Thunder Basin National Grassland

Roads Analysis Report

Medicine Bow-Routt National Forest

June 2004

Forest Service
U.S. Department of Agriculture

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Prepared for, and in coordination with

U.S. Department of Agriculture
Forest Service

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ACRONYMS AND ABBREVIATIONS

ANILCA	Alaska National Interest Lands Conservation Act
ATV	All-Terrain Vehicle
BLM	Bureau of Land Management
CBM	Coal Bed Methane
CFR	Code of Federal Regulations
FSM	Forest Service Manual
FY	Fiscal Year
HUC	Hydrologic Unit Code
IDT	Interdisciplinary Team
m/m^2	mile of road per square mile of land
MOU	Memorandum of Understanding
MSL	Mean Sea Level
MUTCD	Manual on Uniform Traffic Control Devices (MUTCD)
NFS	National Forest System
NHPA	National Historic Preservation Act
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
SIO	Scenic Integrity Objective
ROS	Recreation Opportunity Spectrum
TBNG	Thunder Basin National Grassland
USC	United States Code
USCB	United States Census Bureau
USDOT	United States Department of Transportation
USFS	United States Forest Service

CHAPTER 1
SETTING UP THE ANALYSIS

BACKGROUND

In August 1999, the Washington Office of the USDA Forest Service published Miscellaneous Report FS-643 *Roads Analysis: Informing Decisions about Managing the National Forest Transportation System*. The objective of roads analysis is to provide decision-makers with critical information to develop road systems that are safe and responsive to public needs and desires, are affordable and efficiently managed, have minimal negative ecological effects on the land, and are in balance with available funding for needed management actions.

In October 1999, the agency published Interim Directive 7710-99-1 authorizing units to use, as appropriate, the road analysis procedure embodied in FS-643 to help land managers make major road management decisions. The Rocky Mountain Region of the Forest Service then published a roads analysis guidance document as a supplement to Appendix 1 of FS-643. This document provides guidance concerning the appropriate scale for addressing the roads analysis. On March 3, 2000, the Forest Service proposed revising 36 CFR Part 212 to shift emphasis from transportation development to managing administrative and public access within the capability of the lands.

The proposal was to shift the focus of National Forest System road management from development and construction of new roads to maintaining and restoring needed roads and decommissioning unneeded roads within the context of maintaining, managing, and restoring healthy ecosystems.

On January 12, 2001, the Forest Service issued the final National Forest System Road Management Rule. This rule revises regulations concerning the management, use, and maintenance of the National Forest transportation system. Consistent with changes in public demands and uses of National Forest System resources and the need to better manage funds available for road construction, reconstruction, maintenance, and decommissioning, the final rule removes the emphasis on transportation development and adds a requirement for science-based transportation analysis. The final rule is intended to help ensure that additions to the National Forest System road network are those deemed essential for resource management and use; that construction, reconstruction, and maintenance of roads minimize adverse environmental impacts; and that unneeded roads are decommissioned and restoration of ecological processes are initiated.

PROCESS

Roads analysis is a six-step process. The steps are designed to be sequential, with an understanding that the process may require feedback and iteration among steps over time.

1. Setting up the analysis
2. Assessing benefits, problems and risks
3. Describing the situation
4. Describing opportunities and setting priorities
5. Identifying the issues
6. Reporting—Chapters 1-6 of this report

The amount of time and effort spent on each step differs by project based on specific situations and available information. The process provides a set of possible issues and analysis questions; the answers can help managers make choices about road system management.

PRODUCTS

The product of an analysis is a report for decision-makers and the public that documents the information and analyses used to identify opportunities and set priorities for future national grassland road systems. Included in a report is a map displaying the known road system for the analysis area, and the risks and opportunities for each road or road segment. A report may also include other maps and tables necessary to display specific priorities and changes in a road system.

THIS REPORT

This report documents the information and analysis procedure used for the Thunder Basin National Grassland (TBNG) roads analysis. The report contains a table rating each road for its relative *value* in regards to: the transportation system, mineral resource management, social concerns, recreation, and rangeland use and management; as well as the relative *risk* each road poses to: jurisdictional issues, maintenance costs, wildlife, aquatic communities, hydrology, and noxious weed spread. It contains an analysis of major issues on the National Grassland and a list of management guidelines and opportunities for future actions. It also includes maps with the existing maintenance level 3 road system and the potential minimum level 3 road system, and a map of road density across the TBNG.

Note: Typically, a roads analysis at this scale would focus on USFS maintenance level 3, 4, and 5 roads. However, there are no maintenance level 4 or 5 roads on the TBNG under USFS jurisdiction. Thus, only maintenance level 3 roads are covered in detail under this analysis. Maintenance level 1 and 2 roads are addressed as they pertain to certain area analyses and the management of maintenance level 3 roads.

OBJECTIVES OF THE ANALYSIS

ESTABLISH THE LEVEL AND TYPE OF DECISION-MAKING THE ANALYSIS WILL INFORM

This 'forest scale' roads analysis puts the road system into the context of resource management. In addition, this roads analysis will be used to support travel management plans and project level analyses. This analysis will:

- Include the effects of road management proposals on environmental and social issues.
- Evaluate transportation rights-of-way acquisition and jurisdiction agreement needs.
- Integrate with other non-Forest Service transportation systems (e.g., state and county roads).
- Explore the transportation investments necessary to implement the 2001 Thunder Basin National Grassland Land and Resource Management Plan and meet resource management goals and objectives.
- Assess the current and projected funding levels available to support road construction, reconstruction, maintenance, and decommissioning.

It is intended to identify and prioritize opportunities that address resource concerns and/or road maintenance. It will also be used to develop guidelines for road system management on the TBNG.

IDENTIFY SCALE/ANALYSIS AREA

The analysis will:

- Be at the scale of the Thunder Basin National Grassland (553,300 acres) in northeastern Wyoming, Region 2 of the National Forest System (**Figure 1-1**).
- Concentrate on maintenance level 3 roads, though levels 1 and 2 may be addressed as they pertain to certain analyses and the management of maintenance level 3 roads.
- Be spatial or Geographic Information System (GIS)-based whenever possible.
- Use only existing information.

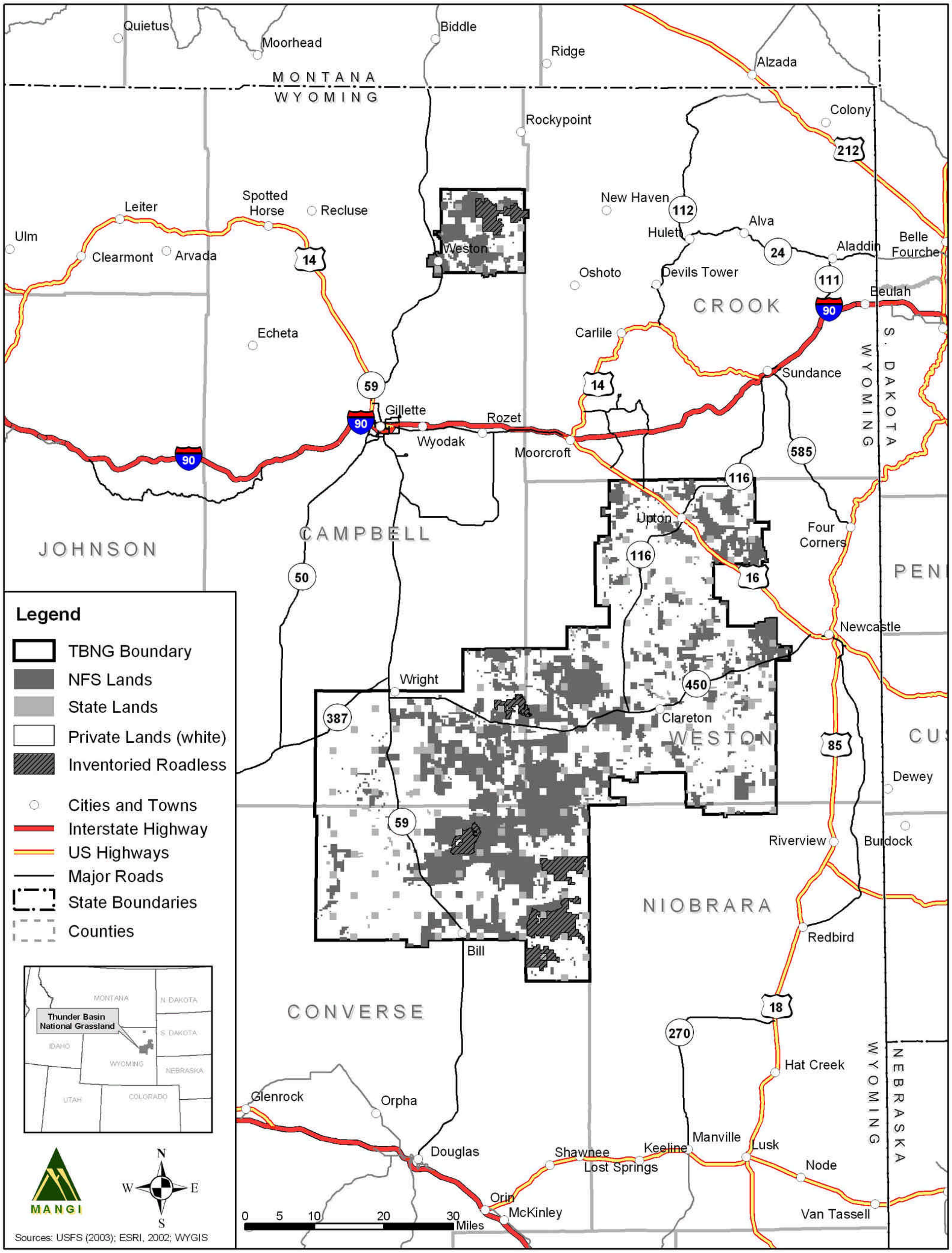

Figure 1-1. The Thunder Basin National Grassland and Vicinity

INTERDISCIPLINARY TEAM MEMBERS AND PREPARERS

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ANALYSIS PLAN

Phase One: Gathering Information

The first step of this phase was to establish a list of preliminary major issues for the RAP based on an initial meeting of the TBNG RAP interdisciplinary (ID) team. In addition, the ID Team reviewed the list of questions in the Region 2 Supplement and developed a tentative list of question-specific concerns that should be addressed in the RAP document.

