel by the public using various kinds of vehicles, both licensed or non-licensed.
- **Regional Forester's Letter** (dated Feb 5, 2007). This letter provided clarification to Forest Supervisors on the appropriate use of the R5 Soil Management Handbook Supplement (R5 FSH Supplement 2509.18-95-1). It states in part:
  - Analysis or evaluation of soil condition is the intended use of the thresholds and indicators in R5 FSH 2509.18-95-1. They are not a set of mandatory standards or requirements. They should not be referred to as binding or mandatory requirements in NEPA documents. Standards and guidelines in Forest Land and Resource Management Plans provide the relevant substantive standard to comply with NFMA.
  - The thresholds and indicators represent desired conditions for the soil resource. Utilization of the thresholds and indicators provides a consistent method to analyze, describe, and report on soil condition throughout the Region.
- **Tahoe National Forest Land and Resources Management Plan** (LRMP) direction for soil and water resources includes the following:
  - Standards and Guidelines for Riparian Conservation Areas and Critical Aquatic Refuges (TNF LRMP as amended by the SNFPA ROD (2004), pp. 62 - 65). *Evaluate new proposed management activities within CARs and RCAs during environmental analysis to determine*

consistency with the riparian conservation objectives at the project level and the AMS goals for the landscape. Ensure that appropriate mitigation measures are enacted to (1) minimize the risk of activity-related sediment entering aquatic systems and (2) minimize impacts to habitat for aquatic- or riparian-dependent plant and animal species.

- Consistent with the first standard and guideline above, a Riparian Conservation Objective (RCO) analysis has been completed for this project. (Refer to Appendix I "Riparian Conservation Objectives.") Appendix I describes how the project is consistent with the RCOs and the applicable standards and guidelines (listed above).
- Water Quality Protection (TNF LRMP, pg. V-35). *Use Best Management Practices (BMPs) to meet water quality objectives and maintain and improve the quality of surface water on the Forest.*
- Best Management Practices (BMPs) are implemented as mitigation measures specified in Appendix A (Site Specific Road, Trail and Open Area Information) for any motorized trail to be added to the National Forest Transportation System or any lands to be established as "Open Areas." These mitigation measures would meet water quality objectives and maintain and improve the quality of surface water on the Forest.
- Soil Restoration (TNF LRMP, pg. V-35). *During project planning, identify areas of soil damage and abandoned roads in need of rehabilitation. Include these areas in project plans for restoration and improvement.*
- Areas of soil damage and abandoned roads in need of rehabilitation were identified in association with this project and documented in the project record. Project plans for restoration and improvement would be implemented through separate NEPA decisions as funding permits.
- Unstable Areas (TNF LRMP, pg. V-38). *Allow no land-disturbing activities on land classed as extremely unstable, unless a geotechnical investigation determines certain activities are appropriate.*
- Any motorized trail additions to the NFTS on extremely unstable lands requiring geotechnical investigation were excluded from consideration in all alternatives.

Effects Analysis Methodology

This is a site specific project, for which there is two levels of analysis. First, there is site-specific analysis of the individual routes proposed for addition to the NFTS. This detailed analysis is by route and is included in Appendix A (and the project record).

Second, there is the analysis of each alternative as a whole, which is informed by the site-specific route analysis noted above and other information. The discussion of the direct, indirect, and cumulative effects of each alternative is in a summary form. For ease of documentation and understanding, the effects of the alternatives are described separately for five discreet actions and then combined to provide the total direct and indirect effects of each alternative (see below). The combination of these discreet actions is then added to the past, present, and reasonably foreseeable actions in the cumulative effects analysis. The five discreet actions common to all action alternatives are: (1) Prohibition of cross country motor vehicle

travel; (2) Additions to the NFTS; (3) Establishment of motorized "Open Areas"; (4) Changes to the existing NFTS (which includes: change in class of vehicles resulting from approval of mixed use, change in class of vehicle resulting from changes in maintenance levels, change in season of use, and reopening Maintenance Level 1 roads to motorized use); and (5) Amendments to the Forest Plan. This discussion is the focus of this Effects Analysis Methodology section.

The Effects Analysis Methodology section describes the methodology used for the effects analysis in Chapter 3, not the site-specific analysis of each route. It addresses impacts relevant to the soil resource, soil resource-specific assumptions, soil resource indicators to be measured, including justification as to why they were chosen, sources of information used to support the analysis, timeframes (short term and long term), and spatial boundary of the effects analysis.

The Effects Analysis Methodology focuses on the assumptions, methodology, and indicators for addressing the direct and indirect effects of each of the five actions and the cumulative effects of implementing the alternative as a whole. The conclusions of the analysis in the Environmental Consequences section present the direct and indirect effects of implementing the alternative as a whole addressing the effects of each of the five proposed actions. Then, the cumulative effects of implementing each alternative (the direct and indirect effects of this action in combination with the effects of past, present, and reasonably foreseeable future actions) are displayed.

Assumptions specific to the soil resources analysis

- Authorized travel routes are a dedicated use of the soil resource and are not a concern for productivity because the soil is no longer dedicated to growing vegetation. The soil dedicated to growing vegetation, which may be affected by runoff water drainage from authorized routes is the principle concern addressed here.
- Continued unauthorized cross country travel by motor vehicles will cause adverse effects to soil productivity from destruction of vegetative cover, soil compaction due to motorized use, alteration of drainage patterns, and increases in erosion risk to soil productivity.
- Erosion risk is influenced by soil type (inherent soil erosivity), topography, precipitation (amount and type), presence of geo-debris slide features, and the type, amount, and season of use which can cause rutting and a subsequent loss of water control.
- Erosion from motor vehicle use of native-surface routes is increased or often caused by wet season use and/or higher levels of traffic and is reduced by maintenance of road drainage features (waterbars, ditches). The erosion is caused by concentrated road water runoff.
- The unauthorized routes receive no maintenance and the lack of erosion and water control poses a high risk of impact to soil resources.
- User-created motorized trails were not constructed to NFTS standards. These trails are not maintained and are assumed to be higher risk routes in terms of erosion and water quality risks.
- This analysis assumes that around 75 percent of the hydrologic footprint of the unauthorized or closed NFTS routes closed to cross country travel would recover vegetative soil cover and have a

reduced risk of erosion within 20 to 30 years. These assumptions are based on the personal observations and experiences of the watershed and vegetation management staff on the TNF.

- The spatial boundary for the effects analysis is the forest boundary. Within the forest boundary, erosion potential has been analyzed at multiple scales.

Data Sources

- Route-specific data collected in the field using the established protocol: OHV green-yellow-red inventories which are documented in Appendix A (Site Specific Road, Trail and Open Area Information).
- GIS analyses of erosion risk, route miles, etc.
- Recent Tahoe National Forest project NEPA documents.
- Air and ground photos, personal knowledge, and anecdotal information documenting the time required for passive restoration of routes closed to motor vehicle traffic (recovery time may vary based on precipitation, elevation, aspect, and other factors).

Soil Resources Indicators

- Acres open to cross country motor vehicle travel by soil erosion hazard rating.
- Miles of unauthorized routes open for motor vehicle travel by R-5 soil erosion hazard (R-5 EHR) rating.
- Miles of closed ML 1 roads receiving motorized use by R-5 EHR rating.
- Miles passively recovered due to vegetative recovery over long-term by soil erosion hazard rating
- Cumulative effects – loss of long-term soil productivity – Equivalent Roaded Areas from cumulative watershed effects analysis are used to track the transportation footprint and to assess the cumulative effects to long-term soil productivity. Cumulative effects on soil productivity include:
  - Cumulative effects from unauthorized use (No Action).
  - Cumulative effects in unauthorized areas that are expected to recover after a cross-country closure is implemented.
  - Cumulative effects in areas that are not expected to recover passively after a cross-country closure is implemented.
  - Cumulative effects from implementation of the particular travel system for each alternative.

Soil Resource Methodology by Action

1) Direct/indirect effects of the prohibition of cross country motor vehicle travel

Considerations: Cross country motor vehicle travel has led to the proliferation of compacted soils outside of the designated Tahoe NFTS. The major effects of cross country motor vehicle travel on soil resources include the loss of vegetative cover, increasing levels of soil compaction, soil displacement, surface soil loss, and loss of soil productivity. Prohibiting cross country motor vehicle travel would end motorized use on routes and areas beyond the authorized NFTS. In the short term, the unauthorized and

closed NFTS routes and areas disturbed by motor-vehicle use would not change much because removal of vegetation, compaction of soils, and alteration of drainage patterns require time to heal without active restoration. Passive vegetative recovery of most previously disturbed areas is estimated to take place over a 20 to 30 year period. It is also assumed that around 75 percent of the routes would recover and have a reduced risk of erosion within that 20 to 30 year period. These assumptions are based on the personal observations and experiences of the watershed staff of the TNF.

Cross country travel has resulted in approximately 869 miles of unauthorized routes and another 830 miles of closed NFTS routes that are still receiving some use on the TNF. As discussed below in the inventory results section, some routes are stable and others need maintenance/mitigation. Site specific erosion risks for these routes are displayed in Appendix A and Appendix L.

Short-term timeframe: 1 year.

Long-term timeframe: The period used for long-term effects analysis is 20 to 30 years. This is a reasonable timeframe to think about and predict the expected vegetative recovery (and reduction in erosion) for areas disturbed by unauthorized use.

Spatial boundary: Tahoe National Forest boundary.

Indicator(s): (1) Acres of prohibition of cross country travel by alternative; (2) Miles of unauthorized routes and R-5 EHR ratings on the TNF; (3) Miles of native surface roads and motorized trails open for motorized use in each of R-5 EHR ratings.

Methodology: GIS analyses of acres of FS lands open for cross country travel by alternative, miles of unauthorized routes, and R-5 EHR ratings.

Rationale: General guidelines in the National Soil Management Handbook and Region 5 Soil Management Handbook Supplement.

Direct Effects: Prohibiting cross country motor vehicle travel would end motorized traffic in areas beyond the NFTS. Generally for the existing unauthorized and closed NFTS routes and use areas, the direct effects to soil productivity have already occurred. The direct effects during construction of a NFTS facility or by unauthorized motor vehicle traffic were: loss of soil cover, physical displacement of soil; loss of soil depth; and loss in soil hydrologic function due to compaction.

Indirect Effects from unauthorized use: The indirect effects of the prohibition of cross county motorized vehicle travel would be gradual reductions in soil erosion and increases in soil productivity as recovery occurs and further disturbances decrease in the long-term. The net effect in the long-term would be vegetative recovery, a decrease in compaction and erosion, and a restoration of soil hydrologic function within unauthorized route treads. Recovery rates would be variable. Once closed to public use, the degree to which site productivity on unauthorized routes recover depends on current condition of the route, location on the landscape, location on the Forest and the effectiveness of enforcing the closure. Seldom used routes and some user created routes would likely recover within the cumulative effects analysis timeframe of 20 to 30 years. More long-standing routes or routes that experience moderate to high use would take longer to recover, with site productivity approaching natural range at the end of the cumulative effects analysis timeframe. Actively eroding routes would experience limited recovery (less erosion, higher productivity) in 20 to 30 years without active restoration.

2) Direct/indirect effects of additions to the NFTS

Considerations: The characteristics of roads and motorized trails are important in defining the affected environment for soil and for analyzing the effects of the proposed actions. Some roads and motorized trails are a lower risk to soil resources than others. Lower-risk roads and motorized trails tend to be more stable and generally have less concentration of water runoff and surface soil loss and a lower potential for soil erosion adjacent to the route and sediment production and transport. Native surface motorized roads and trails generally have a higher risk of concentrating road runoff and surface erosion and increased erosion adjacent to the route than surfaced routes and are considered higher risk routes.

The effects of adding routes to the NFTS are focuses on presently unauthorized routes that would be added to the system routes. This is a change from unauthorized and unmaintained to NFTS status which included maintaining routes for resource protection.

Short-term timeframe: 1 year.

Long-term timeframe: The period used for long-term effects analysis is 20 to 30 years. This is a reasonable timeframe to think about and predict the expected vegetative recovery (and reduction in erosion) for areas disturbed by unauthorized use. This is also the same recovery period used for the Cumulative Watershed Effects analysis in this document.

Spatial boundary: Forest boundary.

Indicator(s): (1) Miles of unauthorized routes added to the NFTS by R-5 EHR rating; (2) Miles of native surface, roads and motorized trails by R-5 EHR rating.

Methodology: (1) erosion potential for the soils on the TNF was modeled using GIS, R-5 EHR rating, and the Ecosystem Management Decision Support model and analyzed at a range of watershed scales; (2) GIS analysis of existing unauthorized routes and the R-5 EHR rating.

Rationale: Analysis guidelines in the National Soil Management Handbook and Region 5 Soil Management Handbook Supplement.

Direct Effects: Additions to the system would have minimal effects to soil resources, because these motorized trails are already part of the existing disturbance footprint and would be managed according to TNF trail and resource standards. Generally for the existing unauthorized and closed NFTS routes, the direct effects to soil productivity have already occurred. The direct effects were: loss of soil cover, physical displacement of soil during construction of a NFTS facility or caused by unauthorized motor vehicle traffic; loss of soil productivity from the displacement and loss of soil depth; and loss in soil hydrologic function due to increased compaction and loss of soil.

Indirect Effects: The indirect effects of adding the proposed routes to the NFTS would be similar to current effects. The primary difference would be that as designated trails these routes would be managed according to TNF trail and resource standards which would decrease any current negative effects caused by those routes.

3) Direct/Indirect effects of establishing motorized “Open Areas”

Considerations: The proposed establishment of “Open Areas” are in areas not dedicated to growing vegetation and have been used by motor vehicles for years. The soil quality standards of long-term soil

productivity do not apply to areas not dedicated to growing vegetation. The potential erosion effects of establishing "Open Areas" are covered in the Hydrology Section of this chapter. Proposed "Open Areas" will not be covered in the effects analysis for soils.

Rationale: Analysis guidelines in the National Soil Management Handbook and Region 5 Soil Management Handbook Supplement.

4) Direct/indirect effects of changes to the existing NFTS - this includes changing the vehicle class and/or season of use and reopening Maintenance Level 1 Roads

Considerations: Changing the class of vehicle allowed to use a particular NFTS road could change the impacts to soil and watershed resources due to the change in road surface. Therefore, these roads are considered to have an increased risk of erosion even though they already have "hardened" surfaces that lack vegetation. It is likely that direct impacts to soil and watershed resources occurred when the road was constructed and many of these routes are stable. Impacts may still be occurring if the road is collecting and concentrating overland flow of water and increasing erosion rates. These indirect and cumulative impacts would continue regardless of the type of vehicle using the route. When the maintenance level of a particular route changes (the maintenance level does not always change when class of vehicle changes), the risk of erosion can increase. However, all roads would be maintained to TNF standards for resource protection no matter what maintenance level.

Native surface roads and motorized trails are most susceptible to damage by motor vehicles when wet. The condition of native surface roads and motorized trailscan quickly decline during winter or wet weather use due to rutting. Wet season use of native surface roads and motorized trails often leaves ruts which channel water and increase the erosive power of that water, this can lead to increased erosion both on the trail and adjacent to the trail. Many of the impacts found during field surveys were caused by wet season use of routes.

Implementing seasonal closures in Alternatives 4, 5, and 6 would reduce rutting and subsequent channeling of surface water runoff. Seasonal closures would decrease the potential effects of motorized vehicle use on native surface roads and motorized trails by decreasing erosion and sedimentation.

Short-term timeframe: 1 year.

Long-term timeframe: The period used for long-term effects analysis is 20 to 30 years. This is a reasonable timeframe to think about and predict the expected vegetative recovery (and reduction in erosion) for areas disturbed by unauthorized use. This is also the same recovery period used for the Cumulative Watershed Effects analysis in this document.

Spatial boundary: Forest boundary.

Indicator(s): (1) Miles of unauthorized routes displayed by miles by R-5 EHR rating; (2) Miles of native surface roads and motorized trails open for motor vehicle use displayed by R-5 EHR rating; (3) miles of native surface roads and motorized trails subject to seasonal use restrictions.

Methodology: (1) erosion potential for the soils on the TNF was modeled using GIS, R-5 EHR rating, and the Ecosystem Management Decision Support model; (2) GIS analysis of existing unauthorized routes.

Rationale: Analysis guidelines in the National Soil Management Handbook and Region 5 Soil Management Handbook Supplement.

Direct Effects: The direct effects of changing class of vehicle would be small, because these are existing routes. The direct effects of changing the season of use in Alternatives 4, 5, and 6 would be to decrease the mechanical erosion caused by motor vehicles during the part of the wet season when soils are most susceptible to damage. Reopening Maintenance Level 1 roads would increase compaction on the tread of the road.

Indirect Effects: The indirect effects of changing class of vehicle would include a rougher road surface which could increase the potential for channelized water movement along the route. The main indirect effects of changing the season of use would be a decrease in rutting, channelized water movement along the route, and decreased erosion potential during the seasonal closure. Maintenance Level 1 roads were previously engineered NFTS routes that were put into "storage" until needed for Forest management. Closed NFTS routes that are proposed to be opened are roads that were engineered to control drainage and erosion and are thus designed to minimize impacts to soil resources.

5) Forest Plan Amendment

Considerations: The Tahoe National Forest Land and Resource Management Plan (LRMP) would be amended to remove the November 1 to May 1 seasonal closure from the Sugar Pine area (Management Area 84 Humbug Sailor) on key winter deer range to improve motorized recreation opportunities. This would result in 10.5 miles of routes that is currently closed to motorized use during the wet season. This action would result in motorized vehicle use during the winter months when roads and trails are subject to damage due to wet season use. In some alternatives the deer winter range seasonal restrictions are replaced by wet weather seasonal restrictions. Alternatives 2, 5, and 6 would remove that closure and make the routes in the management area subject to wet season use; however, the wet weather seasonal closure proposed in Alternatives 5 and 6 would replace the current closure with one that is 2 months shorter.

Short-term timeframe: 1 year.

Long-term timeframe: The period used for long-term effects analysis is 20-30 years. This is a reasonable timeframe to think about and predict the expected vegetative recovery (and reduction in erosion) for areas disturbed by unauthorized use.

Spatial boundary: Management Area 84 Humbug Sailor – 20,238 acres gross (17,554 acres Forest Service lands).

Indicator(s): Number of Amendments

Methodology: GIS analysis

Rationale: Analysis guidelines in the National Soil Management Handbook and Region 5 Soil Management Handbook Supplement.

Direct and Indirect Effects: Native surface roads and motorized trails are most susceptible to damage by motor vehicles when wet. The condition of native surface roads and motorized trails can quickly decline during winter or wet weather use due to rutting. Wet season use of native surface roads

and motorized trails often leaves ruts which channel water and increase the erosive power of that water, this can lead to increased erosion both on the trail and adjacent to the trail. Many of the impacts found during field surveys were caused by wet season use of routes.

6) Cumulative Effects

Considerations: The cumulative effects analysis presented here is for the whole geographic area of the Tahoe National Forest. Short-term effects take place within 1-5 years. Long-term effects take 20-30 years. They represent the additive, incremental effects of past, present, and reasonably foreseeable future activities, actions, and decisions on the soil resource. The current condition of the roads and trails, the number of private roads, and the soil damage at primitive campsites are all a reflection of past and current management activities. Management actions affect traffic, user-created motorized routes, maintenance, the effectiveness of closures, and recovery of closed routes. Cumulatively, these actions influence tread wear and soil erosion.