The second step of this phase involved a meeting of the RAP ID team to assess each individual USFS maintenance level 3 road with respect to its relative values and associated risks. High, moderate, and low rankings were given to each road with respect to its *value* in regards to the following categories: the transportation system, mineral resource management, social concerns, recreation, and rangeland use and management. High, moderate, and low rankings were also given to each road with respect to its associated *risks* relative to the following categories:

jurisdictional issues, maintenance costs, wildlife, aquatic communities, hydrology, and noxious weed spread.

Numeric values were then assigned to each high, moderate, and low value or risk within each category. For example, a road with "high" mineral resource value would be given a numeric rank of 5 for that category, while roads identified as having "moderate" value would be given a numeric rank of 2, and roads with a "low" value a numeric rank of 0. Value ranks for each road were then summed across all categories to yield an overall value for each USFS maintenance level 3 road. Risk ranks for each category were also summed to yield a total overall risk for each USFS maintenance level 3 road.

To assist in the ranking process, a datasheet was compiled that listed several characteristics of each road, including such characteristics as length, surface type, use, maintenance level, number of stream crossings, number of miles within various wildlife habitats. This information was used in conjunction with a large format map to support rankings developed by the ID team members. Refer to Chapter 5, *Describing Opportunities and Setting Priorities*, for a complete description of the ranking process and results.

The summation of each road's value and risk numeric rankings results in each road having a set of descriptive coordinates The descriptive coordinates for each road are plotted on a graph; the four quadrants on the graph represent the following categories:

- Category 1 – High Value, Low Risk
- Category 2 – High Value, High Risk
- Category 3 – Low Value, High Risk
- Category 4 – Low Value, Low Risk

Once the roads are assigned to one of the four categories, recommendations for future actions are developed based on the four categories. This simplifies the final product and makes it possible to map the potential minimum road system.

Phase Two: Assessing Current Conditions

For this phase, the ID team utilized available information and road specific rankings to answer the RAP questions listed in the Region 2 Supplement to FS-643, *Roads Analysis: Informing Decisions About Managing the National Forest Transportation System*. Summarized results from the road ranking effort described under Phase One, GIS data sources, and other ancillary data sources [i.e., the Thunder Basin National Grassland, Land and Resource Management Plan (LRMP) (USFS, 2001a) and accompanying Environmental Impact Statement (EIS) (USFS, 2001b), resource-specific reports, etc.) were used to support these analyses.

Phase Three: Reporting Findings and Making Recommendations

During this phase, information was synthesized to provide an overall assessment of the Thunder Basin National Grassland road system. Based on the RAP findings, a list of recommendations and potential future opportunities for management of the road system was developed.

INFORMATION USED

The following information sources were used for the analysis:

- Annual and deferred maintenance costs in INFRA
- INFRA travel routes
- The TBNG Land and Resource Management Plan (USFS, 2001a) and EIS (USFS, 2001b)

The IDT utilized the following Geographic Information System (GIS) data:

- Roads
- 5th-level watersheds.
- Streams and Waterbodies
- Common Vegetation Unit (CVU) data later (vegetation cover, riparian areas, etc.)
- Common land unit data layer (soils)
- Geographic Area Designations
- Recreation Opportunity Spectrum
- Land status
- TES species observation location information
- Research Natural Area and Special Interest Area layers
- Inventoried Roadless Areas
- Digital Elevation Model data (elevation, derived slope)
- Oil and Gas Well Location and Condition information
- Coal Mine Permit locations
- Rangeland Allotments
- Rangeland Improvement locations and types
- Administrative Boundaries
- Ownership layer (Federal, State, and Private land boundaries)

PUBLIC INVOLVEMENT

The IDT based the development of the issues for this Roads Analysis on a synthesis of comments received from related projects and the recent plan revision effort. The revised Land and Resource Management Plan for Thunder Basin National Grassland was completed between 1995 and 2002. Extensive public comment was received throughout that process, some of it related to roads. Travel management was one of the major revision topics for the Plan. Comments relating to roads and travel management are summarized in Appendix A of the FEIS (USDA, 2001b). Other recent projects with road related issues have also received public comments.

Since this Roads Analysis is not a decision document, the IDT decided not to involve the public directly at this time. There will be additional opportunities for public involvement in the upcoming travel management decisions planned for the next few years. There is also an ongoing effort with the Forest Service and the Counties to establish and formalize road maintenance agreements which also helped in issue development.

CHAPTER 2
DESCRIBING THE SITUATION

THE ANALYSIS AREA

UNDERSTANDING THE THUNDER BASIN NATIONAL GRASSLAND

The Thunder Basin National Grassland (TBNG) is located in northeastern Wyoming in the Powder River, Little Missouri/Belle Fourche, and Cheyenne River basins between the Big Horn Mountains and the Black Hills. These lands generally lie between Douglas on the south, Newcastle on the east, Montana state border on the north, and Wright on the west. The TBNG is administered by the Douglas Ranger District of the Medicine Bow-Routt National Forest. Portions of the TBNG are located within the boundaries of Campbell, Converse, Crook, Niobrara, and Weston counties.

Physical Environment

The TBNG occupies approximately 553,300 acres of National Forest System land highly interspersed with State, Bureau of Land Management (BLM), and private lands. No designated wilderness areas exist on the TBNG.

The TBNG is divided into six geographic areas: Broken Hills, Cellers Rosecrans, Fairview Clareton, Hilight Bill, Spring Creek, and Upton Osage. The climate of all of these areas can be classified as semi-arid continental, characterized by cold winters and warm summers with infrequent periods of hot weather of more than 100 degrees Fahrenheit. Annual precipitation for most of the TBNG ranges from 10 to 14 inches, with about 40 inches of annual snowfall (USFS, 2001a). **Table 2-1** describes other characteristics of the TBNG by geographic area.

Table 2-1. Physical Characteristics of the TBNG			
Geographic Area	**Location**	**Topography/ Elevations**	**Primary Drainages**
Broken Hills	Includes Rochelle Hills, Red Hills, Cow Creek Buttes, and the Downs area southeast of Bill, WY	Rolling hills to steep escarpments; elevations range from 4,500 to 5,200 feet above mean sea level (MSL)	Black Thunder Cr. (and tributaries Little Thunder and HA Cr.); mainstem of Dry Cr. (and tributaries Bobcat, Deer, and Little Rat Cr.); Dry Fork of Cheyenne River; tributaries to Antelope Cr.
Cellers Rosecrans	Central part of TBNG, from Cheyenne River north	Fairly level plains to rolling hills; elevations range from 4,300 to 4,700 feet above MSL	Black Thunder Cr.; lower portion of Little Black Thunder Cr.; portions of Cheyenne River (and tributaries Frog and Horse Cr.); parts of Antelope Cr.
Fairview Clareton	Easternmost part of TBNG, between the Cheyenne River and US Highway 16	Nearly level plains to rolling and moderately steep hills, with some gullied lands; elevations range from 3,800 to 4,800 feet above MSL	Lodgepole Cr. (and tributaries Wildcat, Lone Tree, Deep, and Hay Cr.); Beaver Cr. (and tributaries South Beaver, Mush, Fiddler, and lower Iron and Turner Cr.)
Hilight Bill	Located parallel to State Highway 59 from Bill to Wright, WY	Fairly level plains with slopes less than 15%; elevations range from 4,700 to 5,300 feet above MSL	Headwaters of Antelope Cr. (and tributaries Bates, Spring, and Porcupine Cr.); Dry Fork of Cheyenne River; Dry Cr.
Spring Creek	Eastern Wyoming, about 30 miles north of Gillette, WY	Nearly level to moderately steep plains, with rolling hills and steep escarpments in the west and north; elevations range from 4,100 to 4,600 feet above MSL	Duck Cr.; ZV Cr.; Spring Cr. (and tributaries Dry Fork Spring and Wild Horse Cr.); Prairie Cr. (and tributary Horse Cr.
Upton Osage	Extreme north-eastern portion of TBNG, west of the Black Hills	Nearly level plains to ascending hills; elevations range from 4,200 to 4,500 feet above MSL	Pine, Iron, and Turner Cr. (headwater tributaries of Beaver Cr.) within the Cheyenne River watershed; Wind, Arch, and Willow Cr. within the Belle Fourche River watershed

Soils

The underlying geology of the planning area is predominantly shale. The central and western portions of the planning area have soils of fine to medium texture. Thunder Basin National Grassland has a wide variety of soils that range from deep well drained sand and loamy soils to very shallow clayey soils. Badland areas are made up of primarily shale.

Mitigation measures have been developed to protect the soil resource, which incorporate the Forest Service Region 2 Water Conservation Handbook. Soil-disturbing activities associated with oil, gas, and mineral operations would be prohibited (e.g., road construction, well pad construction) on slopes between 25 and 40 percent with either highly erodible soils or soils susceptible to mass failure. For all activities, revegetation is required after ground-disturbing activities. To prevent soil erosion, non-native annuals or sterile perennial species may be used while native perennials are becoming established.

Biological Environment

Vegetation

The TBNG is located in a broad transition area between the plains of the central U.S. and the range physiographic provinces to the west. The Grassland occupies a north-south transition area between the southern and middle Rocky Mountains. Most of the TBNG is a sagebrush/grass vegetative community type, which consists of a wide variety of vegetation, such as western wheatgrass, needle-and-thread grass, prairie junegrass, little bluestem, buffalo grass, blue grama grass, and prickly pear cactus. Foothill and lower-elevation species also occur, including ponderosa pine, Rocky Mountain juniper, cottonwood, and boxelder. Dominant vegetation types by geographic area of the TBNG are presented in **Table 2-2**.

Table 2-2. Dominant Vegetation in the TBNG Geographic Areas

Geographic Areas	Dominant Vegetation
Broken Hills	sagebrush, needle-and-thread grass, blue grama grass, western wheatgrass, ponderosa pine
Cellers Rosecrans	sagebrush, blue grama grass, western wheatgrass, needle-and-thread grass, cottonwood
Fairview Clareton	blue grama grass, western wheatgrass, sagebrush
Hilight Bill	sagebrush, blue grama grass, western wheatgrass, needlegrass
Spring Creek	sagebrush, western wheatgrass, little bluestem, needlegrass; about 6,000 acres of ponderosa pine occurs in the Weston Hills and northern part of this geographic area
Upton Osage	Ponderosa pine in more hilly locations, with sagebrush and numerous grass species on the more level plains

The current R2 sensitive species list has identified some plant species that are suspected to occur on the Grassland. One sensitive plant species (Barr's milkvetch) has been found and documented on the TBNG.

The TBNG does not have an up-to-date inventory of noxious weed species and infestation levels. Key noxious weeds on the Grassland include leafy spurge, spotted knapweed, Canada thistle, and musk thistle. In addition, the Grassland contains approximately 200 acres of crested wheatgrass. Between 1994 and 1996, approximately 160 acres of noxious weeds were treated on the TBNG (USFS, 2001b).

Wildlife

Birds

The TBNG is listed as a National and State "Important Bird Area." Important Bird Areas are sites identified by the Audubon Society in partnership with BirdLife International, which provide essential habitat to one or more species of birds during some portion of the year (such as breeding areas, crucial migration stopover sites, or wintering grounds). TBNG generally provides habitat for two ecological groups of breeding birds: grassland-sagebrush-steppe associated species and wooded-riparian associated species. To a lesser extent, TBNG also provides riverine and isolated wetland habitats for some aquatic species.

The unglatiated Missouri Plateau region of the Great Plains provides breeding, migratory stopover, and overwintering habitat for over 400 species of birds, almost half of all species known to North America. Emberizid finches (buntings and sparrows), waterfowl, flycatchers, hawks, and blackbirds account for the majority or breeding birds in the region. Wood warblers, shorebirds, waterfowl, and emberizid finches are well represented among species that migrate through the upper plains region of the Mid-continental Flyway.

The TBNG also supports numerous non-migratory bird species. Examples include sage grouse, sharptail grouse, quail, and wild turkey.

Mammals

The prairie dog, an endemic small mammal of the prairie, is a keystone species at TBNG. This species serves as food for a variety of carnivores, such as coyotes, red foxes, raptors, and badgers, and its burrows are used by a host of smaller mammals and burrowing owls for shelter. Prairie dog populations shift on the landscape over time, waning and waxing in relation to yearly environmental pressures.

Ungulates, such as the native pronghorn, mule deer, white-tailed deer, and re-introduced elk, are well adapted to life at TBNG. These species utilize large areas of land, especially in the short-grass prairie or sagebrush communities where sustenance is sparse. The yearly home range of large ungulates can reach 100 square miles or more, and may include separate parts of the regional landscape as calving, foraging, and wintering sites. Big game populations on the TBNG represent a significant portion of the eastern Wyoming herds, and as a result, a large portion of recreational and hunting opportunities.

Less than one quarter of the mammal species found in TBNG, predominantly species like shrews, mice, and bats, are of eastern origin. These species reach their western range limits in the short-grass prairie, finding suitable habitat in riparian wooded or brushy areas.

Fishes

Most streams and natural wetlands on the TBNG are intermittent, retaining surface water for only a portion of the year. These areas become wet after the winter snowpack melts, and gradually dry out during the spring and summer months. Some streams are ephemeral, with flowing water only after storm events. A few areas on TBNG have suitable conditions for permanent fish populations. These are perennial reservoirs and higher order streams (usually 4^{th} order and higher) of the Cheyenne, Little Missouri, and Powder Rivers that do not totally dry down during the summer. Beaver Creek, Turner Creek, and Little Thunder Creek also support fisheries year-round.

Long-nose dace, green sunfish, plains killfish, white sucker, fathead minnow, stonecat, and black bullhead are among the most common species present in these river systems. Recreational fishing occurs primarily at impoundments, where game fish such as channel catfish, largemouth bass, bluegill, yellow, perch, and bullhead can be caught. Limited recreational fishing for river species, including channel catfish, occurs in the main stream of the Little Powder and Cheyenne Rivers.

Herpetofauna

Eight species of amphibians and 12 species of reptiles potentially occur within or near TBNG. Herpetofaunal species, with the exception of snakes, are important trophically as both predators of insects and other invertebrates and prey for mammals, birds, and fish. Snakes are important predators of small mammals. Most species of amphibians are restricted to permanent aquatic sites or areas where temporary wetlands form. However, certain toads, such as the plains spadefoot, have the capacity to withstand drying conditions in upland grassland-sagebrush ecosystems and can take advantage of isolated wetlands for breeding. The tiger salamander and frogs, such as the northern leopard frog, are more restricted to locations of permanent or moderately long-duration wetland sites.

Among species of reptiles, most snakes and lizards, such as the western hognose snake, the bullsnake, and the sagebrush lizard, are adapted to dry upland conditions and generally do not require the presence of surface water. Conversely, a few tortoise species occur in this region, with the ornate box turtle as the only terrestrial species among them. In addition, the TBNG has a healthy population of snapping turtles, which are primarily associated with perennial streams and impoundments.

Social and Economic Environment

People and communities are tied to the TBNG in numerous ways. Management of the TBNG is of concern to people living in nearby communities, as well as those using and visiting the Grassland. Proximity to TBNG resources is what makes many communities adjacent to the Grassland desirable places to visit and live. Populations of the counties containing TBNG lands have generally increased over the past decade by an average of 6.8 percent.

Commodity and amenity benefits from public lands within the TBNG have contributed to the social systems and economic base of many neighboring communities. Economic uses of the TBNG include livestock grazing; oil, gas, and mineral leasing; and recreation and tourism. These uses provide both employment and income to local communities.

Recreation

Most recreation on the TBNG occurs in semi-primitive motorized areas. Motorized travel/ viewing scenery is the most popular recreation use category. There are 19 miles of inventoried motorized trails on the TBNG. No inventoried non-motorized trail systems or developed campgrounds exist on the TBNG, but opportunities for hiking and camping exist. Mountain biking and warm-water fishing opportunities are also available. Currently, 7 miles of recreational riverine fisheries and 6 fishing ponds are provided by the TBNG. There are 2 developed recreation sites, Soda Well Picnic Ground and Turner Reservoir, on the TBNG.

Other popular activities include prairie dog viewing and shooting, elk viewing, and hunting. The TBNG contains some of the largest coal deposits in the United States, and many people drive to the mines to view the mining process. Between 1992 and 1996, recreation use accounted for an annual average of 64,100 Recreation Visitor Days. Currently, the TBNG is experiencing some localized damage from off highway vehicles.

Locatable Minerals

Locatable minerals are those valuable deposits subject to exploration and development under the Mining Law of 1872 and its amendments. Gold and silver have been reported in coal near the eastern boundary of the TBNG. In addition, uranium is available for location under the General Mining Laws if it occurs on public domain lands, and much of the mineral estate of the TBNG is public domain. No active uranium mining occurs on the TBNG. The Bear Creek Uranium site is in the final stages of reclamation. While known uranium resources exist on the western portion of the TBNG, development potential is low.

Mineral resources on the TBNG include scoria scattered through the center of the Grassland in a north-south direction, and shale and sandstone on the eastern portion of the Grassland.

Leasable Minerals

There are 74 developed oil and gas fields within or partially within the TBNG. There are many oil and gas leases having only one producing well and several temporarily abandoned wells. Some wells have been temporarily abandoned for 10 years without being put back into production or plugged. The TBNG has experienced relatively steady, moderate, conventional oil and gas development activity over the past decade. For the next 10 years, up to 230 conventional oil and gas wells are projected.

A small portion of TBNG west of the coal outcrop near Highway 59 has high potential for coal bed methane resources (natural gas). This portion of the Grassland has experienced relatively high levels of coal bed methane development activity on existing leases over the past 5 years. Major coal development occurs on the TBNG; 6 mines on the Grassland produced approximately 138 million tons in 1997. There is a sizable bentonite deposit on the northeast side of the TBNG and existing bentonite leases on the acquired mineral estate.

Since much of the mineral estate is public domain on the TBNG, much of the uranium resource discussed above is considered locatable, although some is also considered leasable. No lands within the TBNG are currently leased for uranium mining.

Heritage Resources

Approximately 40 percent of the TBNG has undergone some degree of archaeological surface examination since the mid-1970s. Just over 1,200 sites, ranging from aboriginal encampments to historic trails and wagon roads to more recent homesteads and pastoral camps, have been located and recorded. About 160 of the historic and prehistoric sites recorded have been determined eligible for the National Register of Historic Places (NRHP), but none are currently listed on the NRHP. Site densities are high, averaging about 4 sites per square mile.

Timber Production

A timber suitability analysis was conducted as part of the TBNG Land and Resource Plan revision. According to this analysis, the TBNG does not contain tentatively suitable forest land. Stands of ponderosa pine, at about 2 thousand board feet per acre, are interspersed among the grasslands. No inventory volumes are available. Personal-use firewood permits are available.

Livestock Grazing

Permits are required for livestock grazing on the TBNG. There are approximately 532,100 capable rangeland acres on the TBNG, of which 532,060 are suitable for grazing. Livestock grazing use has decreased during the past several years, primarily due to continuing drought conditions across Wyoming. Drought conditions have resulted in livestock management strategy changes. Some of these changes were to seasons of use, livestock numbers, and some areas of total non-use.

Special Forest and Grassland Products

The TBNG Land and Resource Management Plan allows for the gathering or collection of special forest and grassland products, such as herbs, mushrooms, rocks, floral products, and medicinal plants. Permits are required to collect sensitive plants or commercially collect special forest or grassland products.

THE NATIONAL GRASSLAND TRANSPORTATION SYSTEM

GENERAL DESCRIPTION

The TBNG road system consists of approximately 1,521 miles of inventoried, classified roads under U.S. Forest Service (USFS) jurisdiction[1] (**Table 2-3**). An additional 1,073 miles of road under State, County, or private jurisdiction either cross through or provide additional and necessary access to USFS roads or Federal land holdings. Together, this mixture of Federal, State, County, and private jurisdiction roads serves as the primary means of access to TBNG for its wide variety of uses and management needs.

[1] "Jurisdiction is the legal right to control or regulate use of a transportation facility derived from fee title, an easement, or other similar method. While jurisdiction requires authority, it does not necessarily reflect ownership." (FSM 7705)

Approximately 13 percent of the TBNG road system under USFS jurisdiction is maintained at operational levels suitable for use by passenger vehicles. These roads, when under USFS jurisdiction, will be the primary focus of this analysis. The remainder of the TBNG road system is maintained at a level that provides access suitable only for high clearance vehicles. These roads provide the primary means of access for much of the industrial, dispersed recreation, and agricultural uses of the TBNG.