Soil cumulative effects parallel the hydrology cumulative effects. The common ground is the Equivalent Roaded Acre (ERA) concept. All ground disturbances in the watershed are given a coefficient value. Roads, mechanical thinning operations, prescribed fire, wildfire, etc. are accounted for relative to past, present, and expected future management activity levels. The USDA Forest Service Region 5 methodology is used to determine the overall disturbed footprint. The disturbed footprint is a semi-quantitative measure of acres of detrimental soil disturbance and hence an approximation of change in Soil Quality as defined by the R5 Soil Quality Standards (USDA 1995c).

Short-term timeframe: not applicable; cumulative effects analysis will be done only for the long-term time frame.

Long-term timeframe: The period used for long-term effects analysis is 20 to 30 years. This is a reasonable timeframe to think about and predict the expected vegetative recovery (and reduction in erosion) for areas disturbed by unauthorized use.

Spatial boundary: Forest boundary. In the DEIS, the cumulative effects analysis was compiled at the HUC7 scale. Comments received on the DEIS said that this analysis was too complex and confusing. Upon further review of the DEIS data, the decision was made to use HUC6 watersheds for the FEIS analysis. This decreases the number of watersheds by around 80 percent, does not change the results of the analysis, and makes the analysis more understandable. This scale is large enough to encompass the effects of management activities, but not so large as to mask the effects of the proposed actions.

Indicator(s): Equivalent Roaded Acres from Hydrology analysis.

Methodology: Utilize observations and understanding of short-term effects to soil productivity to estimate long-term expected cumulative effects on soil productivity.

Rationale: Analysis guidelines in the National Soil Management Handbook and Region 5 Soil Management Handbook Supplement.

Affected Environment: Soil Resources

Soils on the Tahoe National Forest

Soils on the Tahoe National Forest can be separated into 3 physiographic groups, oriented from west to east:

Dominantly Nearly Level to Very Steep Soils of the Westside

Soils in this group are well drained and somewhat excessively drained. They formed in material weathered from volcanic, metasedimentary, granitic, or ultra basic rock, as well as in glacial or alluvial deposits. Rock outcrops are numerous in many areas. Slopes are 2 to 75 percent.

These soils are on the lower slopes of the western Sierra Nevada, at elevations of 1,800 to 6,000 feet. The annual precipitation is 40 to 80 inches, and the frost-free growing season is 130 to 200 days.

Some of the major soil series in this zone are Hurlbut, Deadwood, Putt, Cohasset, Jocal, Holland, McCarthy, Crozier, and Ledmount. The soils in this zone make up about 33 percent of the survey area. Soils in this zone usually have more clay and are more susceptible to rutting and erosion, than those at higher elevations. Likewise, these soils are accessible to OHV use throughout the year because precipitation in this zone is mostly rain.

Dominantly Nearly Level to Very Steep Soils of High Elevation Mountainsides

The soils in this group are excessively drained to moderately well drained. They formed in material weathered from volcanic, metasedimentary, and granitic rock, as well as glacial or alluvial deposits. Rock outcrops are numerous in many areas. Glacial rock land also occurs throughout the area. Slopes range from 2 to 75 percent. These soils are along the crest of the Sierra Nevada, at elevations of 5,400 to 10,000 feet. The annual precipitation is 35 to 80 inches, and the frost-free season is 25 to 125 days. Some of the major soil series in this zone are Tallac, Smokey, Meiss, Bucking, Ledford, Fugawee, Waca, and Ahart. Areas of nearly level to very steep terrain are found in this zone. Rock outcrops are also mapped in this zone. The soils in this zone make up about 48 percent of the survey area. Soils are generally loamy to sandy, and have more rock fragments. Gully erosion is a hazard in this zone. Snow cover makes the season of use shorter, and wet season closures are less of an issue than in the soils of the lower Westside.

Dominantly Nearly Level to Very Steep Soils of the Eastside

The soils in this group are somewhat excessively drained to well drained. They form in material weathered from volcanic, rhyolitic, and granitic rock, and alluvial deposits. Rock outcrops are numerous in many areas. Slopes range from 2 to 75 percent. These soils are on the lower slopes of the eastern Sierra Nevada, and the Verdi ranges, at elevations of 4,800 to 6,500 feet. The annual precipitation is 15 to 40 inches, and the frost-free growing season is 20 to 75 days. Some of the major soil series in this zone are Euer, Martis, Aldi, Franktown, Kyburz, Trojan, and Portola. The soils in this zone make up about 19 percent of the survey area. Soils are generally loamy to sandy, and have more rock. These soils have some of the lowest erosion rates on the Tahoe National Forest (TNF).

Soil Erosion Risk Assessment

Many factors can influence the risk of erosion and potential impacts to watershed resources including: soil erosivity; stream density; and the type and density of roads on the landscape. The presence of highly erosive soils/landscapes or a high density of native-surfaced, motorized routes does not mean that there would be negative effects to soil resources. But the presence of both high erosion risks and a high density of motorized routes indicates that there could be a higher risk of accelerated erosion and sediment production due to motorized roads and trails.

The inherent risk of erosion of the soils within the TNF was assessed using two methods: the soil erosion hazard rating found in TNF Soil Resource Inventory and the Ecosystem Management Decision Support Model (EMDS).

The soil resource inventory erosion hazard ratings were mapped at a large scale. Table 3.02-8 shows the erosion hazard ratings associated with the higher risk routes in the NFTS, the unauthorized routes, and higher risk routes on private land. Seventy-five percent of the currently existing routes within the boundary of the TNF are on high erosion hazard rated (EHR) soils. Eighteen percent are on moderate EHR soils and six percent are on very high EHR soils. Routes with moderate EHR tend to be on ridge-tops and valley bottoms where topography is generally flatter. Therefore the risk of erosion is lower than on the steeper slopes found on the majority of the TNF.

Table 3.02-8. Native surface road and trails (higher risk routes) by Erosion Hazard Rating[1]

	Erosion Hazard Rating	**Alt 1**
National Forest Transportation System (miles)	Very High	96
	High	1,331
	Moderate	337
	N/A	11
Unauthorized Routes and ML 1 Routes receiving unauthorized use (miles)	Very High	111
	High	1272
	Moderate	290
	N/A	21
Private Roads (miles)	Very High	80
	High	1,293
	Moderate	415
	N/A	27
Total (miles)	**Very High**	**287**
	High	**3,896**
	Moderate	**1,042**
	N/A	**59**

[1] Other system routes are not inculded in this total. N/A includes areas such as rock outcroppings.

Using the soil erosion risk ratings found in the Soil Resource Inventory (See Table 3.02-8), 82 percent of the Forest has a high to very high erosion hazard. The inherent risk of erosion of the soils within the TNF was refined using the Ecosystem Management Decision Support Model (EMDS). The parameters

used in the EMDS model to assess soil erosion risk were 1) presence of geo-debris slides, 2) soil erodibility, 3) slope, and 4) precipitation. The EMDS model compared the K factor, percent slope, precipitation, and presence of geodebris slides of each route segment (~300 meters) to all other road and motorized trail segments on the TNF. The result is a relative erosion risk value assigned between 0 (highest risk) and 1 (lowest risk) for each 300 meter segment of every road and motorized trail (See Appendix L). The EMDS scores for the length of roads and motorized trails in each HUC6 watershed were averaged to define the potential erosion risks on the watersheds on the TNF. The modeled erosion is generally higher on much of the west slope of the TNF. This is due to the steeply sloping topography of many of the watersheds, the potential presence of geo-debris slides, higher precipitation values, and finer-textured, more erosive soils. The modeled risk is lower on the east-side of the TNF due to coarser textured soils and less steep slopes.

The EMDS risk assessment is internally referenced to the soils on the TNF. This means that the lowest EMDS erosion risk score modeled using TNF data was defined as the highest potential erosion risk possible on the TNF and the highest EMDS score was defined as the lowest potential erosion risk possible on the TNF. This information was used to prioritize field surveys. In general, modeled risk of erosion was higher than actual amount of resource damage found during field inventories. The GIS analysis predicted more water crossings than were found during field inventories. This is partially due to the fact the ephemeral stream GIS coverage used in this analysis has not been fully field verified across the entire TNF. Geo-debris slides also tend to be over-estimated in the model. Routes were usually higher on the landscape than the feature that was modeled – route was above scoured channel or debris slide was not active. To adjust the model would require field verification and remapping of the ephemeral stream layer and more accurate mapping of location and level of activity of debris slide features across the Forest. The model was not adjusted in this project. Until adjusted the modeled risk is still useful as general a risk assessment because it still assesses the relative potential risk of soil erosion in a road and motorized trail-related disturbed environment on the TNF.

Existing Cross Country Travel

Currently cross country travel occurs on 717,900 acres on the TNF. Cross country travel is prohibited on 86,500 acres due to existing closures. In most years there are site specific issues that occur due to cross country travel somewhere on the Forest. The effects of these disturbances are usually dealt with by Ranger District recreation and watershed staff.

Cross country travel has resulted in 868.7 miles of motorized trails unauthorized for motorized use on the TNF. In addition, some of the Forest's 829.6 miles of closed NFTS roads are receiving some motorized use. As discussed below in the inventory results section, some routes are stable and others need maintenance/mitigation (For route-specific resource information see Appendix A, Site Specific Road, Trail and Open Area Information).

Field Survey Green, Yellow, Red (GYR) Motorized Trail Condition Ratings

Field surveys were completed for approximately 100 miles of authorized and unauthorized motorized trails using the Green-Yellow-Red (GYR) OHV Trail Condition Rating protocol. This data is summarized by route in Appendix A, Site Specific Road, Trail and Open Area Information. Stream crossings were evaluated using the GYR protocol and R-5 Best Management Practices Evaluation Protocol (BMPEP) (USDA Forest Service, 2000). The GYR protocol uses factors, such as water control, erosion off-trail, tread wear, tread width, and crossing data to rate route conditions. Motorized trails were broken into segments in the field based on site conditions. The GYR Trail condition rating form was used to rate each motorized trail segment. A motorized trail segment was defined as a portion of trail that has similar resource impacts. The Green condition class means that erosion and runoff water control on the trail surface is functioning properly. The Yellow condition class means erosion and runoff water control on the trail surface is presently functioning but needs maintenance soon or it could deteriorate and become red condition class. The Red condition class means erosion and runoff water control on the trail surface is not functioning, is causing watershed impacts and should be given highest priority for maintenance and repair. The R-5 BMPEP protocol looks at erosion on route, sediment movement on route and off, route/stream crossings, etc. Many of these trails show impacts caused by wet season use (e.g., rutting, widening of routes around wet spots, channelized water movement, etc.).

Table 3.02-9 shows that approximately 85 percent of the inventoried routes are in Green condition class; 4 percent are in the Yellow condition class; 1 percent are in the in Red condition class; and 11 percent are overgrown and have begun recovery. Additional erosion and runoff water control is still needed on a portion of the routes, especially the route segments in the Yellow and Red condition classes.

Table 3.02-9. Percent of Inventoried Routes by Route Condition Class

Inventoried Routes	Green Condition Class	Yellow Condition Class	Red Condition Class	Overgrown Route
Percent In Condition Class	85%	4%	1%	11%

Note: numbers may not add up to 100% due to rounding.

Existing Seasonal Closures

The condition of native surface roads and motorized trails can quickly decline during winter or wet weather use due to rutting. Rutting is the process where soils are displaced and deform to the shape of the tire tracks that make their way through saturated soils. Rutting makes the route more susceptible to damage in the spring as the area begins to dry out. Rutting can occur if traffic enters the area before the soils have sufficient drying time. To some extent wet season damage can be influenced by soil type, but all soil types are susceptible damage due to wet season use. Native surface roads and motorized trails are most susceptible to damage by motor vehicles when wet. Currently there are approximately 3,400 miles of NFTS native surface roads and motorized trails that are open year round. There are 231 miles of roads and motorized trails closed seasonally. The areas that are seasonally closed for wildlife also function to reduce wet season damage to routes, soils, and watershed resources.

Environmental Consequences: Soil Resources

The primary changes considered in this analysis are the prohibition of cross country travel, changes in miles of motorized use on existing roads and trails, and changes in class of vehicle or season of use. Continued cross country motorized vehicle travel can increase the area of soil disturbance and loss of productivity. Some of the motorized trails unauthorized for motorized use, being considered for addition to the NFTS, are native surface trails that currently exist on the ground. The hydrologic footprint of these trails already exists. The routes where negative effects on soil resources are most likely to occur are: native surface NFTS roads and motorized trails, motorized trails unauthorized for motorized use and non-private roads (with native surface) within the TNF boundary.

Direct and Indirect Effects to Soil Resources

Direct impacts to soils that result from this project are limited. There are no new ground disturbing activities proposed with this project. The roads and trails being evaluated in this analysis already exist on the ground, but may require upgrading to NFTS standards as well as periodic maintenance. They are generally compacted and lack vegetative cover. Runoff from the surface is collected and discharged as potentially erosive flows at points below the route. Some are eroded or causing erosion, others are stable and are not causing any negative resource impacts. From the standpoint of soil productivity and growing vegetation, these routes are already non-productive. Therefore, on these roads and trails the potential effects on soil resources are related to controlling runoff water to prevent concentrated water flow and subsequent erosion and sediment production and movement and protecting soils downslope from the routes from runoff and gully erosion. It should be noted that most roads and motorized trails on the TNF have some site specific risk to soil and water resources. Many of these risks have been or can be mitigated.

All alternatives would have indirect effects on soil and watershed resources, but they vary by alternative. Route designation would indirectly affect soil erosion and subsequent sediment delivery to streams to the extent that activities resulting from designation or closure (1) affect the amount of *traffic and season of use* on routes; (2) designate routes in areas with highly erosive soils; (3) affect levels of *maintenance*; and (4) affect the potential for *recovery* and restoration.

Route Recovery

None of the proposed alternatives includes decommissioning or restoration for motorized trails not designated for motorized use. Based on observations of the TNF watershed and vegetation management staff, approximately 75 percent of the routes should recover passively over the 20 to 30 years after motorized use stops.

The degree of recovery will be dependent upon many factors. Without adequate drainage, some trails could continue to erode even if they could be effectively closed. Other motorized trails not designated for motorized use would most likely start to recover due to ingrowth of shrubs and other plants from the edges and slowly close in to some extent. Some would be used by non-motorized users (mountain bikes, equestrian, and hikers) and would probably remain on the ground in some form. If use of the route ceases,

in the short term (five years or less), some native vegetation may establish on routes that have little soil compaction. It is likely that routes with moderate soil compaction (within the wheel tracks) would take between 5 and 20 years to vegetatively recover (develop native forb or shrub cover). The most severely disturbed sites are not likely to recover without some type of active restoration. The disposition of motorized trails unauthorized for motorized use that are not added to the system would be dealt with in future NEPA documents.

Projected Effects on Soils on the Tahoe National Forest

Projected Soil Erosion Risk Assessment Based on Erosion Hazard Ratings from the Tahoe National Forest Soil Resource Inventory

Maps of currently authorized and unauthorized routes were overlaid on the soil resource inventory map in GIS. The miles of routes were summarized by erosion hazard rating and by alternative. Table 3.02-10 shows the miles of higher risk routes (native surface, motorized routes) by erosion hazard and alternative. It also shows the change from the existing condition if any of the action alternatives are implemented.

Table 3.02-10. Native surface road and motorized trails (high risk routes) by Erosion Hazard Rating

	Erosion Hazard Rating	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
National Forest Transportation System (miles)	Very High	96	125	96	96	135	99	97
	High	1,331	1,682	1,331	1,356	1,759	1,498	1,364
	Moderate	337	413	337	341	439	372	343
	N/A[1]	11	15	11	12	15	13	13
Unauthorized Routes (miles)	Very High	111	0	0	0	0	0	0
	High	1272	0	0	0	0	0	0
	Moderate	290	0	0	0	0	0	0
	N/A[1]	21	0	0	0	0	0	0
Private Roads (miles)	Very High	80	80	80	80	80	80	80
	High	1,293	1,293	1,293	1,293	1,293	1,293	1,293
	Moderate	415	415	415	415	415	415	415
	N/A[1]	27	27	27	27	27	27	27
Total (miles)	**Very High**	**287**	**205**	**176**	**176**	**215**	**179**	**177**
	High	**3,896**	**2,975**	**2,624**	**2,649**	**3,054**	**2,791**	**2,657**
	Moderate	**1,042**	**828**	**752**	**759**	**854**	**787**	**758**
	N/A[1]	**59**	**42**	**38**	**39**	**42**	**40**	**40**
Change from Current (percent remaining)	Very High		71%	61%	61%	75%	62%	62%
	High		76%	67%	68%	78%	72%	68%
	Moderate		79%	72%	73%	82%	76%	73%
	N/A[1]		81%	64%	55%	71%	68%	68%

[1] Includes areas such as rock outcroppings

Environmental Consequences by Alternative

See the effects methodology section above regarding how this analysis was conducted.

Alternative 1 – No action

- **Prohibition of cross country motor vehicle travel:** Cross country travel would continue in Alternative 1 on 717,900 acres on the TNF. Cross country travel would continue to be prohibited on 86,500 acres. It is likely that cross county travel would result in an increase in the motorized footprint on the TNF. Cross country motor vehicle travel would continue on 868.7 miles of motorized trails unauthorized for motorized use on the TNF. This could impact soil resources by increasing erosion which would decrease long-term soil productivity.
- **Additions to the NFTS.** There are no additions of unauthorized roads or trails under this alternative.
- **Changes to the existing NFTS.** There are no changes to vehicle class and/or season of use to the NFTS under this alternative. No Maintenance Level (ML) 1 roads are reopened with this alternative. However, cross country motorized use is allowed, so the net effect would be that use of some ML 1 routes would occur.
- **Forest Plan Amendment:** There are no changes to the Forest Plan with this alternative.
- **Cumulative Effects**
  - There would be 717,900 acres open to cross country motor vehicle travel.
  - There are approximately 868.7 miles of motorized trails unauthorized for motorized use on the TNF. In addition, some of the Forest's approximately 829.6 miles of closed NFTS roads are receiving some motorized use.
  - There are 5,293.8 miles of native surface roads and motorized trails on the TNF (EHRs are displayed in Table 3.02-10.).
  - The Equivalent Roaded Acres (ERAs) in acres associated with the current motorized footprint are 16,030.0.

Alternative 2 – Increased Motorized Recreation and Access Opportunities

- **Prohibition of cross country motor vehicle travel:** Cross country motor vehicle travel would be prohibited on 833,392 acres, and would reduce the mileage available for motorized use by 809.1 miles of unauthorized routes. This would prohibit the proliferation of new routes and prohibit motorized use on all unauthorized routes not added to the NFTS. In the long-term (20 years) this could reduce erosion associated with motorized use on the TNF.
- **Additions to the NFTS.** Adding 5.0 miles of unauthorized roads and 54.6 miles of unauthorized trails to the NFTS would have minimal effects to soil resources. These are pre-existing routes so the loss of productivity has already occurred. These route additions would be subject to FS standards.