Unclassified roads on the TBNG are generally identified in the field during project analysis. The majority of these roads have been created by off-road vehicle traffic, or were temporary roads that have not been effectively closed. There is no current inventory of unclassified roads.

Management and Maintenance

National Forest roads are maintained to varying standards depending on the level of use and management objectives. There are five maintenance levels used by the USFS to determine the work needed to preserve road investment, only three of which are found at TBNG. Direction on how to meet the maintenance levels is included in FSH 7709.58, *Transportation System Maintenance Handbook*. **Table 2-3** summarizes the miles for the four maintenance levels for both USFS and Non-USFS jurisdiction roads that serve as the primary means of access to TBNG for its wide variety of uses and management needs.

Table 2-3. Maintenance Designations by Jurisdiction

Maintenance Level and Description		USFS Jurisdiction Only	Non-USFS Jurisdictions	All Jurisdictions
		Miles	Miles	Total
1	Assigned to intermittent service roads during time they are closed to vehicular traffic.	2	1	3
2	Assigned to roads operated for use by high clearance vehicles.	1,324	453	1,776
3	Assigned to roads operated and maintained for travel by a prudent driver in a standard passenger car.	**194***	193	387
4	Assigned to roads that provide a moderate degree of user comfort and convenience at moderate travel speeds.	0	19	19
Ø	No maintenance level designation.**	0	410	410
TOTAL (All maintenance levels)		1,520	1,075	2,595

* Note: those roads under USFS jurisdiction with a maintenance level 3 or higher will be the primary focus of this analysis.
** The majority of these roads are county roads that have not been given a maintenance designation. These roads are generally maintained in a condition consistent with maintenance level 3, 4 or 5.

Road Function

In general, road maintenance designations are closely tied to the relative use or function of each individual road. All roads can be categorized in a hierarchical system with respect to their functionality within a road system. In general, major *arterial routes* provide connections between populated places or provide high level access to major areas, and are generally built to support high volumes of traffic. *Collector roads* provide mid-level access to areas, are often accessed via larger arterial routes, and are built to support moderate traffic levels. *Local roads* are generally the most numerous, support the lowest traffic volume in the hierarchy, and function to provide direct access to specific locations, sites, and resources.

The vast majority of the TBNG road system under USFS jurisdiction (92 percent) consists of local roads that provide direct access to specific resources, such as recreation sites, windmills, well sites, mining sites, range lands, etc. Local roads are primarily managed for use with high clearance vehicles (their actual mileage may be underestimated due to inventory limitations). A small proportion of local roads (6 percent) are maintained at a higher standard capable of supporting passenger car traffic. These roads require a higher maintenance standard to provide access to mineral resource extraction or rangeland sites.

Arterial and collector roads account for approximately 8 percent of the road system under USFS jurisdiction. Although the majority of arterial and collector roads are maintained at a level capable of supporting passenger car traffic (85 percent), a small portion are maintained at a level suitable for high clearance vehicles (15 percent). **Table 2-4** lists roads under USFS jurisdiction by function and maintenance level.

Table 2-4. Miles of Road under Forest Service Jurisdiction by Road Function and Maintenance Level

Function	Maintenance Level (in miles)			
	1- Closed	2 – High Clearance Vehicles	3 – Passenger Car	Total
A - ARTERIAL		11	46	57
C - COLLECTOR		5	62	67
L - LOCAL	2	1,308	86	1,397
TOTAL	**2**	**1,324**	**194**	**1,520**

Nearly all County or State jurisdiction road miles on TBNG lands are arterial or collector roads. These roads account for approximately half of the 1,073 miles of non-Forest Service jurisdiction roads that cross through or provide additional and necessary access to NFS roads, NFS lands, or private land inholdings. The remaining half of these roads are under private or other jurisdictions, and largely consist of local access roads only suited for high clearance vehicle use.

Land Ownership and Jurisdiction

Due to the intermixed pattern of Federal, State, and private ownership described above, a variety of land ownership/jurisdiction relationships exist for roads within the TBNG. These relationships are formalized through agreements with the USFS, and are necessary 1) when roads cross Federal lands to access private or State owned lands; 2) when access is needed across state or private lands to access federally owned lands; or 3) when access is needed for major highways that cross through Federal lands (State or County highways). Many of these agreements are not up-to-date or have never been formalized. The following tables report road mileages associated with these the conditions.

Approximately 211 miles of road on TBNG lands are managed under State, County, or private jurisdiction. **Table 2-5** lists road mileage by jurisdiction on TBNG lands. (Note: the Infra database does not have a complete inventory of other jurisdiction roads on the Grassland.)

Table 2-5. Non-USFS Roads on USFS Lands by Jurisdiction

Jurisdiction	Miles on National Forest Lands
BLM (Federal)	<1
C - County, Parish, Borough	131
P – Private	72
S – State	2
Roadway	4
Highway	1
State School	<1
TOTAL	211

Conversely, approximately 163 miles of road under USFS jurisdiction exist on either private or State owned lands within or adjacent to TBNG. **Table 2-6** lists the miles of road under USFS jurisdiction by land ownership and maintenance level.

Table 2-6. Miles of Road under USFS Jurisdiction on *Non*-USFS Lands

Land Ownership	Maintenance Level	Miles
State	1	0
	2	16
	3	2
	All	18
Private	1	<1
	2	125
	3	20
	All	145
TOTAL		**163**

Since numerous roads possess "split" jurisdiction conditions as listed above, management of any given road may vary throughout its length. That is, there are roads that, throughout their length, may have private, USFS, and County jurisdictions on the same road. This inherent characteristic of the TBNG road system makes management difficult, as time and energy must be spent to determine who is responsible for maintenance to ensure a safe and efficient travel way. Currently, many of the agreements required to formally determine responsibility for management and maintenance of a given road are not established. This condition has led to inefficiencies in the management and maintenance of the TBNG road system.

MEETING FOREST PLAN OBJECTIVES

National Objectives

The national objectives for the transportation system (Forest Service Manual (FSM) 7702) are:

1. To provide sustainable access in a fiscally responsible manner to National Forest System lands for administration, protection, and utilization of these lands and resources consistent with Land and Resource Management Plan guidance;
2. To manage a transportation system within the environmental capabilities of the land; and
3. To manage transportation system facilities to provide user safety, convenience, and efficiency of operations in an environmentally responsible manner and to achieve road related ecosystem restoration within the limits of current and likely funding levels.

By reference, this manual direction is also part of the Land and Resource Management Plan.

Land and Resource Management Plan Objectives

In addition to national objectives, road related objectives specific to the TBNG Land and Resource Management Plan (2001) include:

1. Consider existing roads and trails open and allow motorized vehicle use on them unless the following occurs:

    - A decision restricts motorized use;
    - The area is designated non-motorized; or
    - Motorized use is specifically prohibited in management area direction or existing orders.

2. Perform site specific roads analysis, including public involvement, prior to making any decisions on road construction, reconstruction, and decommissioning.

Geographic Area Guidelines

In addition to overall Management Plan objectives, geographic area-specific road related guidelines include:

Table 2-7. Land and Resource Management Plan Guidelines by Geographic Area	
Geographic Area	**Guidelines**
Broken Hills	Maintain or reduce the net classified road density. If new short-term roads are constructed, existing unclassified or classified roads should be decommissioned.
Cellers Rosecrans	Maintain or reduce the net classified road density. If new short-term roads are constructed, existing unclassified or classified roads should be decommissioned.
Fairview Clareton	None
Hilight Bill	None
Spring Creek	Maintain or reduce the net classified road density. If new short-term roads are constructed, existing unclassified or classified roads should be decommissioned.
Upton Osage	Maintain or reduce the net classified road density. If new short-term roads are constructed, existing unclassified or classified roads should be decommissioned.

Current and Reasonably Foreseeable Future Road Related Activity

Road planning and construction efforts at TBNG are largely driven by the needs of oil and gas and mining efforts. Operational estimates of road construction needed to support these efforts have been reported in *Oil and Gas Resources of Thunder Basin National Grassland, Wyoming* (Holm, 2001) and in recent NEPA documentation (USFS, 2003). The following table reports the road construction estimates from these sources.

Table 2-8. Projected Oil and Gas Exploration and Development in the TBNG		
Geographic Area/Project	**No. of Wells**	Estimated Road Development (miles)
Spring Creek	40	14.0*
North 1/3 of Fairview-Clareton, Upton-Osage	30	10.5*
South 2/3 Fairview-Clareton	70	24.5*
Hilight-Bill, Broken Hills, Cellar-Rosecrans	90	31.5*
Big Porcupine CBM Project	232	40.6
Powder River Basin CBM	369	129.2*
TOTAL	**460**	**201.6**
*Based on 0.35 miles of road with 40-foot right-of-way per well		

Sources: (Holm, 2001; USDA, 2003)

BUDGET

There are currently 1,520 miles of road under USFS jurisdiction on the TBNG. Approximately 194 miles of these roads are given a maintenance level 3 management objective, and therefore, are the primary focus of maintenance efforts and budget. Current annual and deferred maintenance efforts for these roads total more than $2,250,000. Current road management funding for TBNG accounts for only approximately one tenth, or $250,000, of the annual and deferred maintenance needs.

CHAPTER 3
IDENTIFYING ISSUES

Issues were developed by the interdisciplinary team (IDT) and District Rangers. The IDT developed a list of preliminary issues and discussed them with the District. Following these meetings, issues were determined to either be forestwide, and therefore, carried forward in the analysis, or more limited in scope and not carried forward. Major issues identified are listed below. Where the IDT determined an issue would not be carried forward through the analysis, a rationale is provided for that determination.

Evaluation of the standard questions in Chapter 4 identifies the effect each issue has on different resources and the opportunities or guidelines to address these issues. Chapter 5 uses information from Chapter 4 to explain the issue and summarizes opportunities by issue.

Table 3-1. Major Issues Identified and Relevant Document Sections

Major Issues	Pertinent Questions/Section
Funding	
1. Road maintenance funding is not adequate to maintain existing roads and signs to standard. There is a need for identifying the minimum necessary road system required to facilitate TBNG management, public use, and industrial needs.	See **Chapter 5**, *Identification of the Potential Minimum Road System*
Access Needs	
2. Road access may not be adequate for future land management needs.	TM (1-3); MM(1); RM(1); WP(1); SP(1); SU(1); GT(1-3); AU(1,2); PT(1-3); UR/RR (1,4); CH(3)
3. Rights-of-way across private land may not be adequate to access the forest as ownership and land uses change. Historic access across some of these lands is being closed off to the public. While this is not a change in legal status, it gives the appearance of shutting off large tracts of public land.	SU(1); GT(2); GT(3); **Chapter 5**, *Describing Opportunities and Setting Priorities, Jurisdiction Risks*
Resource Extraction Issues	
4. Roads have to be routinely relocated as coal operations advance.	MM(1)

Table 3-1. Major Issues Identified and Relevant Document Sections	
Major Issues	**Pertinent Questions/Section**
5. Roads that were improved to standards suitable for passenger car use (levels 3 to 5), but were primarily used for oilfield access, have not been decommissioned after activities are completed.	EC(1); MM(1)
6. Higher road densities may promote illegal use of existing unclassified roads, which may increase road densities by the creation of new unclassified roads and additional illegal use (see also Issue #11 below). Resource extraction and mineral resource development have increased road development. The resultant higher road density provides increased access to backcountry areas that were not previously accessible to the public. Illegal motorized use often occurs on these old road beds even after they are closed and may be causing environmental damage (see Issue #9 below). Also, many of the roads that were left open after their use for oil field access are now used by the public and should be considered for decomissioning (see Issue #12 below).	GT(4); MM(1); TW(2); UR/RR(1); UR/RR(4); AU(2); GT(4); EF(1)
Environmental Concerns	
7. There are potentially adverse environmental impacts from the current road system.	AQ(1-14); TW(1-4); EF(1-5); PT(4)
8. Coal bed methane production produces nearly perennial flows in some places, yet the road drainage system was originally designed for ephemeral conditions.	AQ(4)
9. Areas with higher road densities have greater potential to adversely affect resources. High road densities, especially roads open to motorized vehicles, may be fragmenting habitat or isolating habitat for some species. In addition, illegal off-road vehicle use is often greater in areas of high road density further adversely affecting environmental resources. In some cases, the effects of high road density may be degrading the quality of big game hunting. Areas of high road density are also likely to contribute greater amounts of sediment to streams especially at road stream crossings.	TW(1-4); AQ(1-14)
Illegal Use and Road Safety Concerns	
10. Small all-terrain vehicles (ATVs), tractors and other slow moving ranch vehicles and highway vehicles use the same roads, occasionally at the same time. This can be a safety problem, especially in high road density areas.	GT(4); UR/RR(1); SI(5)

Table 3-1. Major Issues Identified and Relevant Document Sections	
Major Issues	**Pertinent Questions/Section**
11. Higher road densities may promote illegal use of existing unclassified roads, which may increase road densities by the creation of new unclassified roads and additional illegal use. This occurs because some users view old roadbeds as access to backcountry areas and use them even if they are closed.	AU(2), EF(1), See also Appendix C
12. Ineffective closures can result in illegal use, which can then have adverse effects on resources. Road closure efforts in the open terrain of the grasslands are difficult. Roads that have not been decommissioned following oil field operations continue to be used by the public, but are no longer maintained at a safety level consistent with maintenance level 3 or higher roads and pose safety hazards.	GT(4); UR/RR(1)
Road Management and Jurisdiction Issues	
13. Road management objectives (RMOs) are not current and need to be updated.	See **Chapter 5**, *Other Road-related Opportunities*
14. Roads crossing multiple jurisdictions have few cooperator agreements.	GT(3); **Chapter 5**, *Describing Opportunities and Setting Priorities, Jurisdiction Risks*, See also *Appendix B*
15. Roads that cross multiple ownerships or jurisdictions are not clearly marked and jurisdiction is not clearly established.	GT(3); **Chapter 5**, *Describing Opportunities and Setting Priorities, Jurisdiction Risks*, See also *Appendix B*
16. Roads that transition from one jurisdiction to another have inconsistent regulations governing the use of ATVs. This creates confusion for the public users and for law enforcement personnel.	AU(2); **Chapter 5**, *Describing Opportunities and Setting Priorities, Jurisdiction Risks*, See also *Appendix B*

CHAPTER 4
ASSESSING BENEFITS, PROBLEMS, AND RISKS

INTRODUCTION

Chapter 4 contains narrative answers to the questions contained in FS-643, *Roads Analysis: Informing Decisions About Managing the National Forest Transportation System*. These questions and answers provide an assessment of the ecological, social, and economic considerations of the current transportation system. **Table 4-1** provides a summary of the questions reviewed to scan the range of possible benefits, problems, and risks and to screen them for those relevant to roads on the TBNG. Where appropriate, questions have been grouped together to facilitate a more coherent discussion of the relevant factors. The scope of the answer to each question is a reflection of its relevance to the issues raised during the RAP, and its relevance to the Forest-wide scale of this analysis. Some questions are more appropriately answered at the watershed and/or project scale, and this is noted in the discussion.

Table 4-1. Questions Reviewed for the Thunder Basin National Grassland Roads Analysis

Question and Topic	Addressed in Report?
AQUATIC, RIPARIAN ZONE, AND WATER QUALITY (AQ)	
AQ (1): Hydrology	Yes. See page 4-3
AQ (2): Surface erosion	Yes. See page 4-5
AQ (3): Mass wasting	Yes. See page 4-7
AQ (4): Stream channels and water quality	Yes. See page 4-7
AQ (5): Chemicals and water quality	Yes. See page 4-8
AQ (6): Hydrological connections	Yes. See page 4-9
AQ (7): Beneficial uses	Yes. See page 4-10
AQ (8): Wetlands	Yes. See page 4-11
AQ (9): Channel dynamics, floodplains, and sediment	Yes. See page 4-12
AQ (10): Aquatic movement restrictions	Yes. See page 4-13
AQ (11): Riparian areas	Yes. See page 4-14
AQ (12): Fishing, poaching, and habitat loss	Yes. See page 4-15
AQ (13): Non-native aquatic species	Yes. See page 4-16
AQ (14): At-risk aquatic species	Yes. See page 4-16
TERRESTRIAL WILDLIFE (TW)	
TW (1) & TW (3): Terrestrial habitat and wildlife	Yes. See page 4-17
TW (2): Human activities and terrestrial habitat and wildlife	Yes. See page 4-28
TW (4): Unique terrestrial communities	Yes. See page 4-32
ECOSYSTEM FUNCTIONS AND PROCESSES (EF)	
EF (1): Roading unroaded areas	Yes. See page 4-37
EF (2): Introduction and spread of exotic species	Yes. See page 4-39
EF (3): Ecological disturbance	Yes. See page 4-40
EF (4): Pest control	Yes. See page 4-41
EF (5): Noise	Yes. See page 4-41

ECONOMICS (EC)	
EC (1): Direct costs and revenues	Yes. See page 4-42
EC (2): Priced and non-priced consequences	Yes. See page 4-44
EC (3): Distribution of benefits and costs	Yes. See page 4-45
COMMODITY PRODUCTION: TIMBER (TM), MINERALS (MM), RANGE (RM), WATER PRODUCTION (WP), SPECIAL FOREST PRODUCTS (SP)	
TM (1), TM (2), & TM (3): Logging feasibility, timber management, and silvicultural treatment	Yes. See page 4-46
MM (1): Locatable, leasable, and salable minerals	Yes. See page 4-47
RM (1): Range management	Yes. See page 4-51
WP (1): Water diversions, impoundments, and canals	Yes. See page 4-51
WP (2): Water quality in municipal watersheds	No. There are no known municipal water locations within the TBNG or within the watersheds containing TBNG lands.
WP (3): Hydroelectric power	No. There are no hydroelectric power generation sites on the TBNG.
SP (1): Special Forest products	Yes. See page 4-52
SU (1): Special use permits	Yes. See page 4-53
GENERAL PUBLIC TRANSPORTATION (GT)	
GT (1): Connection to public roads	Yes. See page 4-54
GT (2): Land connections	Yes. See page 4-56
GT (3): Shared ownerships	Yes. See page 4-57
GT (4): Public safety	Yes. See page 4-59
ADMINISTRATIVE USES (AU)	
AU (1): Research, inventory, and monitoring	Yes. See page 4-63
AU (2): Investigative or enforcement activities	Yes. See page 4-64
PROTECTION (PT)	
PT (1), PT (2), & PT (3): Fuels management and wildfires	Yes. See page 4-65
PT (4): Air quality	Yes. See page 4-65
RECREATION: UNROADED AREAS (UR) AND ROAD-RELATED RECREATION (RR)	
UR (1) & RR (1): Supply and demand of non-motorized and motorized recreation	Yes. See page 4-66
UR (2) & RR (2): Type of recreation, user-created routes	Yes. See page 4-69
UR (3) & RR (3): Noise and recreation	Yes. See page 4-70
UR (4) & RR (4): Recreation users	Yes. See page 4-71
UR (5) & RR (5): User attachment	Yes. See page 4-71
UR (6) & RR (6): Visual quality	Yes. See page 4-72
SOCIAL ISSUES (SI)	
SI (1): Users and user activities	Yes. See page 4-72
SI (2): Local access value	Yes. See page 4-73
SI (3): Social and economic benefits and costs	Yes. See page 4-74
SI (4): Sense of place	Yes. See page 4-75
SI (5): Use conflicts	Yes. See page 4-75
CH (1): Paleontological, archaeological, and historical sites	Yes. See page 4-76
CH (2): Cultural and traditional uses	Yes. See page 4-77
CH (3): Roads that are historic sites	Yes. See page 4-77
CR (1): Minority, low-income, or disabled impacts	Yes. See page 4-78

CURRENT ROAD SYSTEM BENEFITS, PROBLEMS, AND RISKS

AQUATIC, RIPARIAN, AND WATER QUALITY (AQ)

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

Roads have the potential to affect the natural hydrology of a watershed area by intercepting, concentrating, and diverting surface flow from its natural flow pattern. Roads expand the channel network via road ditches and reduce infiltration rates of incident precipitation, generating larger amounts of surface runoff. All of these factors combine to alter the quantity and timing of surface flow, which, in turn, affects the overall hydrology of a watershed. The hydrology at TBNG is predominantly affected by spring runoff from snowmelt and major thunderstorm events. Although subsurface hydrology is not identified as a major issue of concern relative to road-related impacts at TBNG, it can also be modified by road systems through reduced infiltration.