- **Changes to the existing NFTS.**
  - **Change Vehicle Classes through Mixed Use**: Approving mixed use on 241.5 miles would not affect soil resources.
  - **Change Vehicle Classes through Maintenance Levels (ML):** Changing vehicle class on 157.2 miles, to allow licensed operators of non-highway legal vehicles to operate on NFS roads where such use is currently prohibited through the conversion of ML 3 roads to ML 2, would have minimal effects to soil resources. These are pre-existing routes so the loss of productivity has already occurred. As designated routes within the NFTS these routes would be subject to FS standards.
  - **Changes in Seasonal Restrictions:** Seasonal restrictions for deer winter range would be lifted on 10.5 miles of roads resulting from the Forest Plan Amendment to Management Area 84 (Humbug-Sailor) which would slightly increase the risk of wet season damage to these roads and adjacent soils.
  - **Reopening Maintenance Level 1 Roads**: No ML 1 roads would be opened to motorized use.
- **Forest Plan Amendment:** The Tahoe National Forest Land and Resource Management Plan (LRMP) would be amended to remove the November 1 to May 1 seasonal closure in the Sugar Pine area (Management Area 84 Humbug Sailor) on key winter deer range to improve motorized recreation opportunities. The Forest Plan Amendment has the same as effects as Seasonal Restrictions above.
- **Cumulative Effects:** The short-term effects of Alternative 2 would be minimal. The long-term cumulative effects of Alternative 2 would decrease the NFTS soil hydrologic footprint and effects to long-term soil productivity.
  - There would be approximately 2,700 acres of cross country motor vehicle travel in established "Open Areas."
  - There would be 59.6 miles of unauthorized routes added to NFTS.
  - There would be 3,812.3 miles of native surface roads and motorized trails on the TNF.
  - The ERAs associated with the NFTS would be 13,253.7.

Alternative 3 – Cross country Travel Prohibition Only – No Changes to the Existing National Forest Transportation System

- **Prohibition of cross country motor vehicle travel:** Public wheeled motor vehicle travel off designated NFTS roads, NFTS trails, and outside established motorized use areas would be prohibited, except as allowed by permit or other authorization on 836,000 acres and would reduce the mileage available for motorized use by 868.7 miles of unauthorized routes. This would stop the proliferation of new routes and prohibit motorized use on all unauthorized routes not added to the NFTS. This could reduce erosion associated with motorized use on the TNF.
- **Additions to the NFTS.** No unauthorized routes would be added to the NFTS as roads or motorized trails under this alternative

- **Changes to the existing NFTS - this includes changing the vehicle class and/or season of use and reopening Maintenance Level 1 Roads.** No Changes to the NFTS would be made in this alternative.
- **Forest Plan Amendment** No amendments would be made to the Forest Plan.
- **Cumulative Effects:** The short-term effects of Alternative 3 would be minimal. The long-term cumulative effects of Alternative 3 would decrease the NFTS soil hydrologic footprint and effects to long-term soil productivity.
  - There would be 0 acres of cross country motor vehicle.
  - There would be 0 miles of unauthorized routes added to NFTS.
  - There would be 3,595.6 miles of native surface roads and motorized trails on the TNF.
  - The ERAs associated with the NFTS would be 13,180.

Alternative 4 – Increased Resource Protection

- **Prohibition of cross country motor vehicle travel:** Public wheeled motor vehicle travel off designated NFTS roads, NFTS trails, and outside established motorized use areas would be prohibited, except as allowed by permit or other authorization on 836,000 acres which would reduce the mileage available for motorized use by 842.4 miles of unauthorized routes and 829.5 miles of ML 1 roads currently receiving unauthorized use. This would stop the proliferation of new routes and prohibit motorized use on all unauthorized routes not added to the NFTS. This could reduce erosion associated with motorized use on the TNF.
- **Additions to the NFTS.** Adding 3.7 miles of roads and 22.6 miles of trails to the NFTS would have minimal effects to soil resources. These are pre-existing routes so the loss of productivity has already occurred. These route additions would be subject to FS standards.
- **Changes to the existing NFTS.**
  - **Change Vehicle Classes through Mixed Use**: No changes would be made to allow licensed operators of non-highway legal vehicles to operate on NFTS roads where such use is currently prohibited through approval of mixed use.
  - **Change Vehicle Classes through Maintenance Levels:** Changing vehicle class on 3.4 miles, to allow operators of non-highway legal vehicles to operate on NFTS roads where such use is currently prohibited through the conversion of ML 3 roads to ML 2, would have minimal effects to soil resources. These are pre-existing routes so the loss of productivity has already occurred. As designated routes within the NFTS these routes would be subject to FS standards.
  - **Changes in Seasonal Restrictions:** Wet weather seasonal closures from January 1 to May 31 in the Burlington area and January 1 to April 30 on the remainder of the Forest on native surface roads and motorized trails would be added to minimize erosion and protect water quality. A total of 1,312.1 total miles would have changes in seasonal restrictions. Seasonal restrictions would decrease the risk of increased erosion associated with wet season route damage due to motorized use.

  - **Reopening Maintenance Level 1 Roads**: One ML 1 road (0.1 miles) would be reopened to motorized use. Reopening 0.1 miles of ML 1 road would not affect long-term soil productivity. Closed NFTS routes that are proposed to be opened are roads that were engineered to control drainage and erosion. They are expected to receive maintenance when opened.
- **Forest Plan Amendment**: No amendments would be made to the Forest Plan.
- **Cumulative Effects:** The short-term cumulative effects of Alternative 4 would be minimal. The long-term cumulative effects of Alternative 4 would decrease the NFTS soil hydrologic footprint and effects to long-term soil productivity.
  - There would be 0 acres of cross country motor vehicle travel.
  - There would be 26.3 miles of unauthorized routes added to NFTS.
  - There would be 3,625.3 miles of native surface roads and motorized trails on the TNF.
  - The ERAs associated with the NFTS would be 13,353.7.

Alternative 5 – Increased Motorized Recreation Access plus Reopening Maintenance Level 1 and Temporary Roads

- **Prohibition of cross country motor vehicle travel:** Public wheeled motor vehicle travel off designated NFTS roads, NFTS trails, and outside established motorized use areas would be prohibited, except as allowed by permit or other authorization on 836,000 acres which would reduce the mileage available for motorized use by 788.3 miles of unauthorized routes and 736.2 miles of ML 1 roads currently receiving unauthorized use. This would stop the proliferation of new routes and prohibit motorized use on all unauthorized routes not added to the NFTS. This could reduce erosion associated with motorized use on the TNF.
- **Additions to the NFTS.** Adding 5.0 miles of roads and 75.4 miles of trails to the NFTS would have minimal effects to soil resources. These are pre-existing routes so the loss of productivity has already occurred. These route additions would be subject to FS standards.
- **Changes to the existing NFTS.**
  - **Change Vehicle Classes through Mixed Use**: Changing vehicle class on 241.5 miles to allow licensed operators of non-highway legal vehicles to operate on NFTS roads where such use is currently prohibited through approval of mixed use would not affect soil resources.
  - **Change Vehicle Classes through Maintenance Levels:** Changing vehicle class on 157.2 miles, to allow operators of non-highway legal vehicles to operate on NFTS roads where such use is currently prohibited through the conversion of ML 3 roads to ML 2, would have minimal effects to soil resources. These are pre-existing routes so the loss of productivity has already occurred. As designated routes within the NFTS these routes would be subject to FS standards.
  - **Changes in Seasonal Restrictions:** Wet weather seasonal closures from January 1 to May 31 in the Burlington area and January 1 to April 30 on the remainder of the Forest on native surface roads and motorized trails would be added to minimize erosion and protect water quality. A total of 1,396.7 total miles would have changes in seasonal restrictions.
  - **Reopening Maintenance Level 1 Roads**: 113 ML 1 roads (93.4 miles) would be reopened to motorized use. Reopening ML 1 roads would have a small effect on long-term soil productivity

where the routes are reopened. Closed NFTS routes that are proposed to be opened are roads that were engineered to control drainage and erosion. They are expected to receive maintenance when opened.

- **Forest Plan Amendment**: The Tahoe National Forest Land and Resource Management Plan (LRMP) would be amended to remove the November 1 to May 1 seasonal closure in the Sugar Pine area (Management Area 84 Humbug Sailor) on key winter deer range to improve motorized recreation opportunities. The Forest Plan Amendment has the same as effects as Seasonal Restrictions above.
- **Cumulative Effects**: The short-term cumulative effects of Alternative 5 would be minimal. The long-term cumulative effects of Alternative 5 would decrease the NFTS soil hydrologic footprint and effects to long-term soil productivity.
  - There would be 0 acres of cross country motor vehicle travel.
  - There would be 80.4 miles of unauthorized routes added to NFTS.
  - There would be 3,926.5 miles of native surface roads and motorized trails on the TNF.
  - The ERAs associated with the NFTS would be 13,446.

Alternative 6 – Preferred Alternative Motorized Access and Resource Protection

- **Prohibition of cross country motor vehicle travel:** Public wheeled motor vehicle travel off designated NFTS roads, NFTS trails, and outside established motorized use areas would be prohibited, except as allowed by permit or other authorization on 835,800 acres which would reduce the mileage available for motorized use by 807.3 miles of unauthorized routes and 818.2 miles of ML 1 roads currently receiving unauthorized use. This would stop the proliferation of new routes and prohibit motorized use on all unauthorized routes not added to the NFTS. This could reduce erosion associated with motorized use on the TNF.
- **Additions to the NFTS.** Adding 13.1 miles of roads and 48.3 miles of trails to the NFTS would have minimal effects to soil resources. These are pre-existing routes so the loss of productivity has already occurred. These route additions would be subject to FS standards.
- **Changes to the existing NFTS.**
  - **Change Vehicle Classes through Mixed Use**: Changing vehicle class on 130.8 miles to allow licensed operators of non-highway legal vehicles to operate on NFTS roads where such use is currently prohibited through approval of mixed use would not affect soil resources.
  - **Change Vehicle Classes through Maintenance Levels:** Changing vehicle class on 122.0 miles, to allow operators of non-highway legal vehicles to operate on NFTS roads where such use is currently prohibited through the conversion of ML 3 roads to ML 2, would have minimal effects to soil resources. These are pre-existing routes so the loss of productivity has already occurred. As designated routes within the NFTS these routes would be subject to FS standards.
  - **Changes in Seasonal Restrictions:** Wet weather seasonal closures would be added from January 1 to March 31 on the west side of the Forest and January 1 to April 30 on the remainder of the Forest on native surface roads, motorized trails, and “Open Areas” to

minimize erosion and protect water quality. In addition, over the snow travel would be permitted on 3.6 miles of the Fordyce Jeep trail when 15 inches of snow is present on the ground, which prevents soil disturbance. A total of 1,396.7 total miles would have changes in seasonal restrictions.

  - **Reopening Maintenance Level 1 Roads**: Thirteen ML 1 roads (11.4 miles) would be reopened to motorized use. Reopening 11.4 miles of ML 1 roads would have a small affect on long-term soil productivity where the routes are reopened. Closed NFTS routes that are proposed to be opened are roads that were engineered to control drainage and erosion. They are expected to receive maintenance when opened.

- **Forest Plan Amendment**: The Tahoe National Forest Land and Resource Management Plan (LRMP) would be amended to remove the November 1 to May 1 seasonal closure in the Sugar Pine area (Management Area 84 Humbug Sailor) on key winter deer range to improve motorized recreation opportunities. The Forest Plan Amendment has the same as effects as Seasonal Restrictions above.
- **Cumulative Effects**: The short-term cumulative effects of Alternative 6 would be minimal. The long-term cumulative effects of Alternative 6 would decrease the NFTS soil hydrologic footprint and effects to long –term soil productivity.
  - There would be 244 acres of cross country motor vehicle travel in established "Open Areas"
  - There would be 61.4 miles of unauthorized routes added to NFTS.
  - There would be 3,790.3 miles of native surface roads and motorized trails on the TNF.
  - The ERAs associated with the NFTS would be 13,276.

Alternative 7 – Proposed Action as Identified in Notice of Intent (NOI)

- **Prohibition of cross country motor vehicle travel:** Public wheeled motor vehicle travel off designated NFTS roads, NFTS trails, and outside established motorized use areas would be prohibited, except as allowed by permit or other authorization on 836,000 acres which would reduce the mileage available for motorized use by 832.0 miles of unauthorized routes and 828.5 miles of ML1 roads currently receiving unauthorized use. This would stop the proliferation of new routes and prohibit motorized use on all unauthorized routes not added to the NFTS. This could reduce erosion associated with motorized use on the TNF.
- **Additions to the NFTS.** Adding 36.7 miles of trails to the NFTS would have minimal effects to soil resources. These are pre-existing routes, so the loss of productivity has already occurred. These route additions would be subject to FS standards.
- **Changes to the existing NFTS.**
  - **Change Vehicle Classes through Mixed Use**: No changes would be made to allow licensed operators of non-highway legal vehicles to operate on NFTS roads where such use is currently prohibited through approval of mixed use.
  - **Change Vehicle Classes through Maintenance Levels:** Changing vehicle class on 3.4 miles, to allow operators of non-highway legal vehicles to operate on NFTS roads where such use is

currently prohibited through the conversion of ML 3 roads to ML 2, would have minimal effects to soil resources. These are pre-existing routes so the loss of productivity has already occurred. As designated routes within the NFTS these routes would be subject to FS standards.

- **Changes in Seasonal Restrictions:** No changes in seasonal restrictions would be made.
- **Reopening Maintenance Level 1 Roads**: Two ML 1 roads (1.1 miles) would be reopened to motorized use. Route opening may have a minor effect on soil erosion but would be less in relation to construction of new routes. Closed NFTS routes that are proposed to be opened are roads that were engineered to control drainage and erosion. They are expected to receive maintenance when opened.

- **Forest Plan Amendment**: No amendments would be made to the Forest Plan.
- **Cumulative Effects**: The short-term cumulative effects of Alternative 7 would be minimal. The long-term cumulative effects of Alternative 7 would decrease the NFTS soil hydrologic footprint and effects to long-term soil productivity.
  - There would be 0 acres of cross country motor vehicle travel.
  - There would be 36.7 miles of unauthorized routes added to NFTS.
  - There would be 3,636.7 miles of native surface roads and motorized trails on the TNF.
  - The ERAs associated with the NFTS would be 13,220.

Summary of Effects Analysis across All Alternatives

Table 3.02-11. Comparison of Effects to the Soil Resource

Indicators – Soil Resource	Rankings of Alternatives for Each Indicator[1]						
	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Prohibition on Cross County Travel	1	2	4	4	4	3	4
Miles of unauthorized routes displayed by miles -relative ranking	1	NA	NA	NA	NA	NA	NA
Miles of NFTS native surface roads and motorized trails	1	3	7	6	2	4	5
Miles of native surface roads and motorized trails displayed by miles in each of the R-5 EHR ratings – VH, H, M	1	3	7	6	2	4	5
Seasonal Restrictions miles of routes	2	1	2	5	7	6	2
Cumulative effects on soil productivity from unauthorized use (ERAs)	1	4	7	6	2	3	5
Total for Soil Resource	**1.2**	**2.4**	**5.4**	**5.4**	**3.4**	**4.0**	**4.2**

[1] A score of 7 indicates the alternative has the least impact for the soil resource related to the indicator; A score of 1 indicates the alternative has the most impact for the soil resource related to the indicator.

Using the metrics from Table 3.02-11, Alternative 1 would have the highest potential impacts to soil resources, followed in order by Alternative 2, Alternative 5, Alternative 6, Alternative 7, Alternative 4, and Alternative 3.

Hydrology

Introduction

Protection of water quantity and quality is an important part of the mission of the Forest Service (Forest Service Strategic Plan for 2007 to 2012, July 2007). Management activities on National Forest System (NFS) lands must be planned and implemented to protect the hydrologic functions of forest watersheds, including the volume, timing, and quality of streamflow. The use of roads, trails, and other areas on national forests for public operation of motor vehicles has potential to affect these hydrologic functions through interception of runoff, compaction of soils, and detachment of sediment (e.g., Foltz, 2006). Management decisions to eliminate cross-county motor vehicle travel, add new routes and areas to the NFTS, and make changes to the existing NFTS must consider effects on watershed functions.

Meadows and aquatic species are included in the analysis of hydrologically sensitive areas in this section and in Terrestrial and Aquatic Species (Chapter 3.03), Plant Communities (Chapter 3.06), and Appendix R (Riparian Conservation Objectives Analysis)

Analysis Framework: Statute, Regulation, Forest Plan, and Other Direction

Direction relevant to the proposed action as it affects water resources includes:

- **Clean Water Act of 1948 (as amended in 1972 and 1987)** establishes as federal policy the control of point and non-point pollution and assigns the States the primary responsibility for control of water pollution. Compliance with the Clean Water Act by national forests in California is achieved under state law (see below).
- **Non-point source pollution on national forests is managed through the Regional Water Quality Management Plan (USDA Forest Service, Pacific Southwest Region, 2000)**, which relies on implementation of prescribed Best Management Practices (BMPs). The Water Quality Management Plan includes one BMP for OHV use (4-7) and 28 BMPs related to road construction and maintenance (2-1 to 2-28) (See Appendix F, Watershed Analysis). All NFTS roads and trails open to motorized use are required to comply with these BMPs. Of particular relevance for motor vehicle travel management, BMP 4-7 requires each forest to: (1) identify areas or routes where OHV use could cause degradation of water quality, (2) identify appropriate mitigation and controls, and (3) restrict OHV use to designated routes. This BMP further requires forests to take immediate corrective actions if considerable adverse effects are occurring or are likely to occur.
- **The California Water Code** consists of a comprehensive body of law that incorporates all state laws related to water, including water rights, water developments, and water quality. The laws related to water quality (sections 13000 to 13485) apply to waters on the national forests and are directed at protecting the beneficial uses of water. Of particular relevance for the proposed action is section 13369, which deals with nonpoint-source pollution and best management practices.
- **The Porter-Cologne Water-Quality Act**, as amended in 2006, is included in the California Water Code. This act provides for the protection of water quality by the State Water Resources Control

Board and the Regional Water Quality Control Boards, which are authorized by the U.S. Environmental Protection Agency to enforce the Clean Water Act in California.

- **The Sierra Nevada Forest Plan Amendment (SNFPA)**. The Record of Decision (ROD) for the 2004 SNFPA includes standards and guidelines (S&Gs) that apply to the 10 Sierran forests for construction and relocation of roads and for management of riparian conservation areas (RCAs). These standards and guidelines require the Forest Service to avoid road construction, reconstruction, and relocation in meadows and wetlands (SNFPA S&G 70). Reconstructing unauthorized routes to bring them to NFTS standards in meadows or wetlands should therefore be avoided. Only routes that already meet NFTS standards in meadows and wetlands should be proposed for addition to the NFTS. SNFPA S&G 92 requires that the Forest Service evaluate new management activities within RCAs and Critical Aquatic Refuges (CARs) during environmental analysis to determine consistency with Riparian Conservation Objectives (RCOs) at the project level and the Aquatic Management Strategy (AMS) goals for the landscape. Adding an unauthorized route to the NFTS is a new management activity and must comply with S&G 92. SNFPA S&G 100 requires the Forest Service to maintain and restore the hydrologic connectivity of streams, meadows, and wetlands by identifying roads and trails that intercept, divert, or disrupt flows paths and implement corrective actions. SNFPA S&G 102 requires that the Forest Service determine if stream characteristics are within the range of natural variability prior to taking actions that could adversely affect streams.

Water Quality Protection (TNF LRMP, pg. V-35). *Use Best Management Practices (BMPs) to meet water quality objectives and maintain and improve the quality of surface water on the Forest.* Best Management Practices (BMPs) are implemented as mitigation measures specified in Appendix A (Site Specific Road, Trail and Open Area Information) for any motorized trail to be added to the National Forest Transportation or any lands to be established as "Open Areas." These mitigation measures will meet water quality objectives and maintain and improve the quality of surface water on the Forest.