Roads can affect the timing of water delivered to a stream with the potential to either increase or decrease the downstream peak flows, depending on whether or not runoff from other portions of the stream's watershed is synchronized with runoff from the road system. The most common net effect is generally thought to include increases in peak discharges downstream. Streams at TBNG are primarily ephemeral. Increases in peak flows occur if surface flows are intercepted and routed directly to waterways. These effects are most likely to occur in areas with high drainage density, clay soils, and steeper slopes, where surface and shallow subsurface runoff is greatest. Roads at TBNG are generally flat to gently sloped and have surfaces consisting of native materials or crushed aggregate. Due to the high clay content in many of the soils on the TBNG and high intensity precipitation events, infiltration is relatively slow and surface water often moves as sheet flow. However, roads can also act to decrease downstream peak flows at locations where the roads intercept and store water or route it away from nearby waterways. Many roads on the TBNG also cross small drainages with no drainage structures (e.g culverts) installed in the road and therefore serve to impound some streamflows and may reduce peak flows downstream in the watershed.

There are twenty four 5th level watersheds containing roads on National Forest System (NFS) lands on the TBNG. A Watershed Condition Assessment was completed on the TBNG in 2003, and each of the watersheds was designated with a class condition based on physical, chemical, and biologic characteristics, as well as the stability of the drainage network (Gloss et al., 2003). There are no Class I watersheds within TBNG. Twenty of the watersheds were determined to be Class II, and four watersheds were determined to be non-

> **Class I** watersheds are functional watersheds with generally stable drainage networks that support beneficial uses. **Class II** watersheds are at-risk watersheds, which may exhibit unstable drainage network. **Class III** watersheds are non-functional watersheds in which the majority of the drainage network may be unstable.

functional, or Class III. Significantly, 3 of the 4 Class III watersheds at TBNG were found to contain a relatively high road density.

Road density can be used to effectively represent the scale of a road system in a watershed. While many specific road factors have the potential to affect local hydrology, road density is used as an indicator of the system's general potential to impact or modify the surface and subsurface hydrology of an area. Road density was calculated for each 5th level watershed. All roads on NFS lands (from the USFS INFRA database), roads outside NFS lands, but within the administrative boundary (USFS modified TIGER data, U.S. Census Bureau), and roads outside the administrative boundary (TIGER road layer, U.S. Census Bureau) were included for the calculations[1]. Watersheds were classified as having a high, moderate, or low road density and respective potential to affect hydrology[2]. Watersheds with road densities exceeding 2 miles of road per square mile were ranked as high density. Watersheds with between 2 and 1.6 miles of road per square mile were ranked as moderate density. Watersheds with fewer than 1.6 miles of road per square mile were ranked as low density. [Note: The road density breakdowns were based on division of the population of density values for the 24 watersheds into 3 relatively equally populated categories (quantiles). Thus, high, moderate, and low density rankings are not based on known absolute values. Instead, they are relative to the distribution of road densities across TBNG watersheds, and are presented here to prioritize the watersheds (see **Table 4-2**).]

Design and maintenance of appropriate drainage structures minimizes the potential effects that roads may have on hydrology. Inadequate road drainage can trap water on the road surface or concentrate water flow with increased sediment load. For example, road crossings can act to attenuate flood flows and induce significant upstream backwatering, when flows exceed the design discharge of a culvert. In addition to culvert maintenance and replacement, several other types of maintenance needs related to surface drainage are currently required at TBNG. These include the replacement and general maintenance of low water crossings, drainage ditch maintenance and repair, and grading and repair of numerous road cross drains.

[1] Three different GIS-based road layers of different land area coverage were used for this calculation to take advantage of the most current and accurate road layers, wherever possible. Unmodified TIGER road information is considered the least accurate, and was only used for areas outside of the administrative boundary of the grasslands.
[2] These road density ratings are for comparative purposes for hydrologic impact – they are not relevant to wildlife concerns.

Table 4-2. Road Density by Watershed					
5th Level Hydrologic Unit Code (HUC)	**5th Level Watershed Name**	**Watershed Condition Class***	**Watershed Size (Sq. Miles)**	**Road Density in Watershed (Miles/Sq. Mile)**	**Watershed Road Density Ranking**
1012020105	Belle Fourche River-Wind Creek	II	326	2.58	HIGH
1012010701	**Upper Beaver Creek**	**III**	**427**	**2.58**	**HIGH**
1012010303	**Little Thunder Creek**	**III**	**243**	**2.53**	**HIGH**
1011020101	Little Missouri River-Prairie Creek	II	364	2.30	HIGH
1012020107	Belle Fourche River-Arch Creek	II	333	2.29	HIGH
1012010702	Oil Creek	II	263	2.26	HIGH
1012010502	Dry Creek	II	209	2.14	HIGH
1012010305	Lodgepole Creek	II	368	2.12	HIGH
1012010103	**Lower Antelope Creek**	**III**	**337**	**2.12**	**HIGH**
1012010501	Lightning Creek	II	375	2.08	HIGH
1012010201	Upper Dry Fork Cheyenne River	II	263	1.96	MOD
1012010101	Bear Creek	II	292	1.96	MOD
1012010301	Upper Cheyenne River	II	226	1.92	MOD
1012010202	**Lower Dry Fork Cheyenne River**	**III**	**223**	**1.89**	**MOD**
1012020108	Inyan Kara Creek	II	334	1.74	MOD
1012010302	Black Thunder Creek	II	309	1.74	MOD
1012010304	Lower Cheyenne River	II	264	1.71	MOD
1012010102	Upper Antelope Creek	II	396	1.66	MOD
1012010402	Lower Lance Creek	II	407	1.61	MOD
1012020104	Belle Fourche Creek-Buffalo Creek	II	460	1.55	LOW
1012010601	Upper Cheyenne River	II	297	1.50	LOW
1012010703	Lower Beaver Creek	II	317	1.43	LOW
1009020803	Little Powder River-Spring Creek	II	300	1.20	LOW
1009020802	Little Powder River-Dry Creek	II	277	1.13	LOW

* Watersheds with a Condition Class of III and a High relative road density rank are in bold as they may pose a special concern for road management decisions.

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

The existence and magnitude of surface erosion is highly dependent on site- and project-specific conditions of road grade, design, efficiency of drainage structures, surface material, traffic level, and maintenance level. Conditions within the road corridor, such as soil type, slope, and vegetative cover, are also major factors.

Table 4-3. Road Surface Materials by Road Type		
Surface Type	**Miles of USFS Maintenance Level 2 Roads**	**Miles of USFS Maintenance Level 3 Roads**
Crushed Aggregate or Gravel	39	116
Native Material	1285	78
Total	**1324**	**194**

All roads within the TBNG have some potential to erode due to either a natural soil surface (maintenance level 2 roads) or a surface of crushed aggregate or gravel (maintenance level 2 and 3 roads). **Table 4-3** presents a breakdown of the number of USFS roads by surface type on the TBNG. A common aggregate used on site is scoria, a volcanic rock formed of shale, sandstone, clays, and silts, which is crushed and used as a rock aggregate for road pavement. Soils on the TBNG are predominantly well-drained clay loams, which support rangeland uses.

Road maintenance activities along unpaved surfaces, such as grading and ditch clearing, can cause increased surface erosion over the short-term. However, over the long-term, these practices prevent roads from degrading and developing conditions that might otherwise induce high levels of erosion of the road surface. Roads without side ditches may be more prone to erosion of the road surface, whereas roads with drainage ditches have reduced erosion on the surface, but elevated erosion along the length of the ditch. Roads with gravel surfaces combined with vegetated or rock lined ditches are generally the optimal condition for reduced road-related erosion.

Unvegetated surfaces rapidly convert precipitation to surface runoff, more easily detaching fine particles from the native surface and elevating surface erosion rates. The inherent erodibility of a soil is the susceptibility or resistance of fine particles to detach with the runoff. Medium-textured soils with a high silt content are the most erodible of all soils. They are easily detached and tend to crust and produce high rates of runoff. Conversely, soils high in clay and coarse textured soils, such as sands, are the least erodible soils and produce low rates of runoff. Of specific concern for erosion processes are native surface roads located on highly erosive soils and steep topography. Local concentrations of highly erosive soils on hillslopes are found in southeastern Campbell County and northeastern Converse County (the Broken Hills geographic area). Significant segments of maintenance level 3 roads highly susceptible to erosion in this area, and throughout the TBNG, are summarized in **Table 4-4**.

Table 4-4. Roads with a Significant Length on Highly Erodible Soil

Road ID	Road Name	Miles of USFS Jurisdiction Roads on Highly Erodible Soil	Miles of Other Jurisdiction Roads on Highly Erodible Soil	Total Miles of Road on Highly Erodible Soil
973	Phillips Road	0.40	0.17	0.57
1618	Beckwith Road	0.21	0.26	0.47
13.38	Dull Center Road	0.03	0.37	0.40
1109	(blank)	0.28	0.08	0.36
934.A	(blank)	0.34	0.02	0.36
968	School Creek Road	0.32	0.03	0.36
1107	(blank)	0.31	0.00	0.31
937	Keyton Road	0.30	0.00	0.30
13.40	Stienle Road	0.00	0.28	0.28
933	Rochelle Hills Road	0.23	0.05	0.27

Sediment derived from the above described erosion processes is discussed in questions AQ (4) and AQ (6).

AQ (3): How and where does the road system affect mass wasting?

Mass wasting related to roads often results from a combination of several factors, such as placement of roads on unsuitable soils or unstable hillsides, inappropriate placement of road fills and stream crossings, or inadequate drainage structures for the road. The potential susceptibility of an area to mass wasting related to the TBNG road system was measured by the length of road located within 100 feet of 40% or greater slopes. Of 194 miles of USFS maintenance level 3 roads, only 0.4 miles of road were determined to be at risk for mass wasting by the IDT.

Though mass wasting is not generally a major concern for the TBNG, there are a few localized areas where breakland conditions can be found and where the 0.4 miles of potentially susceptible roads were identified. An example of this is the Rochelle Hills area (USFS Route 933), located towards the southwest of NFS lands in the Broken Hills geographic area. This area is characterized by rolling to steep topography and highly erodible soils. A wildfire in the Rochelle Hills in 1988 resulted in the removal of vegetation and subsequent increase in instability of some of the steeper sideslopes. This instability is likely to continue until vegetation reestablishes in this area. A recent coring study of the trees of the Rochelle Hills indicates that many of the trees, although small, are nearly 500 years old. This suggests that vegetative growth in the area is extremely slow and revegetation may take considerable time. Mass failures on several sections of NFSR 933 have resulted in the closure of a portion of this road which crossed through this mass wasting landscape.

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

In general, road-stream crossings have a greater influence on local stream channels and water quality than other road areas because of their close proximity to the stream channel. Poorly designed crossings can constrict a stream channel through undersized culverts or misaligned water diversions, or act as a conduit, facilitating erosion or the transport of pollutants into the channel.

As described in question AQ (1), numerous culverts and cross drains are in need of cleaning, repair, replacement, or new installation on TBNG. Undersized culverts, or blockages to flow in culverts, can cause upstream channel aggradation as particles settle and are trapped in sluggish backwater zones. When blockage is complete, flow may be redirected across or along the road, resulting in road surface erosion and added sediment delivery to streams. Likewise, without adequate cross drains to facilitate drainage of roads, intercepted precipitation may collect and cause increased surface runoff with added sedimentation.

Of additional concern is the tendency for gullies to form downslope of unprotected culvert outlets on hillslopes or in the absence of adequate cross drains. The formation of gullies is significant because it indicates a road-related extension of a surface flowpath that would not exist without the road. Several factors may influence the formation of gullies: soil type, depth to bedrock, topographic shape of hillslope, vegetation/root strength, culvert spacing, and plunge height. These factors are related to the force of water and sensitivity of the site to concentration of water and erosion of the soil mantle.

Low water crossings are also a concern due to their potential for stream channel modification and associated sediment delivery. Failing low water crossings can cause upstream sediment deposits and sluggish backwater zones. Without maintenance, redirected flow around the crossing during flood events can result in stream bank scour and undercutting of the low water crossing structure on its downstream side. High levels of sediment delivery and channel modification can ultimately result.

Roads that are located in a watershed with significant, or the potential for significant, coal bed methane (CBM) development are of particular concern for contributing to the hydrological modification of an area, particularly at road-stream crossings. Coal bed gas occurs as 1) free gas, 2) gas adsorbed on pore or micropore surfaces in coal matrix, and 3) gas dissolved in water that commonly occurs in coal. The removal (pumping off) of water and reduction in hydrostatic pressure results in the release of the methane adsorbed on the coal surfaces and dissolved in groundwater. As the gas is collected, the pumped off ground water is released into nearby drainages as surface water. This discharge can alter the hydrologic character of some drainages, converting them from an ephemeral to a nearly perennial condition. Hydrologic modifications associated with change in flow regime may include, alterations in the timing of flows, increased channel erosion and sedimentation, and dispersion of waters high in sodium and other contaminants. These changes are of greatest concern for roads at road/stream crossings, where road drainage structures that were originally designed for lower flow volumes and ephemeral flow conditions may no longer be adequate.

Current estimates suggest that approximately 540 new CBM wells are projected to be constructed in the TBNG through 2010, and 486 of these wells are predicted to produce methane (USFS, 2003a). As a result of this projected level of development and the concerns discussed above regarding road stream crossings, the IDT assessed maintenance level 3 roads with respect to watershed with the potential for CBM development. Based on this analysis, approximately 21 miles of road (17 roads in total) have the potential to be affected by increased drainage produced as a result of CBM production. Five of these 17 roads were also rated ‘high’ for mineral resource value. Drainage structures on roads in these areas should adequately account for increased flow volumes resulting from the CBM discharges, and road maintenance should be prioritized in watersheds with significant CBM development.

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

Roads can be a source of both point and non-point pollutants. Point sources would be primarily spills of materials transported on the roads, such as petroleum products and industrial or agricultural chemicals. Non-point pollutants would be primarily sediment from aggregate or natural surface roads, or dispersed chemicals unintentionally deposited on the traffic surface. Other potential pollutants include de-icing salt products, dust abatement agents, and pesticides used to maintain the road right-of-way.

Chemical pollutants can enter nearby streams through direct runoff from compacted and impervious road surfaces or through runoff, leaching, and adsorption to soil particles from gravel surfaces. Most of the potential for the addition of pollutants is associated with road-stream crossings and areas where the road is located close to streams or floodplains. Road ditches have a high potential to convey pollutants to streams where the vegetation buffer is insufficient to absorb runoff. Pollutants can be transmitted to surface waters directly or indirectly in erosion processes. Runoff and groundwater are other likely sources to transfer pollutants to streams. Maintaining vegetated buffer zones and providing frequent road surface drainage are often very effective in limiting pollutant concentrations in water.

While all roads could potentially be a source of pollutants, roads used for management activities, such as oil and gas development, are at greatest risk. These roads are the most likely to be used to transport various chemicals, experience spills from vehicle wrecks, use pesticides to maintain the road right-of-way, and be treated with de-icing or dust abatement chemicals. Unpaved roads, in particular natural surface or aggregate surface interior roads on the National Grasslands, pose the least risk due to lower traffic and maintenance needs.

On the TBNG, magnesium or calcium chloride is applied as a dust abatement measure to high traffic roads approximately twice yearly. The roads are treated by means of minimal scarifying, followed by application of the chemical (Ormseth, 2004). The applications harden unsurfaced roads, thereby reducing the needs for maintenance. Unlike the use of magnesium chloride as a de-icing agent, of which no specific information was gathered regarding the application on TBNG lands, when used for dust abatement measures, the chemical adheres to the road surface relatively well and poses a smaller risk of being transported into surface waters as runoff and affecting water quality. During application, however, spillage into adjacent surface waters can occur, and may be of a concern in areas where aquatic threatened, endangered, or sensitive species are present.

AQ (5) is best addressed on a project scale, with site-specific information about distance to streams, traffic levels, materials transported on the roads, and the potential of aquatic species of concern to be located nearby.

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

"Hydrologically connected" road segments are ones that deliver surface runoff directly to a stream channel. Along these road segments, a greater proportion of road drainage reaches the streams since little buffer between the stream and road is available for water infiltration. This condition occurs at stream crossings and along those roads that run closely to either a riparian area or a water body.

Roads that are closely associated with stream courses contribute to elevated peak flows by adding storm water runoff directly to the channel. This causes stream peak flows to occur earlier in the precipitation event, although the magnitude of this increase is unknown. Physically, increased peak flows can cause erosion of the stream channel, resulting in deeper or wider channels and greater sediment deposition at downstream areas away from the hydrologically connected road segment.

To provide a relative measure of the hydrologic connection concerns of TBNG roads, several data categories were assessed for each road. The length of road falling within 300 feet of a riparian area, the length of road falling within 300 feet of a water body, and the number of stream crossings per road mile were used to determine the overall potential risk of a road or road segment being hydrologically connected. Of the 194 miles of USFS maintenance level 3 roads, the IDT identified 10.6 miles of road within 300 feet of a riparian area and 10.6 miles of road within 300 feet of a water body. There are an estimated 471 USFS maintenance level 3 road stream crossings based on available GIS data (127 of these involve 3rd order or higher streams), resulting in an overall average of approximately 2½ stream crossings per road mile for USFS maintenance level 3 roads.

Table 4-5 reports those roads that have a high relative risk of affecting the hydrology of an area. In addition to the hydrological connection of a road or road segment, the length of road located in a high road density watershed and the length of road located along potentially highly erodible conditions with a significant risk of increased surface runoff (as measured by length of road located within 100 feet of 40% or greater slopes), were included in the risk assessment. Road rehabilitation and maintenance efforts along these roads would have greater potential to impact nearby streams, which include Frog Creek, Lake Creek, School Creek, Dugout Creek, Gibson Draw and Newel Prong.

Table 4-5. Roads with a High Relative Risk of Affecting Hydrology*

Road ID	Road Name	Average No. of Stream Crossings per Mile	Miles of Road within 300 feet of a Riparian Area	Miles of Road within 300 feet of a Water Body
1269	(blank)	2.8	0.5	0.7
914.03	East Upton Road	1.2	1.1	0.7
942	Steckley Road	1.5	0.9	0.7
968	School Creek Road	2.5	0.7	0.3
973	Phillips Road	1.6	0.1	0.2
1423	(blank)	1.0	0.4	0.0
938	Frog Creek Road	0.3	1.5	0.6

*USFS maintenance level 3 roads only.

As discussed in AQ (5), any pollutants in the surface runoff from the road, including chemical pollutants, have the greatest ability to degrade water quality along hydrologically connected portions of road.

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

Water uses that are protected on Wyoming waters include agriculture, fisheries, aquatic life other than fish, industry, drinking water, fish consumption, recreation, scenic value, and wildlife. There are also numerous surface water classifications in the State, and with the exception of Class 1, waters are classified according to their designated uses. The Cheyenne River, Belle Fourche River, and Little Powder River Drainages are all classified as 2AB warmwater waters, though most of the tributaries to these drainages that are located on TBNG land are classified as 3B waters (WDEQ, 2001).

Class 2AB warmwater waters are those known to support warm water game fish populations or spawning and nursery areas at least seasonally, as these waters may be perennial, intermittent, or ephemeral. Unless it is shown otherwise, these waters are presumed to have sufficient water quality and quantity to support drinking water supplies and game fishery and are protected for those uses. Additionally, Class 2AB waters are protected for non-game fisheries, fish consumption, aquatic life other than fish, primary contact recreation, wildlife, industry, agriculture, and scenic value uses.

Class 3 waters found on the TBNG are intermittent, ephemeral, or isolated waters which, due to natural habitat conditions, do not support nor have the potential to support fish populations or spawning, or, they are certain perennial waters lacking the water quality to support fish. Class 3 waters provide support for invertebrates, amphibians, or other flora and fauna that inhabit waters of the State at some life cycle stage. Uses designated on Class 3 waters include aquatic life other than fish, recreation, wildlife, industry, agriculture, and scenic value. Class 3B waters are tributary waters, including adjacent wetlands that are not known to support fish populations or drinking water supplies and where those uses are not attainable.