Effects Analysis Methodology

This is a site specific project, for which there is two levels of analysis. First, there is site-specific analysis of the individual routes proposed for addition to the NFTS. This detailed analysis is by route and is included in an Appendix A (Site Specific Road, Trail and Open Area Information) and the project record.

Second, there is the analysis of each alternative as a whole, which is informed by the site-specific route analysis noted above and other information. The discussion of the direct, indirect, and cumulative effects of each alternative is in a summary form. For ease of documentation and understanding, the effects of the alternatives are described separately for five discreet actions and then combined to provide the total direct and indirect effects of each alternative (see below). The combination of these discreet actions is then added to the past, present, and reasonably foreseeable actions in the cumulative effects analysis. The five discreet actions common to all action alternatives are: (1) The prohibition of cross country motor vehicle travel; (2) The addition of facilities (unauthorized roads and trails) to the NFTS, including

identifying seasons of use and vehicle class; (3) The establishment of Motorized "Open Areas"; (4) Changes to the existing NFTS (which includes: change in Class of Vehicles resulting from approval of mixed use, change in Class of Vehicle resulting from changes in maintenance levels, change in Season of Use, and reopening ML 1 roads to motorized use); and (5) Amendments to the Forest Plan. This discussion is the focus of this Effects Analysis Methodology section.

The Effects Analysis Methodology section describes the methodology used for the effects analysis in Chapter 3, not the site-specific analysis of each route. It addresses impacts relevant to the hydrology resource, hydrology resource-specific assumptions, hydrology resource indicators to be measured, including justification as to why they were chosen, sources of information used to support the analysis, timeframes (short term and long term), and spatial boundary of the effects analysis.

The Effects Analysis Methodology focuses on the assumptions, methodology, and indicators for addressing the direct and indirect effects of each of the five actions and the cumulative effects of implementing the alternative as a whole. The conclusions of the analysis in the Environmental Consequences section present the direct and indirect effects of implementing the alternative as a whole addressing the effects of each of the five proposed actions. Then, the cumulative effects of implementing each alternative (the direct and indirect effects of this action in combination with the effects of past, present, and reasonably foreseeable future actions) are displayed.

The cumulative effects analysis considers all roads and motorized trails including private on the TNF. This analysis focuses on native surface (dirt) roads and motorized trails for direct and indirect effects analysis.

Impacts relevant to water resources include

- Modification of surface-water runoff timing and magnitude owing to interception of surface and subsurface runoff by routes during rainfall and snowmelt.
- Increased erosion of route surfaces, hillslopes, and channels, with consequent increases in fluvial loads of sediment and sediment-related pollutants such as nutrients, heavy metals, and pesticides.
- New NFTS roads and trails that traverse hydrologic features such as streams and wet meadows and cross riparian conservation areas and other designated riparian buffers that are protected from disturbance by forest LRMPs and SNFPA Standards and Guidelines.

Assumptions specific to the water resources analysis

- Adverse effects of route use by motor vehicles include long-term damage to soil and water resources owing to soil compaction, alteration of drainage patterns, and destruction of vegetation.
- Without active restoration, these effects would persist for periods of years to decades (20-30 years) following prohibition of public motor vehicle use in the Tahoe National Forest.
- Sediment production from motor vehicle use of native-surface NFTS routes is increased by higher levels of traffic and is reduced by maintenance of road drainage features (culverts, waterbars, and ditches).

- Spatial boundary for the effects analysis is the forest boundary. Within the forest boundary, specific areas that are analyzed include hydrologically sensitive areas, inventoried unauthorized routes, and NFTS routes for which changes in season of use or vehicle class are proposed. Cumulative watershed effects are analyzed for HUC 6 watersheds.
- Hydrologically sensitive areas include all designated riparian protection areas, such as riparian conservation areas. All areas of perennial and seasonal standing or running surface water and areas of perennially or seasonally saturated soil are included. Examples of hydrologically sensitive areas include streams, lakes, reservoirs, fens, wet meadows, marshes, and unstable hill slopes. Hydrologically sensitive areas will be referred to as RCAs in this document.

Data Sources

- Route-specific data collected in the field using established protocols for road erosion inventories or OHV green-yellow-red inventories.
- GIS analyses of route miles and stream crossings in hydrologically sensitive areas.
- Hydrologic data collected by the forest or other agencies, such as United States Geographical Survey (USGS), Environmental Protection Agency (EPA), and California Department of Fish and Game (CDF&G), on streamflow, sediment loads, and stream biota and habitat.
- Air and ground photos and anecdotal information documenting the time required for passive restoration of routes closed to motor vehicle traffic (recovery time may vary based on precipitation, elevation, aspect, and other factors (See Soil Resources).

Water Resources Indicators

- Miles of unauthorized routes in RCAs.
- Sum of routes proposed for addition to the NFTS in RCAs on the forest.
- Acres of “Open Areas” in RCAs.
- Numbers of locations where routes divert or have potential to divert streamflow. (All stream crossings were assumed to have potential to divert streamflow.)
- Miles of ML 1 routes receiving unauthorized motorized use in RCAs.
- Sum of route miles with documented erosional features.
- Miles of routes with proposed changes in vehicle class and/or season of use in RCAs.
- Landscape Erosion Risk (HUC6 watershed) - Density of native surface roads and motorized trails and EMDS erosion risks class.
- Route-related Equivalent Road Areas (ERAs) in acres (cumulative effects).

Water Resources Methodology by Action:

1) Direct/indirect effects of the prohibition of cross country motor vehicle travel

Considerations: The major effects of cross country motor vehicle travel and route proliferation on water resources include increased peak flows and sediment loads due to compacted and unvegetated route surfaces and detachment of sediment by vehicles. The effect of the prohibition of cross country motor

vehicle travel would be to end traffic on routes and areas beyond the authorized NFTS. In the short term, the unauthorized routes and areas disturbed by motor-vehicle use would not change much because removal of vegetation, compaction of soils, and alteration of drainage patterns require time to heal without active restoration. Elimination of traffic on unauthorized routes and areas would reduce erosion, but the routes would still intercept and concentrate surface flows and produce sediment. In the long term, some or all unauthorized routes and areas would probably revegetate and regain some of their hydrologic and geomorphic functions, although use of these routes by non-motorized vehicle traffic could delay or prevent recovery

Short-term timeframe: 1 year.

Long-term timeframe: The period used for long-term effects analysis is 20 to 30 years. This is a reasonable timeframe to think about and predict the expected vegetative recovery (and reduction in erosion) for areas disturbed by unauthorized use. The personal observations of the watershed staff (20-30 years experience on the TNF) support this recovery period. This is also the same recovery period used for the Cumulative Soil Effects analysis in this document.

Spatial boundary: Major River Basins and Sub-basins and The Forest Boundary.

Indicator(s): Miles of unauthorized routes in RCAs.

Methodology: GIS analysis of existing unauthorized routes in Riparian Conservation Areas (RCAs). Compare no-action to action alternatives, and compare all alternatives to regulatory framework.

Rationale: Published studies (see Reference section) have documented that erosion of native-surface roads is increased by traffic.

In a study of cross country ATV impacts, Foltz and Meadows (2007) looked at the degree of disturbance based on leaf litter and vegetation cover, trail width (both tread and displaced material) and ATV rut depth. Tests showed that 40 to 120 passes of an ATV along a cross country route could result in what they called “high” disturbance (i.e., >60 percent loss of ground cover, trail width of greater than 72 inches, and ruts exceeding 6 inches in depth). The study concludes that ATV traffic adversely affects natural resources, and that all of the vehicles tested contributed to those effects regardless of the type of ATV or tire type.

Taylor (2001) reviewed studies that document impacts of motor vehicle use on erosion, water resources, and riparian and aquatic habitats, including studies in Texas that found statistically significant effects from motor vehicle use on benthic macro invertebrates, water quality in pools, and disturbed versus non-disturbed riffles.

Chin and others (2004) conducted a study on the effects of ATVs on stream dynamics that evaluated the amount of pool filling by fine sediment (i.e., the reduction of pool volume and depth) as compared to control watersheds where ATV use was not occurring. They found that the watersheds impacted by ATV use showed a reduction of mean pool volume by as much as 50 percent.

Impacts to stream channels, riparian areas, and water quality are possible where motorized use occurs in RCAs. The RCA widths in the SNFPA (USDA-FS 2004), which are used for the analysis of this project, were prescribed to protect both physical and biological components of the riparian system, including sediment and nutrient delivery, large woody debris recruitment, and habitat occupancy and use

by various species. (Outside of RCAs, disturbances that result from motor vehicle use would be less likely to affect water and sediment reaching streams, meadows, or other hydrologically sensitive areas.)

Comments: The short-term effects would be small and unquantifiable reductions in traffic-related sediment and related pollutants. Long-and short-term effects would essentially be the same for all action alternatives. The effects of the action alternatives would differ from the effects of the no-action alternative because the elimination of traffic from the unauthorized routes would reduce sediment detachment by motor vehicle use. The long-term effects would be smaller (less adverse) than short-term effects. Effects for the action alternatives would be smaller (less adverse) than the No Action Alternative, as measured by miles and area, because under the No Action Alternative, route proliferation and use of unauthorized routes would continue.

2&3) Direct/Indirect effects of additions to the NFTS and establishing motorized "Open Areas"

Considerations: Roads can directly affect physical channel dynamics when they encroach on floodplains or restrict channel migration. Roads can also affect meadows and wetlands directly by encroachment, and indirectly by altering surface and subsurface flow paths. Alteration of the hydrologic flow paths can indirectly affect meadow and wetland function, with the effects extending far beyond the area road itself. The effects can include erosion and/or lowering of the water table. Effects such as these would only be possible if routes are located within RCAs.

Stream crossings in particular have the potential to deliver increased runoff and sediment from the road, destabilize stream banks, and affect channel function. Schnackenberg and MacDonald (1998) found that fine sediment in stream channels in Colorado was more strongly correlated with the number of road crossings than with the Equivalent Clearcut Area (similar to the Equivalent Roaded Acres used in this analysis, but indexed to the effects of clearcuts rather than to roads) in the watershed.

The potential for water to run down roads or trails is termed "diversion potential". When this occurs, streamflow diversions can be a major cause of road-related erosion (Best and others 1995; Furniss and others 1997).

Short-term timeframe: 1 year.

Long-term timeframe: The period used for long-term effects analysis is 20 to 30 years. This is a reasonable timeframe to think about and predict the expected vegetative recovery (and reduction in erosion) for areas disturbed by unauthorized use.

Spatial boundary: The Forest Boundary.

Indicator(s): (1) miles of unauthorized routes added to NFTS in RCAs; (2) miles of ML 1 roads reopened in RCAs; (3) acres of motorized "Open Areas" in RCAs; (4) numbers of locations where routes divert or have potential to divert streamflow; (5) sum of route miles with documented erosional features.

Methodology: GIS analysis of routes and "Open Areas" in RCAs and stream crossings (assume all crossings have potential to divert streamflow). Compare no-action to action alternatives, and compare all alternatives to regulatory framework. Field road erosion inventories follow established protocol using Green-Yellow-Red OHV monitoring.

Rationale: Published studies (see Reference section) have documented that streamflow diversions are a major cause of road-related erosion. Many published studies have documented that roads are a major disturbance in managed watersheds (Trombulak and Frissell 2000; Switalski and others 2004). Studies have consistently shown that roads produce more sediment than other forest management practices (Robichaud and others 2006). Unsurfaced roads and trails (such as the routes being analyzed for addition to the NFTS) contribute much more sediment than surfaced roads. For example, Coe's study (2006) on the Eldorado National Forest found that native surface roads produced 10 to 25 times more sediment than rocked roads. Surface erosion was also dependent on soil type, road surface type, road grade, cross slope, age of the road, traffic volumes, and the effectiveness and spacing of drainage structures. In the South Fork Platte River, Welsh and others (2006) found that the mean sediment production from motor vehicle trails was five times higher than the mean from unpaved road segments.

When roads concentrate surface flow and deliver it to streams via surface flow paths, they are termed "hydrologically connected", and they functionally increase the drainage density (Wemple and others 1996). Surface runoff can be delivered directly into streams via stream crossings or gullies formed at culvert outlets. In general, the greatest impacts from the transportation network come from the portions that are hydrologically connected. Roads and trails whose runoff drains onto hillsides where water infiltrates without reaching streams have fewer impacts on hydrology and water quality. In a study of forest road segments on the Eldorado National Forest, Coe (2006) found that 25 percent of the road segments surveyed was hydrologically connected. A study in the Kings River Experimental Watershed (KREW) area in DNK analysis unit found that 13 percent of the road length in the study area was hydrologically connected (Korte and MacDonald 2005). Robichaud and others (2006) note that studies in the western US have found between 23 and 75 percent hydrologic connectivity of roads.

Roads concentrate overland flow and generate more runoff than undisturbed areas, and hydrologically connected roads deliver that runoff to streams more quickly and efficiently than undisturbed areas. Studies of the effects of roads on streamflows have had varied results, including that roads increased peak flows, decreased peak flows, and had no detectable effect (Gucinski and others 2001). Several studies (Bowling and Lettenmaier 1997, Ziegler and others 2007) have attributed the majority of the increases in streamflows on roads intercepting subsurface flow at cutbanks. Since very few of the unauthorized routes have cut and fill construction, interception of subsurface flow is likely to be less prevalent on these routes than on roads. However, the unauthorized routes still concentrate surface flow, and may be more likely to deliver it via hydrologically connected segments than authorized roads are due to the lack of maintenance they receive. Jones and Grant (1996) found that roads shifted the timing of peak flows to be slightly earlier, and also increased the peak flows slightly, though the increase was not statistically significant due to the variability of the events. There is more agreement that roads do not appear to affect annual water yield (Gucinski and others 2001).

4) Direct/Indirect effects of changes to the existing NFTS (this includes changing the vehicle class, season of use, and reopening Maintenance Level 1 roads)

Considerations: Changing the class of vehicle on already established routes would not increase the impacts to watershed resources. These are already existing routes; therefore there would be no additional

ground disturbance. These routes would still have to meet standards and guidelines for resource protection.

Reopening ML 1 roads would have a small increase.

Traffic on native surface roads generally results in elevated sediment production, particularly if it occurs during the wet season. Road erosion rates increase with increased traffic, and if traffic is removed, the sediment concentration in road runoff decreases over time (Robichaud and others 2006). Ziegler and others (2001) found that motorcycle passes during rainfall simulation caused elevated sediment production; they also cite another study that found a more marked result from truck traffic. They attribute the increased sediment production to the amount of loose material on the road surface that is available for transport, because the spike in sediment transport gets smaller with each successive vehicle pass; however, they note that if the new routes had become incised by flowing water, the erosion would have been more persistent.

For example, Forsyth and others (2006) found that high traffic levels on a gravel road during wet weather created ruts that increased erosion. Even in coarse-grained soils that do not develop rutting as a result of wet-weather use, more subtle surface deformation occurs that eventually renders the design shape of the road (crowning, drainage dips, etc) ineffective, and leads to increased road surface erosion.

Short-term timeframe: 1 year.

Long-term timeframe: The period used for long-term effects analysis is 20 years. This is a reasonable timeframe to think about and predict the expected vegetative recovery (and reduction in erosion) for areas disturbed by unauthorized use.

Spatial boundary: The Forest Boundary.

Indicator(s): (1) miles of NFTS routes with proposed changes in vehicle class, season of use, and reopening of ML 1 roads in RCAs; (2) sum of route miles with documented erosional features; (3) numbers of locations where routes divert or have potential to divert streamflow (all stream crossings are assumed to have potential to divert streamflow).

Methodology: Field road erosion inventories follow established protocol using Green-Yellow-Red OHV monitoring. Compare no-action to action alternatives, and compare all alternatives to regulatory framework.

Rationale: Published studies (see Reference section) have documented that streamflow diversions are a major cause of road-related erosion.

5) Amendment to Forest Plan

The effects from the Forest Plan Amendment are covered under the changes to seasonal restriction in element 4.

6) Cumulative Effects

Considerations: The cumulative effects to erosion/sediment risks were analyzed using the EMDS erosion risk values averaged at the HUC6 scale (See the Soil Resources Section and Appendices F, Watershed Analysis and L , Soils Analysis). This cumulative effects analysis compares the HUC6 route related

erosion risk and the native surface, motorized route density to assess the effects of proposed changes in route density related to sub-basin erosion risk.

The Equivalent Road Acre (ERA) model was developed as a way to evaluate the accumulation of impacts from different activities through time. There are limitations to the ERA model, including: ERAs are only an indicator, and cannot be used to estimate quantitative changes in stream channel conditions; the higher risk associated with near-stream disturbance (as opposed to disturbance far from any stream channel) is not factored into the analysis; and the method does not account for site-specific BMPs (i.e., all roads are weighted the same, regardless of their management and condition). Changes to the existing NFTS are minor and not expected to have a perceptible contribution to cumulative effects. The detailed assessment found in Appendix A (Site Specific Road, Trail and Open Area Information) details for more specific information of the area, including the position of the disturbances relative to the drainage network and whether mitigations are in place to be factored into the final determination of the risk for CWEs.

Short-term timeframe: not applicable; cumulative effects analysis will be done only for the long-term time frame.

Long-term timeframe: The period used for long-term effects analysis is 30 years. This is a reasonable timeframe to think about and predict the expected vegetative recovery (and reduction in erosion) for areas disturbed by unauthorized use.

Spatial boundary In the DEIS analysis, this information was compiled at the HUC7 scale. Comments received on the DEIS said that this analysis was too complex and confusing. Upon further review of the data, the decision was made to use HUC6 watersheds for the FEIS analysis. This decreases the number of watersheds by around 80 percent, does not change the results of the analysis, and makes the analysis more understandable. This scale is large enough to encompass the effects of management activities, but not so large as to mask the effects of the proposed actions. In the FEIS, the CWE results are reported at the sub-basin, basin, and Forest scale.

Because HUC6 watersheds range from 10,000 to 40,000 acres in size, density (e.g., miles of road & trails/acre of HUC6 or number of crossings/acre of HUC6) is a more meaningful measurement of route risks than simply number of miles. Therefore, road/trail density is used in this analysis as well as the miles of roads and trails and the number of crossings. For a more site specific scale, see Appendix A, Site Specific Road, Trail and Open Area Information, for trail-specific erosion mitigation measures.

Indicator(s): Equivalent Roaded Areas in acres.

Methodology: Standard ERA model per Regional policy, focusing on road and trail related ERAs and assuming unauthorized routes without traffic would passively recover within the timeframe. The method allows a quantitative assessment of past, present, and reasonably foreseeable effects for all USFS land-use activities, and the differences between alternatives can be compared to the existing route related ERAs.

Rationale: See considerations discussed under methodology.

Comments: See the Soils Methodology section for assumption regarding passive recovery of unauthorized routes that are not brought into the NFTS.

Affected Environment: Hydrology

Existing Water Supply

The TNF contains portions of headwaters of the American, Bear, Feather, Truckee and Yuba Rivers. The American, Bear and Yuba Rivers flow westward from the crest of the Sierra Nevada to the Sacramento River in the City of Sacramento. The headwaters of the Middle Fork Feather River are in the Sierra Valley area. The river is formed by the confluence of several streams draining the surrounding mountains and then flows west to join the Sacramento River near Marysville. The American, Bear, Feather, and Yuba rivers and their tributaries provide water for domestic, agricultural, environmental and industrial uses as well as power production. The Truckee River Basin covers an area from Lake Tahoe in California to Pyramid Lake, located approximately 50 air miles away in Nevada. Approximately 760 square miles (almost 25 percent of the basin), lie within California. Most of the precipitation and water storage occur within the California part of the Truckee River Basin. The Truckee River, from south of Bear Creek confluence to the area near the California border near Floriston, is within the TNF boundary. The Truckee River provides the majority of the municipal water supply for the Reno-Sparks area.

The Wild and Scenic status of rivers on the TNF can be found in Section 3.09, Inventoried Roadless Areas and Special Areas.

Most of the watersheds on the Tahoe are highly regulated systems. The American, Yuba, and Bear River systems are due to complete FERC re-licensing by 2013. Truckee River operates under the Truckee River Operating Agreement. The Sierra Valley is an adjudicated basin. This project is not likely to impact existing water supply to any measurable extent.

Existing Water Quality

Compared to other parts of California and the United States, the Sierra Nevada overall has relatively low sediment yields (Kattelmann, 1996). General estimates show that the Sierra Nevada has the lowest sediment yield in California (generally less than 100 $m^3/km^2/year$). Sediment transport measurements in a variety of streams in the eastern Sierra Nevada were generally less than 10 $m^3/km^2/year$. A Soil Conservation Service report classified sediment yield below 150 $m^3/km^2/year$ as “low” with respect to nationwide rates (Kattelmann, 1996). Table 3.02-12 shows some annual sediment yield data for watersheds on the Tahoe National Forest. These figures show that the Truckee River system has lower sediment yields than the rivers on the west side of the Forest. The American, Yuba and Feather River systems appear to have similar sediment yields.

Table 3.02-12. Sediment yields from reservoir surveys, suspended sediment records, and other estimates (Kattelmann, 1996)

Watershed	**Annual Sediment Yield** (m^3/km^2)
American – Ralston	80
American – Auburn Dam Site	130
American – Folsom	250
Bear – Combie	360
Feather – Oroville	90 100 120
Truckee – Upper Truckee Squaw Creek Trout Creek	21 12, 93 12
Yuba – Nonmining Mining North Yuba – Bullards Bar	160 3,300 130

Water Quality Management

According to the California Water Plan Update (CA DWR 1998) the TNF is encompassed by three major hydrologic regions. One region is on the Westside of the Sierra Nevada crest (the Sacramento River); the North and South Lahontan regions are on the eastern side. The Central Valley Regional Water Quality Control Board oversees and sets the standards for the Feather, Yuba, Bear and American River systems. The Lahontan Regional Water Quality Control Board oversees and sets the standards for the Truckee River. The Forest Service has a memorandum of understanding with the State that names the Forest Service as a "Designated Management Agency" that will prescribe and implement a water quality control program to protect the waters of the state to meet state and federal regulations as well as the standards set in the Central Valley Water Quality Control Board Basin Plan as amended for commercial silvicultural practices by Resolution R5-2006-0026 (2006).

The TNF generally produces surface water of excellent quality, suitable for almost any use. Contaminant levels in most waters are lower than amounts specified in the States of California and Nevada stream quality standards (Kattelmann 1996). Most runoff would be suitable as drinking water except for the risk of bacteria and pathogens, such as *Giardia lamblia*, *Campylobacter* ssp., and *Cryptosporidium* ssp. In the backcountry, inadequate disposal of human waste and pathogens carried by mammals have caused sufficient contamination to make drinking untreated water risky. Low-level release of nutrients from human activities along wilderness lakes may have stimulated increased plant growth on some lake bottoms (Kattelmann 1996) reducing clarity and causing shifts in aquatic communities as well as reducing the aesthetics of natural lake conditions. Generally, very little water from National Forests in the Sierra Nevada region is heavily polluted or contaminated by chemicals, bacteria, or parasites at concentrations above background levels (Kattelmann 1996). Most waters satisfy the fishable and swimmable objectives of the Clean Water Act (1987).

Water quality in forested areas can be impacted by many activities. Most pollutants come from non-point sources, i.e. from diffuse sources not concentrated into pipes, drains, flumes, or ditches (Clean Water Act, 1987). Examples include erosion from roads and parking areas. Sediment at levels above natural rates of erosion is the most common non-point source pollutant in forested ecosystems. Roads can pollute groundwater as well as surface water. Forest roads potentially add more sediment to streams than any other forest operation. Research has shown that 90 percent of the sediment that ends up in our nation's waters from forested lands is associated with improperly designed and maintained roads. Water quality in lakes, streams, springs, and wetlands can be protected by proper road location and construction and adequate maintenance. A few rural communities and abandoned mining sites within national forests constitute point sources of pollution.

There are six water bodies on the TNF that are listed as impaired on the EPA's 303(d) List. These are the Truckee River (sediment); Stampede Lake (pesticides of unknown origin), Donner Lake (PCBs), Kanaka Creek (arsenic), Squaw Creek (sedimentation/siltation) and Humbug Creek (lead, sediment, etc.). Table 3.02-13 displays the 303(d) listed water bodies and the reason for listing.

Table 3.02-13. Impaired Water Bodies on the TNF Listed on the EPA 303(d) List

Water Body Name	Pollutant/Stressor	Source	Area Affected
Humbug Creek	Copper, Mercury, Zinc, Sedimentation/Siltation	Resource extraction abandoned mines	9 miles
Kanaka Creek	Arsenic	Resource extraction abandoned mines	1 mile
Donner Lake	Priority Organics	Source Unknown	960 acres
Stampede Reservoir (recommended for delisting)	Pesticide (lindane)	Source Unknown	3,444 acres
Squaw Creek	Sedimentation/Siltation	Construction/Land development, Other Urban Runoff, Hydro modification, Drainage/Filling of Wetlands, Highway Maintenance And Runoff, Natural Sources, Recreational Activities, Nonpoint Source	8 miles
Truckee River	Sedimentation/Siltation	Source Unknown	106 miles

The Truckee River, Squaw Creek, and Humbug Creek (Middle Yuba River) are currently listed on the Impaired Water body list (303(d)) for sediment. The Lahontan Regional Water Quality Control Board recently developed a Total Maximum Daily Load (TMDL) for sediment. Effects of this project on these watersheds are discussed under Environmental Consequences in the cumulative effects section.

Existing Routes in Riparian Conservation Areas

The most serious impacts of roads and motorized trails occur where they are in close proximity to streams or wetlands (see Appendix A [Site Specific Road, Trail and Open Area Information] and Appendix I [Riparian Conservation Objectives]). Native surface roads and motorized trails within RCAs have the potential to impact water resources including water quality. Table 3.02-14 shows the miles and density of native surface roads and motorized trails by major river basin. There are currently 1054.1 miles of native

surface roads and motorized trails within RCAs. So current density of native surface roads and motorized trails in RCAs on the TNF is 2.6 miles per square mile. The highest number of miles in RCAs is found in the Yuba River Basin and the lowest number of miles in RCAs is in the Feather Basin. The highest density of native surface roads and motorized trails is found in the Truckee and Feather River basins and the lowest in the American River and Bear River basins.

Table 3.02-14. Miles and density of native surface roads and motorized trails in RCAs by major river basin and the number and density of native surface road and motorized trail perennial and intermittent stream crossings by major river basin

River Basin	Miles of Native Surface Roads and Motorized Trails in RCAs (Density mi/sq mi)	Number of Native Surface Road and Motorized Trail Stream Crossings (Density # crossings/ sq mi RCA)
Middle Truckee River	*170.2 (5.1)*	*213 (6.3)*
Little Truckee River	*136.1 (2.9)*	*281 (4.6)*
Subtotal Truckee	**306.4 (3.8)**	**494 (6.1)**
Feather	**114.9 (3.8)**	**358 (12.0)**
North Yuba	*207.8 (2.4)*	*485 (5.6)*
Middle Yuba	*85.9 (2.4)*	*288 (7.2)*
South Yuba	*140.0 (2.2)*	*322 (5.1)*
Subtotal Yuba	**433.7 (2.3)**	**1095 (5.8)**
Bear	**16.6 (1.6)**	**59 (8.1)**
Middle Fork American	*83.9 (1.6)*	*157 (3.3)*
North Fork American	*79.4 (1.7)*	*239 (4.6)*
Subtotal American	**163.3 (1.6)**	**396 (4.0)**
Tahoe National Forest	**1054.1 (2.6)**	**2408 (5.9)**

Existing Native Surface Road and Motorized Trail Stream Crossings

Stream crossings have direct effects on the channel and local sediment regime. The basic problem comes down to disturbing the stream bed, banks, floodplain, and terraces of the stream. Streamflow diversions at road and motorized trail-stream crossings can result in significant erosion of road surfaces and hillslopes (for example, Best, 1995). Because the crossing is coincident with the channel, there is little opportunity to buffer any impacts of the crossing. Also, ditches near the crossing drain directly into the stream, often contributing sediment to the stream. Although any stream crossing can have some impact on the channel, careful engineering, construction, and maintenance can limit the severity of the impacts.

All road-stream crossings were assumed to have the potential to divert streamflow. Table 3.02-14 shows the number and density of native surface roads and motorized trail stream crossings by major river basin. Currently there are 2,408 native surface road and motorized trail perennial and intermittent stream crossings on the TNF. Crossing density on the TNF is 5.9 crossings per square mile. Crossing density is highest in the Feather River basin and lowest in the American River basin.

Documented Erosional Features

Field surveys were completed for approximately 100 miles of authorized and unauthorized motorized routes. See the Soil Resources section for full discussion of field surveys. See Appendix A (Site Specific Road, Trail and Open Area Information) for route specific erosion impacts. Projecting the percent erosion found during field surveys, an estimated 250 miles of routes could have erosional features.

Existing Landscape Erosion/Sedimentation Risk

Many factors can influence the risk of erosion and potential impacts to watershed resources including: soil erosion/sedimentation potential; stream density; and the type and density of roads on the landscape. The presence of highly erosive soils/landscapes or a high density of native-surfaced, motorized routes does not mean that there would be negative effects to soil resources. But the presence of both high erosion risk and a high density of motorized routes indicate that there could be a higher risk of accelerated erosion and sediment production due to motorized roads and trails.

The inherent risk of erosion of the soils and subsequent sediment movement within the TNF was assessed using two methods: the R-5 soil erosion hazard rating found in TNF Soil Resource Inventory and the Ecosystem Management Decision Support Model (EMDS). The R-5 EHR ratings indicate that 82 percent of the soils on the TNF have a high to very high erosion risk (Table 3.02-8). The EMDS model was used to refine the potential soil erosion risk analysis (See the Soil Resources section and Appendix L). The EMDS erosion risk scores were averaged by HUC6 watershed to assess the motorized route related erosion risk at the landscape scale. This scale is large enough to encompass the effects of management activities, but not so large as to mask the effects of the proposed actions. The EMDS landscape erosion risk score were divided into quartiles to compare the relative erosion potential of individual watersheds. The Truckee River landscape erosion scores were the only average score in the bottom 25 percent, therefore the Truckee River Basin has the lowest potential erosion risks on the TNF. Whereas the North Yuba River, which is much steeper, has more geodebris slides, and more erosive soils, has the highest potential erosion risks on the TNF, see Figure 3.02-2 and Table 3.02-15.

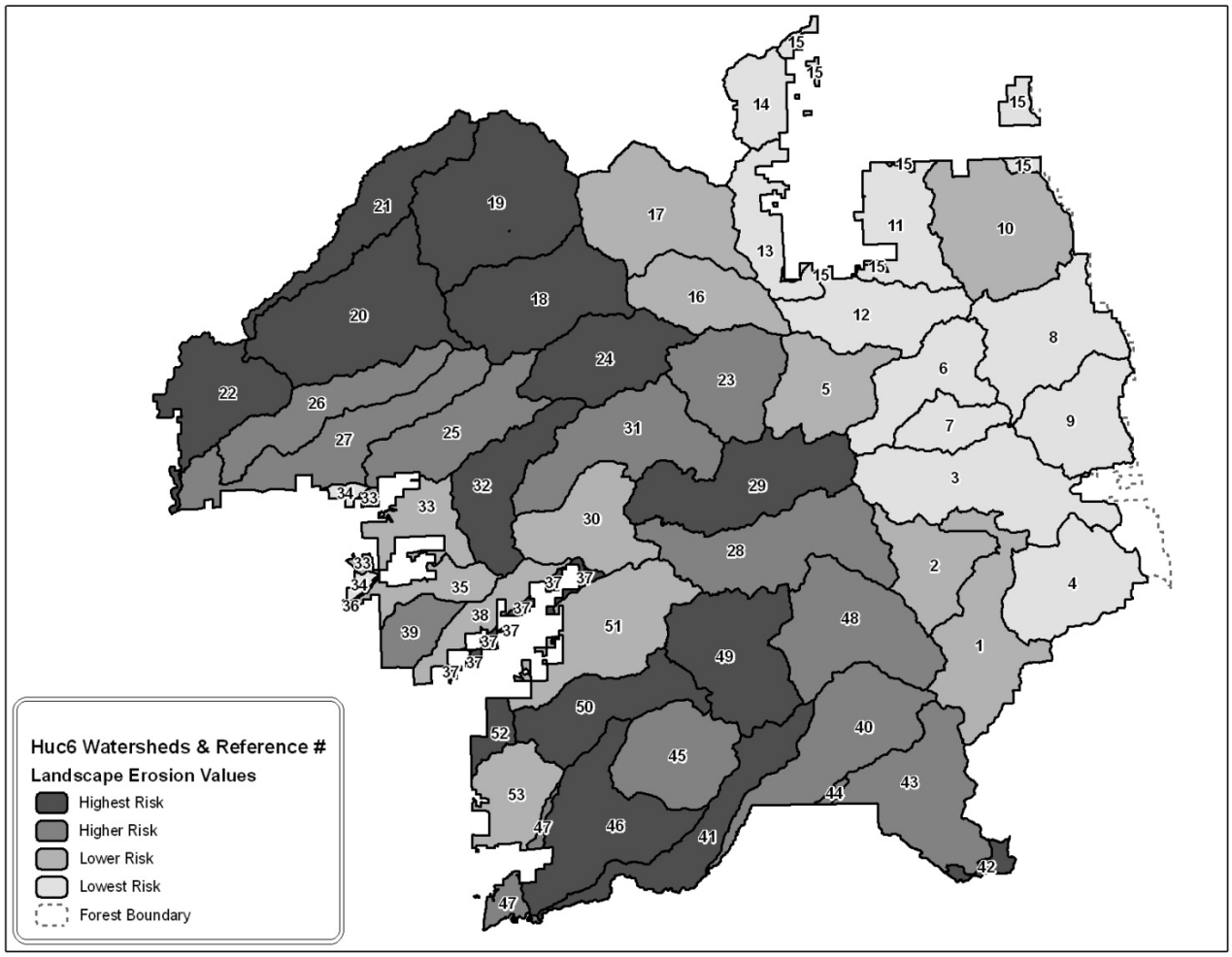

Figure 3.02-2. EMDS Landscape erosion values by HUC6.

Table 3.02-15. EMDS Erosion Risk rating and density of native surface roads and motorized trails by major river basin

River Basin	EMDS Potential Erosion Risk Class	Density of Native Surface Roads and Motorized Trails (miles/sq. mi.)
Middle Truckee River	*0.58 (0-25%)*	*4.4*
Little Truckee River	*0.65 (0-25%)*	*2.9*
Subtotal Truckee	**0.61 (0-25%)**	**3.7**
Feather	**0.62 (0-25%)**	**2.6**
North Yuba	*0.40 (75-100%)*	*2.5*
Middle Yuba	*0.44 (50-75%)*	*2.8*
South Yuba	*0.48 (25-50%)*	*2.7*
Subtotal Yuba	**0.44 (50-75%)**	**2.7**
Bear	**0.44 (50-75%)**	**3.7**
Middle Fork American	*0.45 (50-75%)*	*2.5*
North Fork American	*0.42 (50-75%)*	*2.0*
Subtotal American	**0.43 (50-75%)**	**2.2**
Tahoe National Forest	**0.48 (25-50%)**	**2.8**

This analysis focuses native surface (dirt) roads and motorized trails. Not incorporated in the focused analysis were surfaced roads, non-motorized trails, over-snow routes, and county and state roads because these routes tend to have a lower erosion potential. Because HUC6 watersheds range from 10,000 to 40,000 acres in size, density (e.g., miles of road & trails/acre of HUC6 or number of crossings/acre of HUC6) is a more meaningful measurement of route risks than simply the number of miles. Therefore, road/trail density is used in this analysis as well as the miles of roads and trails and the number of crossings. For a more site specific scale, see Appendix A, Site Specific Road, Trail and Open Area Information, for trail-specific erosion mitigation measures.

The existing native surface road and motorized trail density of HUC6 watersheds was divided into the following density classes based on quartiles (25 percent of watershed in each density class): 0.8 to 2.3 mi/sq.mi., 2.3 to 2.8 mi/sq.mi., 2.8 to 3.5 mi/sq.mi., and 3.5 to 6.5 mi/sq.mi. For example, the Middle Truckee River basin currently has a density of 4.4 mi/sq mi, which is in the highest density class found on the TNF. This analysis was done so that proposed changes in route density could be compared to the existing condition.

Table 3.02-15 shows the average EMDS Erosion Risk rating and the existing native surface road and motorized trail density by major river basin. The potential erosion risks in the Truckee and Feather River basins are the lowest on the TNF. The Truckee River and the Bear River basins have existing density of native surface road and motorized trails of 3.7 miles per square mile (the highest on the TNF). Erosion risk in the Middle Truckee River basin is in the lowest erosion risk class (The basins with erosion risk values in the 0-25 percent of the scores on the TNF). The Bear River basin is in the higher potential EMDS Erosion Risk quartile (50-75% Class). The potential erosion risk is higher in the Bear River basin than in the Truckee River basin; therefore more erosion related impacts due to motor vehicle use would be

expected in the Bear River than the Truckee River. The Yuba River and American River basins have similar erosion risks (higher EMDS Erosion Risk class), with the South Yuba having a slightly lower EMDS Erosion Risk than the rest of the Yuba River basin. The existing density of native surface roads and motorized trails in the Yuba River basin averages 2.7 miles/ square mile. The Middle Yuba has the highest density (2.8 mi/sq mi) and the North Yuba has the lowest (2.5 mi/sq mi). The American River basin is in the higher EMDS Erosion Risk quartile. Native surface road and motorized trail density averages 2.2 mi/sq mi. The Middle Fork American River basin has a density of 2.5 mi/sq mi and the North Fork American River basin has a density of 2.0 mi/sq mi.

Existing Equivalent Road Acres

The cumulative effects of this project on watershed resources (CWE) are analyzed at several scales (Forest, HUC6 Watershed, and RCA (See Riparian Conservation Objectives in Appendix I). The Forest-wide CWE analysis run for a recent Forest-wide fire planning exercise and project specific NEPA documents were used to identify HUC 7 watersheds that are at or over Threshold of Concern (TOC). Table 3.02-16 displays the number of watersheds and acres that are currently over the Threshold of Concern.

Table 3.02-16. Watersheds and acres that are currently over the Threshold of Concern

Threshold of Concern	Number of Watersheds	Acres
Over 100% Threshold of Concern	2	7,600
Under 100% Threshold of Concern	222	812,800

There are two HUC7 watersheds identified as being over TOC. These watersheds are Trout Creek and Alder Creek. The majority of the ERA disturbance in the Trout Creek and Alder Creek watersheds is due to the Tahoe Donner Subdivision on private land.

Environmental Consequences: Hydrology

Cross country motorized vehicle travel increases the amount of native surface routes on the TNF. The motorized trails being considered for addition to the NFTS are native surface wheel tracks that currently exist on the ground, so the hydrologic footprint of the routes already exists. The primary change considered in this analysis are the prohibition of cross country travel, changes in miles of motorized use on existing native surface roads and motorized trails and changes in class of vehicle or season of use on the existing NFTS. Therefore, the effects of route designation on soil and watershed resources focus on native surface roads and motorized trails within the FS boundary. These are the roads and motorized trails where effects on soil and watershed resources are most likely to occur. Surfaced roads are not included because generally mechanical soil loss by erosion and subsequent sediment production is very low on them.

Permitting motor vehicle use only on designated routes would reduce the extent of impacts off of the NFTS. While impacts on designated routes may be more severe than those that occur from more

dispersed use, they can be effectively managed and mitigated. Restricting cross country travel would minimize the number of stream crossings and riparian impacts, and limit them to known areas that can be monitored and maintained.

Direct and Indirect Effects to Watershed Resources

Direct impacts to watersheds and stream courses that result from this project are limited. There are no new ground disturbing activities proposed with this project. The routes being evaluated in this analysis already exist on the ground, but may require upgrading to NFTS standards as well as periodic maintenance. They are compacted and generally lack vegetation. Runoff from the surface is collected and discharged as potentially erosive flows at points below the road or motorized trail. Some are eroded or causing erosion, others are stable and are not causing any negative resource impacts. From the standpoint of watershed resources, most adverse impacts associated with these roads and motorized trails have already occurred. Therefore, on these routes the potential effects on watershed resources are related to sustaining road or trail function and protecting water quality. It should be noted that most roads and motorized trails on the TNF have some site specific risk to water resources. Many of these risks can be mitigated.

Road and trail closures may result in less erosion to the extent that recurrent disturbance of the soil surface by OHV traffic is the primary cause of erosion. In many situations, however, erosion and subsequent sediment delivery to water bodies is the result of a combination of factors that include motorized use, as well as, season of use, a lack of drainage, inadequate maintenance, and poor trail design or location. If non-motorized trail users continue to use the routes some erosion and sediment transport could continue to occur.

The primary concern or effect of this project on the watershed resource is the potential for soil erosion and subsequent effects of sediment transport and deposition. Subsequent sediment deposition can damage terrestrial plants and aquatic organisms. High levels of sediment deposition can also reduce the utility of facilities for water storage and diversion and hydroelectric production. Activities in and near stream channels have the greatest potential for altering sediment delivery and storage as well as channel form. Because this document covers existing wheel tracks, the impacts to hydrologic function and buffering capacity have already taken place.

The erosion that may occur on the trail or road surface is a concern regarding loss or degradation of the facility. Erosion and sediment generated by the trail or road surface may be a concern to water quality if there is the potential for its delivery to a drainage feature.

All alternatives would have direct and indirect effects on watershed resources that vary by alternative. Route designation would affect soil erosion and subsequent sediment delivery to streams to the extent that activities resulting from designation or prohibition of use (1) affect the amount of *traffic* on routes; (2) affect the season of use (3) add motorized trails to the NFTS with highly erosive soils; (3) affect types of *maintenance*; and (4) affect the potential for *recovery* and restoration.

Route Recovery: See Soils section above

Projected Effects on Watershed Resources on the TNF

Projected Water Supply (direct, indirect, cumulative)

None of the action alternatives would increase impacts to water supplies, because this project only designates the class of vehicles and season of use on existing routes and does not propose to construct any new routes.

Projected Water Quality

There are six water bodies on the TNF that are listed as impaired on the EPA's 303(d) List. Table 3.02-17 displays the 303(d) listed water bodies, the reason for listing and any potential impacts which may contribute to the reasons for their listing.

Humbug Creek is listed as a 303(d) Impaired Water Body by EPA due to copper, mercury, zinc, sedimentation and siltation. While the source of the copper, mercury and zinc contamination is unknown, it is generally felt to be generated by abandoned mines. There is no change under any of the alternatives to the number of abandoned mines potentially contributing to this contamination.

The water body is also listed for sedimentation and siltation. Native surface roads and trails and their season of use can contribute to sedimentation and siltation. Virtually all of the native surface roads in this watershed are privately owned. None of the alternatives change the amount of private roads or their season of use. The Forest Service has jurisdiction of less than one mile of unauthorized routes in this watershed. All of the action alternatives except Alternative 5 prohibit use of this route by motorized vehicles. In Alternative 5 this motorized trail is added to the NFTS, however seasonal restrictions prohibit use of this motorized trail during the wet time of the year thereby reducing the potential for sedimentation and siltation.

Cross country travel by motorized vehicles can also have an impact of sedimentation and siltation. Cross country travel is prohibited in all of the action alternatives.

Kanaka Creek is listed as a 303(d) Impaired Water Body by EPA due to arsenic. While the source of the arsenic contamination is unknown, it is generally felt to be due the number of abandoned mines in the area and the type of rock formations. None of the alternatives change the number of abandoned mines nor alter the rock formations.

Donner Lake is listed as a 303(d) Impaired Water Body by EPA due to priority organics (PCB). While the source of the priority organics contamination is unknown, it is generally felt to be due to historic activity associated with the transportation utility corridor running through the watershed. None of the alternatives change the activities associated with the transportation utility corridor.

Table 3.02-17. 303(d) listed water bodies, the reason for listing and potential impacts

Impaired Water Body	Pollutant/Stressor	Indicator of Potential Impact	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Humbug Creek	Copper, Mercury, Zinc, Sedimentation & Siltation	National Forest System Native Surface Roads and Trails Open Year Round (Miles)	<1	0	0	0	0	0	0
		National Forest System Native Surface Roads and Trails Open Seasonally (Miles)	0	0	0	0	<1	0	0
		Private Ownership Native Surface Roads and Trails Open Year Round (Miles)	4	4	4	4	4	4	4
		Cross Country Travel	Continues	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited
		Abandoned Mines	No Change	No Change	No Change	No Change	No Change	No Change	No Change
Kanaka Creek	Arsenic	Mining, Rock Formations	No Change	No Change	No Change	No Change	No Change	No Change	No Change
Donner Lake	Priority Organics	Transportation Utility Corridor Activity	No Change	No Change	No Change	No Change	No Change	No Change	No Change
Stampede Reservoir	Pesticide (lindane)	Pesticide Applications	No Change	No Change	No Change	No Change	No Change	No Change	No Change
Squaw Creek	Sediment & Siltation	National Forest System Native Surface Roads and Trails Open Year Round (Miles)	<1	0	0	0	0	0	0
		National Forest System Native Surface Roads and Trails Open Seasonally (Miles)	0	0	0	0	<1	0	0
		Private Ownership Native Surface Roads and Trails Open Year Round (Miles)	40	40	40	40	40	40	40
		Cross Country Travel	Continues	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited
Truckee River	Sediment & Siltation	National Forest System Native Surface Roads and Trails Open Year Round (Miles)	91	98	91	0	0	0	92
		National Forest System Native Surface Roads and Trails Open Seasonally (Miles)	273	337	273	375	442	415	283
		Private Ownership Native Surface Roads and Trails Open Year Round (Miles)	930	930	930	930	930	930	930
		OHV Open Areas (Number)	4	5	1	1	1	4	1
		Cross Country Travel	Continues	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited

Stampede Reservoir is listed as a 303(d) Impaired Water Body by EPA due to pesticides (lindane). While the source of the pesticide contamination is unknown, it is generally felt to be due historic pesticide applications in the area. None of the alternatives change the activities associated with pesticide applications in the area.

Squaw Creek is listed as a 303(d) Impaired Water Body by EPA due to sedimentation and siltation. Native surface roads and trails and their season of use can contribute to sedimentation and siltation. Virtually all of the native surface roads in this watershed are privately owned. None of the alternatives change the amount of private roads or their season of use. The Forest Service has jurisdiction of less than one mile of unauthorized routes in this watershed. All of the action alternatives except Alternative 5 prohibit use of this trail by motorized vehicles**.** In Alternative 5 this unauthorized route is added to the NFTS, however seasonal restrictions prohibit use of this route during the wet time of the year thereby reducing the potential for sedimentation and siltation.

Cross country travel by motorized vehicles can also have an impact of sedimentation and siltation. Cross country travel is prohibited in all of the action alternatives.

The **Truckee River** is listed as a 303(d) Impaired Water Body by EPA due to sedimentation and siltation.

Native surface roads and trails and their season of use can contribute to sedimentation and siltation. Approximately half (628 miles) of the native surface roads in this watershed are privately owned. None of the alternatives change the amount of private roads or their season of use. The Forest Service has jurisdiction of 685 miles of native surface roads and motorized trails within this watershed. All of the action alternatives reduce the number of native surface roads and motorized trails available for use by motorized vehicles by approximately 100 miles (15%). In addition all action alternatives include seasonal restrictions which prohibit use of these roads during the wet time of the year thereby reducing the potential for sedimentation and siltation.

There are also 4 OHV “Open Areas” within this watershed. The Prosser Pits OHV Open Area is already established as an “Open Area.” Any sedimentation being generated by this area would continue under all alternatives. Boca, Prosser and Stampede Reservoirs are currently managed to allow access to the shoreline below the high water line by motor vehicles when the soils are dry. Speeds are generally slow and since this access is allowed on dry soils only, any additional sediment generated by vehicles accessing the shoreline is minimal. Some fugitive dust could be created by the vehicles on the dry soils and possible drift into the reservoir, but the amount is also felt to be minimal. These reservoirs are established as “Open Areas” for shoreline access by motorized vehicles in Alternative 2 for a total of 2,589. In Alternative 6, 244 acres of the most stable, highly used areas are proposed as “Open Areas.” In Alternative 6 the class of vehicles allowed in these “Open Areas” is restricted to highway legal vehicles only which further mitigate the potential for sedimentation. The use of these dry lake beds by motorized vehicles is prohibited in Alternatives 3, 4, 5, and 7. Use is not prohibited at these reservoirs in Alternative 1.

Cross country travel by motorized vehicles can also have an impact of sedimentation and siltation. Cross country travel is prohibited in all of the action alternatives.

Stream crossings and native surface roads and motorized trails within close proximity to streams are the areas of highest potential sediment delivery to the stream channel. Figure 3.02-3 shows the density of native surface road and motorized trail perennial and intermittent stream crossings by alternative. Figure 3.02-4 shows the native surface road and motorized trail density in RCAs by alternative. All action alternatives would decrease the density of native surface roads and motorized trails within RCAs and native surface road and motorized trail stream crossings.

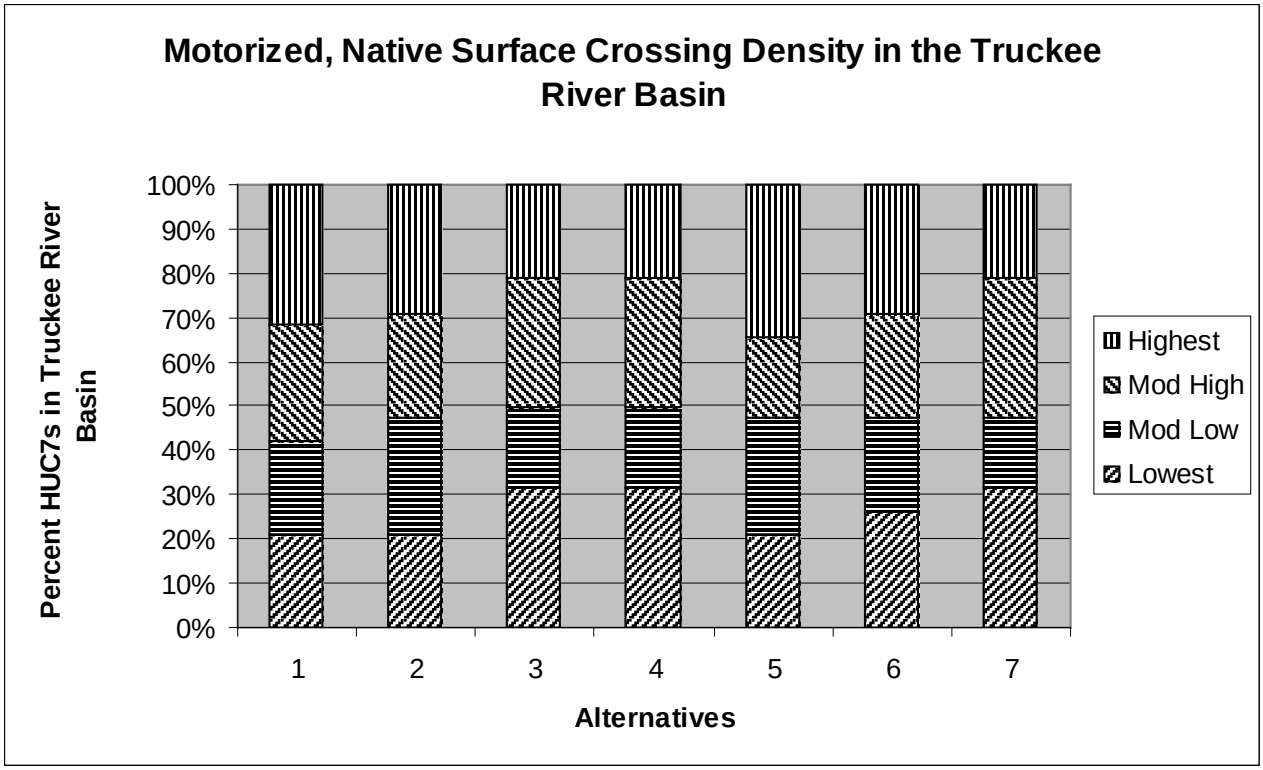

Figure 3.02-3. Native surface road and motorized trail crossing density in the Truckee River Basin (within the TNF boundary) **by Alternative**

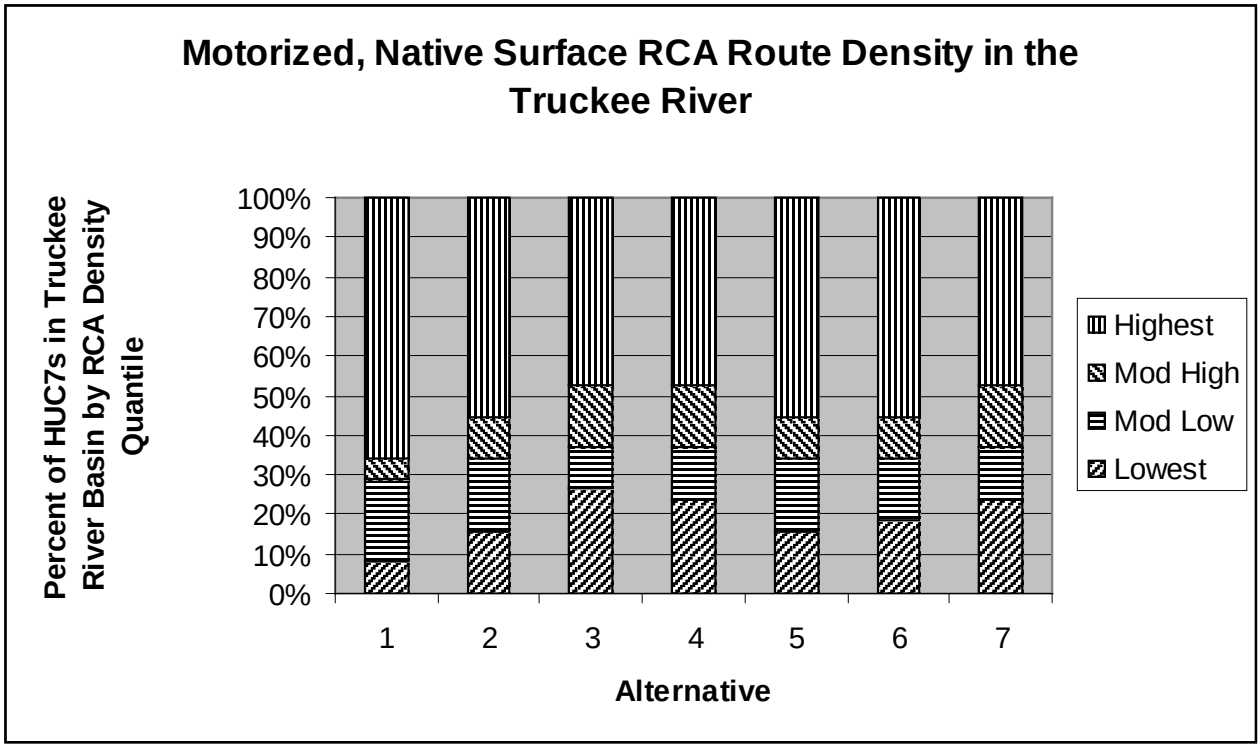

Figure 3.02-4. Native surface road and motorized trail density in RCAs in the Truckee River Basin (within the TNF boundary) **by Alternative**

Proposed Routes in Riparian Conservation Areas

Table 3.02-18 shows the miles and density of native surface roads and motorized trails in RCAs by major river basin and alternative. These figures include 394.6 miles of private roads within RCAs on private land. Action alternatives would decrease the number of existing crossings by 20 to 31 percent. The largest decrease is Alternative 3 and the smallest is Alternative 5.

Table 3.02-18. Miles and density of native surface roads and motorized trails in RCAs by alternative (Density mi per square mile of RCA)

River Basin	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Middle Truckee River	170.2 (5.1)	144.3 (4.3)	141.3 (4.2)	141.3 (4.2)	144.4 (4.3)	143.9 (4.3)	141.3 (4.2)
Little Truckee River	136.1 (2.9)	95.1 (2.0)	83.2 (1.8)	85.5 (1.8)	97.1 (2.0)	82.4 (1.7)	85.9 (1.8)
Subtotal Truckee River	**306.4 (3.8)**	**239.4 (3.0)**	**224.5 (2.8)**	**226.8 (2.8)**	**241.6 (3.0)**	**236.3 (2.9)**	**227.2 (2.8)**
Feather River	**114.9 (3.8)**	**78.9 (2.6)**	**62.5 (2.1)**	**62.5 (2.1)**	**78.9 (2.6)**	**70.7 (2.4)**	**62.5 (2.1)**
North Yuba River	*207.8 (2.4)*	*155.3 (1.8)*	*126.9 (1.5)*	*127.1 (1.5)*	*169.4 (1.9)*	*135.8 (1.6)*	*127.4 (1.5)*
Middle Yuba River	*85.9 (2.4)*	*64.8 (1.6)*	*59.3 (1.5)*	*59.8 (1.5)*	*65.0 (1.6)*	*62.6 (1.6)*	*59.3 (1.5)*
South Yuba River	*140.0 (2.2)*	*123.5 (1.9)*	*107.8 (1.7)*	*110.7 (1.8)*	*123.6 (2.0)*	*114.6 (1.8)*	*111.0 (1.8)*
Subtotal Yuba River	**433.7 (2.3)**	**343.6 (1.8)**	**294.0 (1.5)**	**297.6 (1.6)**	**358.0 (1.9)**	**313.0 (1.6)**	**297.8 (1.6)**
Bear River	**16.6 (2.3)**	**13.7 (1.8)**	**10.8 (1.5)**	**11.6 (1.6)**	**14.0 (1.9)**	**11.7 (1.6)**	**11.6 (1.6)**
North Fork American River	*83.9 (1.6)*	*68.8 (1.4)*	*63.4 (1.3)*	*63.6 (1.3)*	*69.6 (1.5)*	*66.3 (1.4)*	*63.6 (1.3)*
Middle Fork American River	*79.4 (1.7)*	*66.2 (1.3)*	*53.1 (1.0)*	*53.1 (1.0)*	*67.2 (1.3)*	*55.7 (1.1)*	*53.8 (1.0)*
Subtotal American River	**163.3 (1.6)**	**135.0 (1.4)**	**116.4 (1.2)**	**116.7 (1.2)**	**136.9 (1.4)**	**121.9 (1.2)**	**117.4 (1.2)**
TNF Total	**1054.1 (2.6)**	**828.7 (2.0)**	**726.2 (1.8)**	**733.3 (1.8)**	**847.4 (2.1)**	**771.8 (1.9)**	**734.6 (1.8)**
Percent Reduction by Alternative		**21%**	**31%**	**30%**	**20%**	**27%**	**30%**

Proposed Native Surface Road and Motorized Trail Stream Crossings

There are currently 2,408 native surface road and motorized trail perennial and intermittent stream crossings on the TNF (Table 3.02-19). Crossing density is 5.9 crossings per square mile averaged over the TNF. This includes 714 stream crossings on private land. All of the Action alternatives would decrease the number of crossings by 21 to 35 percent. The largest decrease is Alternative 3 and the smallest is Alternative 5.

Table 3.02-19. Number and density of native surface road and motorized trail stream crossings by alternative (Density, number of crossings per square mile of RCA)

River Basin	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Middle Truckee River	213 (6.3)	186 (5.5)	183 (5.4)	183 (5.4)	187 (5.6)	189 (5.6)	183 (5.4)
Little Truckee River	281 (5.1)	217 (4.6)	183 (3.9)	187 (3.9)	218 (4.6)	205 (4.3)	189 (4.0)
Subtotal Truckee River	**494 (6.1)**	**403 (5.0)**	**366 (4.5)**	**370 (4.6)**	**405 (5.0)**	**394 (4.9)**	**372 (4.6)**
Feather River	**358 (12.0)**	**236 (7.9)**	**192 (6.4)**	**192 (6.4)**	**236 (7.9)**	**218 (7.3)**	**192 (6.4)**
North Yuba River	485 (5.6)	351 (4.0)	256 (2.9)	259 (3.0)	396 (4.6)	280 (3.2)	259 (3.0)
Middle Yuba River	288 (7.2)	226 (5.7)	208 (5.2)	209 (5.3)	226 (5.7)	221 (5.6)	208 (5.2)
South Yuba River	322 (5.1)	262 (4.2)	223 (3.5)	229 (3.6)	262 (4.2)	237 (3.8)	228 (3.6)
Subtotal Yuba	**1095 (5.8)**	**839 (4.4)**	**687 (3.6)**	**696 (3.7)**	**884 (4.7)**	**738 (3.9)**	**695 (3.7)**
Bear River	**59 (8.1)**	**47 (6.4)**	**38 (5.2)**	**41 (5.6)**	**47 (6.4)**	**41 (5.6)**	**41 (5.6)**
North Fork American River	157 (3.3)	127 (2.6)	117 (2.4)	118 (2.5)	127 (2.7)	125 (2.6)	118 (2.5)
Middle Fork American River	239 (4.6)	195 (3.8)	154 (3.0)	156 (3.0)	199 (3.8)	159 (3.1)	155 (3.0)
Subtotal American	**396 (4.0)**	**322 (3.2)**	**271 (2.7)**	**272 (2.7)**	**326 (3.3)**	**284 (2.8)**	**273 (2.7)**
TNF Total	**2408 (5.9)**	**1851 (4.5)**	**1558 (3.8)**	**1576 (3.9)**	**1902 (4.7)**	**1679 (4.1)**	**1577 (3.9)**
Percent Reduction by Alternative		23%	34%	35%	21%	30%	35%

Proposed Routes with Documented Erosional Features

Field surveys measured the amount of existing erosional features. Table 3.02-20 shows the existing erosional features found by alternative. Alternative 1 uses an estimate of the miles of erosion based on the percentage of erosion found during surveys times the miles of unauthorized routes and ML 1 routes receiving unauthorized use.

Table 3.02-20. Erosional features (miles) on proposed routes by alternative

	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Tahoe National Forest	250	54.1	0	19.1	54.1	41.7	38.4

Proposed Native Surface Road and Motorized Trail Route Density – Erosion/Sedimentation Risk

All action alternatives would lower densities of native surface roads and motorized trails on the Tahoe National Forest 21 to 32 percent. Table 3.02-21 shows the density of native surface roads and motorized trails by major river basin by alternative. The No Action Alternative (Alternative 1) has the highest densities of native surface roads and motorized trails used by motorized vehicles. Alternatives 3, 4 and 7 would have the lowest route density (1.9 mi/sq/mi) of motorized use on native surface roads and motorized trails. Alternative 6 densities would be slightly higher than Alternatives 3, 4 and 7. Of the action alternatives, Alternatives 2 and 5 would result in the highest route densities (2.2 mi/sq.mi). Alternative 6 would result in a density of 2.0 mi/sq.mi.

Table 3.02-21. Density of "Higher Risk Routes" by major river basin by alterative (mi./sq. mi.)

River Basin	EMDS Erosion Risk (risk quartile (0-25%, 25-50%, 50-75%, 75-100%))	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Middle Truckee River	0.58 (Lowest)	4.4	3.9	3.8	3.8	3.9	3.9	3.8
Little Truckee River	0.65 (Lowest)	2.9	2.2	1.9	1.9	2.2	2.1	1.9
Subtotal Truckee River	**0.61 (Lowest)**	**3.7**	**3.1**	**2.9**	**2.9**	**3.1**	**3.0**	**2.9**
Feather River	**0.62 (Lowest)**	**2.6**	**1.7**	**1.5**	**1.5**	**1.7**	**1.6**	**1.5**
North Yuba River	*0.40 (Highest)*	*2.5*	*1.8*	*1.4*	*1.5*	*2.0*	*1.5*	*1.5*
Middle Yuba River	*0.44 (Higher)*	*2.8*	*2.2*	*2.1*	*2.1*	*2.2*	*2.1*	*2.1*
South Yuba River	*0.48 (Lower)*	*2.7*	*2.2*	*2.0*	*2.0*	*2.3*	*2.1*	*2.0*
Subtotal Yuba	**0.44 (Higher)**	**2.7**	**2.1**	**1.8**	**1.8**	**2.2**	**1.9**	**1.8**
Bear River	**0.44 (Higher)**	**3.7**	**3.1**	**2.7**	**2.8**	**3.1**	**2.9**	**2.8**
North Fork American River	*0.45 (Higher)*	*2.5*	*1.8*	*1.6*	*1.6*	*1.9*	*1.7*	*1.6*
Middle Fork American River	*0.42 (Higher)*	*2.0*	*1.6*	*1.5*	*1.5*	*1.6*	*1.6*	*1.5*
Subtotal American	**0.43 (Higher)**	**2.2**	**1.7**	**1.5**	**1.5**	**1.7**	**1.6**	**1.5**
TNF Total	**0.48 (Lower)**	**2.8**	**2.2**	**1.9**	**1.9**	**2.2**	**2.0**	**1.9**
	% reduction		**21%**	**32%**	**32%**	**21%**	**29%**	**32%**

Existing native surface road and motorized trail route densities were divided into quartiles (25% in each density class) to track proposed changes in route density. So the HUC6 watersheds with the lowest 25 percent EMDS erosion risk scores represent the watersheds on the TNF with the lowest risk of motorized routes related erosion. Table 3.02-21 shows that forest-wide there is a decrease in native surface road and motorized trail density of 21 to 32 percent from implementing any of the Action Alternatives. On the eastside of the Tahoe, where erosion risks are the lowest on the Forest, native surface road and motorized trail density would decrease by 16 to 22 percent in the Truckee River basin and 35 to 42 percent in the Feather River basin (Sierra Valley). On the Westside of the Forest, where erosion risks are the highest, there would be a decrease of 18 to 33 percent in the Yuba River basin, 16 to 27 percent in the Bear River basin, and 22 to 31 percent in the American River basin. The North Yuba River sub-basin has the highest erosion risk on the Forest. Native surface road and motorized trail density would decrease by 20 to 40 percent in the Action alternatives.

Figure 3.02-5 and Table 3.02-22 show the percent of the HUC6 watersheds on the TNF by Alternative and native surface road and motorized trail density class. Currently 25 percent of the HUC6 watersheds on the TNF have a native surface road and motorized trail density of 3.5 to 6.5 miles per square mile. All of the action alternatives would decrease the HUC6 watersheds in this density class by 12 to 17 percent. There would be an increase in the HUC6 watersheds within the lowest existing density class (0.8-2.3) of 21 to 44 percent with implementation of the action alternatives.

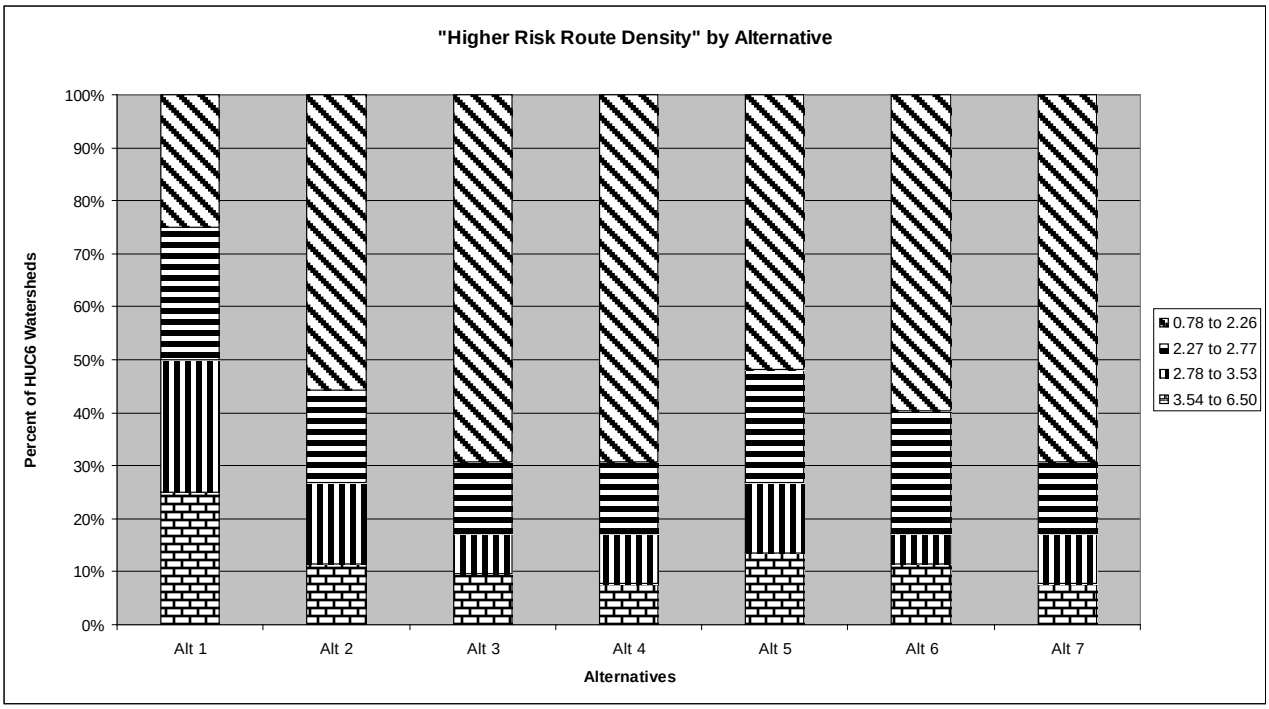

Figure 3.02-5. Native surface roads and motorized trails by alternative and density class

Table 3.02-22. Native surface roads and native trails by Alternative and Density Class

Existing Density Class	% of HUC6 watersheds by high risk route density class by Alt						
	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
3.5 to 6.5	25%	12%	10%	8%	13%	12%	8%
2.8 to 3.5	25%	15%	8%	10%	13%	6%	10%
2.3 to 2.8	25%	17%	13%	13%	21%	23%	13%
0.8 to 2.3	25%	56%	69%	69%	52%	60%	69%

Equivalent Road Acres Analysis

The forest-wide review of smaller HUC 7 watersheds (described above under "Existing Equivalent Road Acres") shows that 222 of the Forest's 224 HUC 7 watersheds are below their TOCs; therefore, larger-scale watersheds (HUC 6 and HUC 5) would not be expected to exceed the TOC. This allowed a forest-wide ERA analysis to be conducted at the HUC 6 watershed scale, keeping other ERA disturbance factors constant and varying the miles of motorized routes by alternative (and including existing routes on private lands), to assess effects of motor vehicle use in terms of ERAs. The results of the HUC 6 ERA analysis are included in Appendix F: "Watershed Analysis." Table 3.02-23 below displays the results of this ERA analysis aggregated at the river basin (approximately HUC 5) scale: all action alternatives would decrease the ERAs associated with roads and trails on the TNF over the long term (20 to 30 years) as undesignated routes passively recover over time.

Table 3.02-23. Equivalent Road Acres associated with roads and trails due to cumulative effects of all proposed actions (ERA percents of watershed)

River Basin	Basin Acres	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Middle Truckee River	118,238	2,417.6 2.05%	2,241.0 1.90%	2,239.0 1.89%	2,240.8 1.90%	2,242.4 1.90%	2,245.3 1,90%	2,240.5 1.90%
Little Truckee River	109,1558	1,329.1 1.22%	1,182.6 0.99%	1,066.3 0.98%	1,074.2 0.98%	1,095.1 1.00%	1,087.1 1.00%	1,072.8 0.98%
Subtotal Truckee River	**227,393**	**3,746.7 1.65%**	**3,423.6 1.46%**	**3,305.3 1.45%**	**3,315.0 1.46%**	**3,337.5 1,47%**	**3,332.4 1.47%**	**3,313.3 1.46%**
Feather River	**249,750**	2,726.7 1.09%	2,067.2 0,83%	2,063.1 0.83%	2,064.2 0.83%	2,078.8 0,83%	2,072.7 0.83%	2,060.6 0.83%
North Yuba River	229,995	2,469.8 1.07%	1,923.5 0.84%	1,902.5 0.83%	1,906.0 0.83%	2,043.3 0.89%	1,922.4 0.84%	1,913.0 0.83%
Middle Yuba River	126,370	1,757.9 1.39%	1,530.8 1.21%	1,528.6 1.21%	1,529.9 1.21%	1,536.4 1.22%	1,533.3 1.21%	1,529.4 1.21%
South Yuba River	174,566	2,123.7 1.22%	1,798.6 1.03%	1,781.1 1.02%	1,785.2 1.02%	1,806.8 1.04%	1,799.7 1.03%	1,789.5 1.03%
Subtotal Yuba River	**530,932**	**6,351.4 1.20%**	**5,252.9 0.99%**	**5,212.3 0.98%**	**5,221.2 0.98%**	**5,386.4 1.02%**	**5,255.4 0.99%**	**5,231.9 0.99%**
Bear River	**23,310**	343.7 1.48%	290.0 1.24%	288.4 1.24%	290.0 1.24%	293.2 1.26%	290.6 1.25%	290.0 1.24%
Middle Fork American River	153,368	1,570.2 1.02%	1,241.6 0.81%	1,238.6 0.81%	1,239.5 0.81%	1,264.9 0.83%	1,245.9 0.81%	1,240.2 0.81%
North Fork American River	140,869	1,165.8 0.83%	958.0 0.68%	952.1 0.68%	955.6 0.68%	965.2 0.69%	958.6 0.68%	957.2 0.68%
Subtotal American River	**294,237**	**2,726.0 0.93%**	**2,199.7 0.75%**	**2,190.7 0.75%**	**2,195.1 0.75%**	**2,230.1 0.76%**	**2,204.5 0.75%**	**2,197.4 0.75%**
Total TNF	**1,325,623**	**16,030.1 1.21%**	**13,353.7 1.00%**	**13,179.5 0.99%**	**13,205.9 1.00%**	**13,446.3 1.01%**	**13,275.9 1.00**	**13,219.6 1.00%**

Environmental Consequences by Alternative

Alternative 1 – No action

- **Prohibition of Cross Country Motor Vehicle Travel:** Cross country travel would not be prohibited in Alternative 1 on 717,900 acres. Cross country travel is currently prohibited on 86,500 acres. It is likely that cross-county travel would result in an increase in the motorized footprint on the TNF. Cross country travel would continue on approximately 1,081miles of native surface, motorized unauthorized routes and ML 1 routes receiving unauthorized use (207 miles in RCAs). This could impact hydrology resources by increasing erosion, sediment production and delivery to streams which could decrease water quality.
- **Additions to the NFTS.** There are no additions of routes to the NFTS under this alternative.
- **Establishment of motorized "Open Areas."** There are no establishments of "Open Areas" under this alternative.
- **Changes to the existing NFTS.** There are no changes to vehicle class and/or season of use to the NFTS under this alternative. No Maintenance Level (ML) 1 Roads are reopened with this

alternative; however, cross country motorized use is allowed, so the net effect would be that use of some ML 1 route would probably occur.

- **Forest Plan Amendment**: There are no changes to the Forest Plan with this alternative.
- **Cumulative Effects**
  - There are 2,649 acres of "Open Areas" in RCAs (Greenhorn Area – 60 acres; Boca, Prosser, and Stampede Reservoir access – 2,589 acres)
  - There is a total of 1,080.5 miles of native surface roads and motorized trails in RCAs on the TNF.
  - There are 2,462 perennial and intermittent crossings on the TNF.
  - There is an estimated 250 miles of routes on the Forest with erosional features (Based on percent of erosional features found during route surveys for this project).
  - The ERAs associated with the NFTS are 16,030.

Alternative 2 – Increased Motorized Recreation and Access Opportunities

- **Prohibition of Cross Country Motor Vehicle Travel:** Public wheeled motor vehicle travel off designated NFTS roads, NFTS trails, and outside established motorized use areas would be prohibited, except as allowed by permit or other authorization. This would prohibit the proliferation of new routes and prohibit motorized use on all unauthorized and closed system routes not added to the NFTS. This could reduce erosion and subsequent sediment delivery to waterbodies associated with motorized use on the TNF.
- **Additions to the NFTS.** Adding 2.6 miles of roads in RCAs and 9.7 miles of trails in RCAs to the NFTS would have minimal effects to hydrology resources. These are pre-existing routes so no new soil compaction/disturbance would be created. These route additions would be subject to FS standards.
- **Establishment of motorized "Open Areas"** Four "Open Areas" totaling 2,649 acres would be established in the Bear River basin (Greenhorn Area at 60 acres) and the Truckee River basin (Prosser, Boca and Stampede Reservoirs at 2,589 acres). These areas are currently being used as "Open Areas" even though they are not established "Open Areas". Localized effects to hydrology resources in these areas have been reported especially during wet season use.
- **Changes to the existing NFTS.**
  - **Change Vehicle Classes through Mixed Use**: Approving mixed use on 241.5 miles would not affect hydrology resources.
  - **Change Vehicle Classes through Maintenance Levels:** Changing vehicle class on 34.3 miles of routes in RCAs to allow licensed operators of non-highway legal vehicles to operate on NFS roads where such use is currently prohibited through the conversion of ML 3 roads to ML 2 would have minimal effects to watershed resources. These are pre-existing "routes." As NFTS routes, these routes would be subject to FS standards.
  - **Changes in Seasonal Restrictions:** Seasonal restrictions for deer winter range would be lifted on 1.6 miles of roads in RCAs resulting from the Forest Plan Amendment to Management Area

84 (Humbug-Sailor) which would slightly increase the risk of wet season damage to these roads and adjacent watersheds.

- **Reopening Maintenance Level 1 Roads**: No ML 1 roads would be opened to motorized use.

- **Forest Plan Amendment**: There would be the same effects as the Seasonal Restrictions above.
- **Cumulative Effects:** The short-term cumulative effects of Alternative 2 would be minimal. The long-term cumulative effects of Alternative 2 would decrease the NFTS hydrologic footprint and effects to watershed resources.
  - There would be 2,649 acres of "Open Areas" in RCAs (Greenhorn Area; Boca, Prosser, and Stampede Reservoir access).
  - There would be a total of 772 miles of native surface roads and motorized trails in RCAs on the TNF (density =0.7 mi./sq.mi.).
  - There would be 1,689 perennial and intermittent crossings.
  - There are 54.1 miles of routes on the Forest proposed for addition to the NFTS with documented erosional features. These erosion features would be mitigated prior to opening for motorized use.
  - The ERAs associated with the NFTS would be 13,254.

Alternative 3 – Cross country Travel Prohibition Only – No Changes to the Existing National Forest Transportation System

- **Prohibition of Cross Country Motor Vehicle Travel:** Public wheeled motor vehicle travel off designated NFTS roads, NFTS trails, and outside established motorized use areas would be prohibited, except as allowed by permit or other authorization. This would prohibit the proliferation of new routes and prohibit motorized use on all unauthorized and closed system routes not added to the NFTS. This could reduce erosion and subsequent sediment delivery to waterbodies associated with motorized use on the TNF.
- **Additions to the NFTS.** No unauthorized routes would be added to the NFTS as roads or motorized trails under this alternative
- **Establishment of motorized "Open Areas"** No additional motorized "Open Areas" would be established under this alternative.
- **Changes to the existing NFTS - this includes changing the vehicle class and/or season of use and reopening ML 1 Roads.** No Changes to the NFTS would be made in this alternative.
- **Forest Plan Amendment**: No amendments would be made to the Forest Plan.
- **Cumulative Effects:** The short-term cumulative effects of Alternative 3 would be minimal. The long-term cumulative effects of Alternative 3 would decrease the NFTS hydrologic footprint and effects to watershed resources.
  - There are 0.0 miles of unauthorized native surface roads and motorized trails in RCAs proposed for addition to NFTS.
  - There would be 0 acres of "Open Areas" in RCAs (Greenhorn Area; Boca, Prosser, and Stampede Reservoir access).

- There would be a total of 725.8 miles of native surface roads and motorized trails in RCAs on the TNF (density = 0.7 mi./sq.mi.).
- There would be 1,558 perennial and intermittent crossings.
- There are 0.0 miles of routes on the Forest proposed for addition to the NFTS with documented erosional features.
- The ERAs associated with the NFTS would be 13,180.

Alternative 4 – Increased Resource Protection

- **Prohibition of Cross Country Motor Vehicle Travel:** Public wheeled motor vehicle travel off designated NFTS roads, NFTS trails, and outside established motorized use areas would be prohibited, except as allowed by permit or other authorization. This would prohibit the proliferation of new routes and prohibit motorized use on all unauthorized and closed system routes not added to the NFTS. This could reduce erosion and subsequent sediment delivery to waterbodies associated with motorized use on the TNF.
- **Additions to the NFTS.** Adding 1.7 miles of roads in RCAs and 3.7 miles of trails in RCAs to the NFTS would have minimal effects to hydrology resources. These are pre-existing routes so no new soil compaction/disturbance would be created. These route additions would be subject to FS standards.
- **Establishment of motorized "Open Areas"** No additional motorized "Open Areas" would be established under this alternative.
- **Changes to the existing NFTS.**
  - **Change Vehicle Classes through Mixed Use**: No changes would be made to allow licensed operators of non-highway legal vehicles to operate on NFS roads where such use is currently prohibited through approval of mixed use.
  - **Change Vehicle Classes through Maintenance Levels:** Changing vehicle class on 2.0 miles or routes in RCAs to allow operators of non-highway legal vehicles to operate on NFS roads where such use is currently prohibited through the conversion of ML 3 roads to ML 2 would have minimal effects to hydrology resources. These are pre-existing "routes." As NFTS routes, these routes would be subject to FS standards.
  - **Changes in Seasonal Restrictions:** Wet weather seasonal closures from January 1 to May 31 in the Burlington area and January 1 to April 30 on the remainder of the Forest on native surface roads and motorized trails would be added to minimize erosion and protect water quality. A total of 245.8 total miles in RCAs would have changes in seasonal restrictions. Seasonal restrictions would decrease the risk of increased erosion and sediment deliver to water bodies associated with wet season route damage due to motorized use.
  - **Reopening Maintenance Level 1 Roads**: Reopening 0.1 miles on one ML 1 road in RCAs to motorized use would not affect long-term hydrology resources. Closed NFTS routes that are proposed to be opened are roads that were engineered to control drainage and erosion and are

thus designed to minimize stream sedimentation. They are expected to receive maintenance when opened.

- **Forest Plan Amendment**: No amendments would be made to the Forest Plan.
- **Cumulative Effects:** The short-term cumulative effects of Alternative 4 would be minimal. The long-term cumulative effects of Alternative 4 would decrease the NFTS hydrologic footprint and effects to watershed resources.
  - There would be 0 acres of "Open Areas" in RCAs (Greenhorn Area; Boca, Prosser, and Stampede Reservoir access).
  - There would be a total of 733.3 miles of native surface roads and motorized trails in RCAs on the TNF (density =0.7 mi./sq.mi.).
  - There would be 1,576 perennial and intermittent crossings on the TNF.
  - There are 19.1 miles of routes on the Forest proposed for addition to the NFTS with documented erosional features. These erosion features would be mitigated prior to opening for motorized use.
  - The ERAs associated with the NFTS would be 13,206.

Alternative 5 – Increased Motorized Recreation Access plus Reopening Maintenance Level 1 and Temporary Roads

- **Prohibition of Cross Country Motor Vehicle Travel:** Public wheeled motor vehicle travel off designated NFTS roads, NFTS trails, and outside designated motorized use areas would be prohibited, except as allowed by permit or other authorization. This would prohibit the proliferation of new routes and prohibit motorized use on all unauthorized and closed system routes not added to the NFTS. This could reduce erosion and sediment delivery to waterbodies associated with motorized use on the TNF.
- **Additions to the NFTS.** Adding 2.6 miles of roads in RCAs and 13.7 miles of trails in RCAs to the NFTS would have minimal effects to soil resources. These are pre-existing routes so no new soil compaction/disturbance would be created. These route additions would be subject to FS standards.
- **Establishment of motorized "Open Areas"** No additional motorized "Open Areas" would be established under this alternative.
- **Changes to the existing NFTS.**
  - **Change Vehicle Classes through Mixed Use**: Changing vehicle class on 241.5 miles to allow licensed operators of non-highway legal vehicles to operate on NFS roads where such use is currently prohibited through approval of mixed use would not affect hydrology resources.
  - **Change Vehicle Classes through Maintenance Levels:** Changing vehicle class on 34.3 miles of roads in RCAs to allow operators of non-highway legal vehicles to operate on NFS roads where such use is currently prohibited through the conversion of ML 3 roads to ML 2 would have minimal effects to hydrology resources. These are pre-existing "routes." As NFTS routes, these routes would be subject to FS standards.

  - **Changes in Seasonal Restrictions:** Wet weather seasonal closures from January 1 to May 31 in the Burlington area and January 1 to April 30 on the remainder of the Forest on native surface roads and motorized trails would be added to minimize erosion and protect water quality. A total of 263.1miles of routes in RCAs would have changes in seasonal restrictions.
  - **Reopening Maintenance Level 1 Roads**: Reopening 14.8 miles on 113 ML 1 roads in RCAs to motorized use would have a small affect on hydrology resources where the routes are reopened. Closed NFTS routes that are proposed to be opened are roads that were engineered to control drainage and erosion and are thus designed to minimize stream sedimentation. They are expected to receive maintenance when opened.
- **Forest Plan Amendment**: There would be the same effects as the Seasonal Restrictions above.
- **Cumulative Effects**: The short-term cumulative effects of Alternative 5 would be minimal. The long-term cumulative effects of Alternative 5 would decrease the NFTS hydrologic footprint and effects to watershed resources.
  - There would be 0 acres of "Open Areas" in RCAs (Greenhorn Area; Boca, Prosser, and Stampede Reservoir access).
  - There are 16.1 miles of unauthorized native surface roads and motorized trails routes in RCAs proposed for addition to NFTS.
  - There would be 50.1 miles of ML 1 roads in RCAs reopened.
  - There would be a total of 791 miles of native surface roads and motorized trails in RCAs on the TNF (density = 0.7 mi./sq.mi.).
  - There would be 1,740 perennial and intermittent crossings.
  - There are 54.1 miles of routes on the Forest proposed for addition to the NFTS with documented erosional features. These erosion features would be mitigated prior to opening for motorized use.
  - The ERAs associated with the NFTS would be 13,446.

Alternative 6 – Preferred Alternative Motorized Access and Resource Protection

- **Prohibition of Cross Country Motor Vehicle Travel:** Public wheeled motor vehicle travel off designated NFTS roads, NFTS trails, and outside designated motorized use areas would be prohibited, except as allowed by permit or other authorization. This would prohibit the proliferation of new routes and prohibit motorized use on all unauthorized and closed system routes not added to the NFTS. This could reduce erosion and subsequent sediment delivery to waterbodies associated with motorized use on the TNF.
- **Additions to the NFTS.** Adding 7.0 miles of roads in RCAs and 9.0 miles of trails in RCAs to the NFTS would have minimal effects to hydrology resources. These are pre-existing routes so no new soil compaction/disturbance would be created. These route additions would be subject to FS standards.
- **Establish motorized "Open Areas"** Three areas totaling 244 acres (Boca, Prosser, and Stampede Reservoir access) would be established as motorized "Open Areas" under this alternative.

- **Changes to the existing NFTS.**
  - **Change Vehicle Classes through Mixed Use**: Changing vehicle class on 130.8 miles of roads in RCAs to allow licensed operators of non-highway legal vehicles to operate on NFS roads where such use is currently prohibited through approval of mixed use would not affect hydrology resources.
  - **Change Vehicle Classes through Maintenance Levels:** Changing vehicle class on 25.2 miles of roads in RCAs to allow operators of non-highway legal vehicles to operate on NFS roads where such use is currently prohibited through the conversion of ML 3 roads to ML 2 would have minimal effects to hydrology resources. These are pre-existing routes so the loss of productivity has already occurred. As NFTS routes, these routes would be subject to FS standards.
  - **Changes in Seasonal Restrictions:** Wet weather seasonal closures would be added from January 1 to March 31 on the west side of the Forest and January 1 to April 30 on the remainder of the Forest on native surface roads, motorized trails, and "Open Areas" to minimize erosion and protect water quality. In addition, over the snow travel would be permitted on 3.6 miles of the Fordyce Jeep trail when 15 inches of snow is present on the ground. A total of 255.5 miles of routes in RCAs would have changes seasonal restrictions.
  - **Reopening Maintenance Level 1 Roads**: Reopening 2.2 miles of 13 ML 1 roads in RCAs to motorized use would have a small affect on hydrology resources where the routes are reopened. Closed NFTS routes that are proposed to be opened are roads that were engineered to control drainage and erosion and are thus designed to minimize stream sedimentation. They are expected to receive maintenance when opened.
  - **Forest Plan Amendment**: There would be the same effects as the Seasonal Restrictions above.
- **Cumulative Effects**: The short-term cumulative effects of Alternative 6 would be minimal. The long-term cumulative effects of Alternative 6 would decrease the NFTS hydrologic footprint and effects to watershed resources.
  - There would be 244 acres of "Open Areas" in RCAs (Boca, Prosser, and Stampede Reservoir access).
  - There would be a total of 769.2 miles of native surface roads and motorized trails in RCAs on the TNF (density =0.7 mi./sq.mi.).
  - There would be 244 acres of "Open Areas" in RCAs (Boca, Prosser, and Stampede Reservoir access).
  - There would be 1,676 perennial and intermittent crossings.
  - There are 41.7 miles of routes on the Forest proposed for addition to the NFTS with documented erosional features. These erosion features would be mitigated prior to opening for motorized use.
  - The ERAs associated with the NFTS would be 13,276.

Alternative 7 – Proposed Action as Identified in Notice of Intent (NOI)

- **Prohibition of Cross Country Motor Vehicle Travel:** Public wheeled motor vehicle travel off designated NFTS roads, NFTS trails, and outside designated motorized use areas would be prohibited, except as allowed by permit or other authorization. This would prohibit the proliferation of new routes and prohibit motorized use on all unauthorized and closed system routes not added to the NFTS. This could reduce erosion and subsequent sediment delivery to waterbodies associated with motorized use on the TNF.
- **Additions to the NFTS.** Under this alternative, adding 6.8 miles unauthorized trails in RCAs to the NFTS would have minimal effects to hydrology resources. These are pre-existing routes so no new soil compaction/disturbance would be created. These routes would be subject to FS standards.
- **Establishment of motorized "Open Areas"** No additional motorized "Open Areas" would be established under this alternative.
- **Changes to the existing NFTS.**
  - **Change Vehicle Classes through Mixed Use**: No changes would be made to allow licensed operators of non-highway legal vehicles to operate on NFS roads where such use is currently prohibited through approval of mixed use.
  - **Change Vehicle Classes through Maintenance Levels:** Changing vehicle class on 2.0 miles of roads in RCAS to allow operators of non-highway legal vehicles to operate on NFS roads where such use is currently prohibited through the conversion of ML 3 roads to ML 2 would have minimal effects to hydrology resources. These are pre-existing "routes." As designated routes within the NFTS these routes would be subject to FS standards.
  - **Changes in Seasonal Restrictions:** No changes in seasonal restrictions would be made.
  - **Reopening Maintenance Level 1 Roads**: Reopening two ML 1 roads (0.1 miles in RCAs) to motorized use may have a minor effect on hydrology resources. Closed NFTS routes that are proposed to be opened are roads that were engineered to control drainage and erosion and are thus designed to minimize stream sedimentation. They are expected to receive maintenance when opened.
- **Forest Plan Amendment**: No amendments would be made to the Forest Plan.
- **Cumulative Effects**: The short-term cumulative effects of Alternative 7 would be minimal. The long-term cumulative effects of Alternative 7 would decrease the NFTS hydrologic footprint and effects to watershed resources.
  - There would be 0 acres of "Open Areas" in RCAs (Greenhorn Area; Boca, Prosser, and Stampede Reservoir access).
  - There would be a total of 734.6 miles of native surface roads and motorized trails in RCAs on the TNF (density =0.7 mi./sq.mi.).
  - There would be 1,577 perennial and intermittent crossings on the TNF.
  - There are 38.4 miles of routes on the Forest proposed for addition to the NFTS with documented erosional features. These erosion features would be mitigated prior to opening for motorized use.

- The ERAs associated with the NFTS would be 13,220.

Summary of Effects to Hydrology Resources

Table 3.02-24 summarizes the effects analysis for hydrology resources by ranking each alternative regarding how well it provides for each of the indicators. This summary is not meant to convey that the indicators are equal in importance. The following rankings were used: A score of 7 indicates the alternative has the least impact for hydrology resources to the indicator. A score of 1 indicates the alternative has the most impact for hydrology resources related to the indicator.

Table 3.02-24. Comparison of Effects to Hydrology Resources

Indicators – Hydrology Resources	Rankings of Alternatives for Each Indicator[1]						
	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Miles of unauthorized routes in hydrologically sensitive areas (RCAs).	1	0	0	0	0	0	0
Native Surface Roads and Motorized Trails in RCAs Sum of the erosion potential in cubic yards or tons or route miles with existing erosional features on unauthorized routes and areas proposed for addition to the NFTS in hydrologically sensitive areas on the forest.	1	3	7	6	2	4	5
Numbers of locations where routes divert or have potential to divert streamflow. All Higher Risk Route crossings are assumed to have diversion potential.	1	3	7	6	2	4	5
Sum of route miles with documented erosional features.	1	2	7	6	2	5	6
Equivalent roaded areas in acres.	1	4	7	6	2	3	5
Prohibition on Cross County Travel	1	2	4	4	4	3	4
Seasonal Restrictions miles of routes	2	1	2	5	7	6	2
Native surface road and motorized trail density	1	3	5	6	2	4	6
Average for Water Resources	**1.0**	**2.0**	**7.0**	**6.0**	**3.0**	**4.0**	**5.0**

[1] A score of 7 indicates the alternative has the least impact for water resources related to the indicator; A score of 1 indicates the alternative has the most impact for water resources related to the indicator.

Using the metrics from Table 3.02-24, Alternative 1 would have the highest potential impacts to hydrology resources. All of the action alternatives would have a similar potential impact to hydrology resources. Included in Table 3.02-24 are the prohibition of cross country travel and the seasonal closures. Because these two proposed actions cover the most of the TNF, they would greatly outweigh the proposed additions and changes to the NFTS. Taking into account the magnitude of impacts of the proposed prohibition of cross country travel and the seasonal closures, the alternatives would be ranked from highest potential impact to lowest: Alternative 1, Alternative 2, Alternative 7, Alternative 3, Alternative 5, Alternative 6, and then Alternative 4.

Summary of Effects to Geologic, Soil and Hydrology Resources

This project defines where motorized vehicle traffic use is authorized on the Tahoe National Forest. Therefore, direct impacts to soils and adjacent watersheds and stream courses that result from this project are limited. There are no new ground disturbing activities proposed with this project. The roads, motorized trails and "Open Areas" being evaluated in this analysis already exist on the ground, but may require upgrading to NFTS standards as well as periodic maintenance. They are compacted and generally lack vegetation. Runoff from the surface is collected and discharged as potentially erosive flows at points below the road or motorized trail. Some are eroded or causing erosion, others are stable and are not causing any negative resource impacts. From the standpoint of soil productivity and growing vegetation, these roads, motorized trails and "Open Areas" are already non-productive. Therefore the potential effects on soil and watershed resources are related to sustaining road or trail function, protecting adjacent soils from runoff and gully erosion, protecting water quality, or restoring the routes to a productive state. Given that Alternative 1 (no action) the existing hydrologic footprint is the largest proposed, all action alternatives would reduce the footprint of motorized use.

It should be noted that although many roads and motorized trails on the TNF have some site specific risks to geology, soil and/or water resources, most of these risks can be mitigated. The field surveys performed for this assessment found site specific concerns to be mitigated, but with regular maintenance and control of wet season use the roads, motorized trails and "Open Areas" seem to be sustainable. All known erosional sites would be fully mitigated before shown on the MVUM, so that adverse effects of adding new routes would be minimized.

Conclusion

All of the action alternatives meet existing standards and guidelines, laws, and policies. Prohibition of cross country travel and wet season closures are the two most important potential actions proposed in this project. Prohibiting cross country travel would limit the expansion of the road and trail related disturbance footprint. Equally as important in limiting the negative effects of motorized travel on geologic, soil and hydrology resources, is the wet season closure. The positive effects of these two actions would far outweigh the proposed additions of motorized trails to the NFTS or the changes in vehicle class. The order of potential cumulative effect of the alternatives, from highest potential to lowest potential, would be Alternative 1, Alternative 2, Alternative 7, Alternative 3, Alternative 5, Alternative 6, and then Alternative 4.