The known downstream beneficial uses of surface water near the TBNG include agriculture, recreation, and aquatic life support. Water is used for both agricultural irrigation and stock watering. Downstream of TBNG lands, the Cheyenne, Little Missouri, and Little Powder Rivers support recreational game fishing opportunities.

Roads have the potential to impact beneficial uses by changing water quality, quantity, or timing [as discussed under AQ (1) through AQ (6)] to the extent it no longer meets the requisite standards. Overall, the USFS road network on TBNG is not a major contributor of road-derived pollutants, such as oils and chemicals. However, there may be individual circumstances that would warrant change in road management strategies to reduce the risk of road-derived pollutants. Aquatic habitat and species may be put at risk from sediment runoff from some of the unpaved roads, road induced bank scour, changes in riparian habitat, reductions in large woody debris availability, or modifications in stream flow timing or quantity. Municipal water supplies are not likely to be impacted by USFS road management, as there are no municipal water locations identified in any of the TBNG watersheds.

Changes in beneficial uses and demand are best addressed at project scale, since site-specific conditions are needed to predict what changes might occur.

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

Information on the distribution and type of wetlands on the TBNG is not readily available in electronic format. The National Wetlands Inventory (NWI) is only available electronically for a small portion of the northwestern corner of the Hilight Bill geographic area.

<u>Playas</u>: Small, circular, isolated depressional wetlands that have an ephemeral hydroperiod.

In general, wetlands on the TBNG consist of open water ponds and reservoirs, playas, and emergent wetlands. Permanent ponds and reservoirs are man-made and used for watering cattle and recreation. Islands often occur in the larger reservoirs. Playas are an important wetland feature on the TBNG, providing wetland habitat for shorebirds and waterfowl. Most playas on the TBNG are an acre or less in size. Emergent wetlands are typically associated with riparian areas along perennial streams including Antelope Creek, Cheyenne River, Little Thunder Creek, Black Thunder Creek, School Creek, Turner Creek, East Iron Creek, Walcott Draw, and Little Powder River (Byer, 2004). Characteristic species include cottonwoods, willow, snowberry, sedges, and rushes. Isolated wet meadows may also occur in upland prairies.

The road system can impact wetlands by direct encroachment and loss of wetland area from road fill and by indirect alteration of wetland hydrology, function, and water quality. Examples of these direct impacts have been observed on the TBNG (Gloss, 2004) but data is not available to characterize the overall extent and location of the direct impacts of roads on wetlands on the TBNG. Indirect impacts to hydrology and water quality are similar to those discussed above for streams and other waterbodies [AQ (4-7)]. Roads that cross or parallel streams on the TBNG have the potential to impact wetlands associated with riparian areas. Cases in which roads run parallel to streams are few and only for short distances at some road-stream crossings. Therefore, water quality impairment from road runoff is likely minimal. **Table 4-6** (under AQ 6) highlights roads with a high relative risk of affecting wetland hydrology and water quality.

GIS data for intermittent lakes was used to identify roads that came within 300 feet of a playa. This data layer is likely incomplete; therefore, this analysis does not identify all potential impacts to playas from roads on the TBNG. Roads that came within 300 feet of 6 or more playas include USFS Road 13.38 (Dull Center Road), 13.40 (Stienle Road), 937 (Keyton Road), 942 (Steckley Road), 958 (East Bill/Cow Creek Road), 1248, and 1276. These roads would have the greatest potential to impact the hydrology and water quality of nearby playas during spring snowmelt and rainstorms when runoff is high.

The Standards and Guidelines in the TBNG *Land and Resource Management Plan* (pp. 1-9 and 1-10) provide actions to protect wetlands from road impacts.

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

Bridge and culvert installations at stream crossings constrain the channel from migrating or changing as it would naturally. Roads can also encroach upon or isolate floodplains, compromising their function. During periods of peak or flood flows, roads and road crossings may restrict flow or become blocked so that the water backs up, causing an actual increase in peak flows. This may, in turn, reduce the flow below the crossing, preventing flooding into the stream's normal flood-prone areas further down the drainage.

Roads passing through a major floodplain or damming an ephemeral drainage can also create sluggish backwater conditions. This can occur, for example, when waters receding from periods of high flow are trapped by roadbeds that traverse a major floodplain. Initially, ponding waters may contain small fish, macroinvertebrates, and developing amphibians that are stranded by the receding water level. If sluggish backwater conditions persist at these sites, algal blooms may likely occur resulting in drastic reductions in oxygen available for other aquatic organisms and eventual death of much of the aquatic community.

Road-stream crossings can also act as a local barrier to large woody debris recruitment and movement, as well as temporary barriers to organic matter and sediment movement. These blockages may prevent a more regular distribution of large woody debris along a stream course, and limit the distribution of large woody debris-induced pools and associated aquatic habitat. Large woody debris is not a significant aquatic habitat component in this grassland ecosystem. Only a few of the larger riparian areas contain cottonwood and other tree species that provide potential large woody debris.

On the TBNG, only 5 percent of USFS maintenance level 3 roads (10.6 miles) lie within 300 feet of a major riparian area. This suggests that, in general, the road system does not pose major constraints on lateral channel migration, large woody debris inputs, or floodplain processes along long continuous segments of streams.

Additional discussion pertinent to this question can be found under questions AQ (1), AQ (4), and AQ (6). More detailed discussion is most appropriate at the project level, where site-specific instances of altered channel dynamics, debris, and sediment buildups are known.

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

Road crossings, such as culverts and fords, can act as barriers to aquatic organism movement and migration within stream systems. This effect can be further exacerbated by culvert blockages caused by debris buildup, structural failures, or as a result of trappers putting snare traps in culverts. Upstream and downstream migration obstacles can result in a decrease in population numbers and an increase in genetic isolation. Small fish, mollusk, some macroinvertebrate, amphibian, and reptile populations may experience life-cycle interruptions as a result of these obstructions. Obstructed culverts can also increase maintenance costs, lead to the failure of a culvert, or lead to road damage.

Available information concerning the maintenance needs of fords and culverts on the TBNG indicates that several fords and numerous culverts are in need of either cleaning or installation. The majority of these culverts are small in size and found on intermittent or ephemeral drainages. Although viable fish populations are not likely found in the majority of small ephemeral drainages at TBNG, these drainages are a water source for higher order streams, as well as a source of organic matter and food. Restrictions in water flow from these small drainages can be detrimental to viable fish communities in connected higher-order streams. In contrast, some species of mollusk, macroinvertebrates, amphibians, and reptiles may utilize small ephemeral drainages for all or a portion of their lifecycle. These species may be impacted by culvert blockages that limit habitat connectivity or alter local hydroperiods (the duration of water level at or above the substrate surface).

Road drainage associated impacts can also alter local hydroperiods by increasing drainage efficiency in some areas (reducing the hydroperiod), and decreasing it in others (lengthening the hydroperiod) (Forman et al., 2003). If hydroperiod is shortened, amphibian and some macroinvertebrates may become dessicated prior to reaching their adult lifestage. If hydroperiod is lengthened, such as ponding that occurs upstream of blocked culverts or in road-impounded drainages, the potential increases for predatory fish to become established. Predatory fish populations can induce the extinction of localized amphibian populations. In some cases, it should also be noted that culvert blockages and road drainage structures, may improve or create habitat where no or only limited habitat previously existed (Forman et al., 2003).

More detailed discussion of this issue is best left to the project level scale, where habitat type and blockage locations are known and can be compared with detailed current and historic aquatic organism survey data.

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

Road systems often affect shading, litterfall, and riparian plant communities where roads cross streams or where roads run parallel to streams. There are a total of 471 USFS maintenance level 3 road-stream crossings on the TBNG identifiable from GIS data layers. Although reduced canopy cover and litter fall may occur at some sites due to the presence or construction of a road right-of-way, it is not generally considered a widespread concern on the TBNG due to the limited number of riparian areas with appreciable canopy cover.

Roads that run parallel to streams are generally the greatest concern when considering limits on stream shade and litter fall due to the lack of canopy cover within the road corridor. In these areas, decreased stream shading can increase stream water temperature. Although this is often a major concern in forested landscapes with cool water streams, it is not considered a major concern on the TBNG for several reasons. First, due to the gentle topography of the landscape, few roads parallel a stream course for any appreciable length on the TBNG[1]. Moreover, as described above, few riparian areas have significant canopy cover. Lastly, and perhaps most importantly, fish populations and other aquatic organisms and habitat in this landscape are well adapted to warm water conditions and any minor increases in stream temperature as a result of road associated reductions in canopy cover are likely to have minimal effects on these species. Similarly, reductions in litter fall as a result of a road crossing in this landscape would not be expected to significantly reduce organic debris input to a stream or significantly affect aquatic habitat and food supply associated with litter fall.

Riparian plant communities are directly impacted by roads as a result of removal and disturbance of plants during road construction. In addition, improved access to the riparian area also

[1] In areas of variable topography, roads are often constructed along major stream courses and in river floodplains to avoid logistical difficulties and high road construction costs.

increases human activity and associated disturbance associated with these activities. Both construction and increased disturbance in the riparian area also result in indirect impacts from an increase in the potential for invasive species establishment at the road/riparian corridor interface. These conditions may be a concern for some roads listed in **Table 4-5** in AQ(6), and field conditions should be verified.

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

While poaching is not generally considered an issue of concern at TBNG and does not significantly affect aquatic populations and at-risk aquatic species, the open road system of the TBNG does provide public access for recreational fishing. Recreational fishing is primarily limited to on-site reservoirs and portions of the Cheyenne, Little Missouri, and Little Powder rivers, where channel catfish, largemouth bass, bluegill, yellow perch, and bullhead can be found.

There are few natural lakes, ponds, or marshes on TBNG with sufficient water depth to maintain game fish. However, aquatic plants, amphibians, and smaller native fish, such as dace, chub, and minnow, can be found in the streams and creeks on the grassland, where the road system can directly contribute to habitat loss. Threats to native species include the introduction of non-native predatory species, reduced water flows from surface water diversions, channelization of streams, pollution, and increased sedimentation from road runoff. Roads that cross or run parallel to creeks and streams are of particular concern as they have the potential to degrade habitat quality through increased sediment input, increased peak stream flows, and by limiting the passage of aquatic organisms when flow obstruction or blockages are created at culverts and bridges.

Species specifically at risk from these threats include the flathead chub, finescale dace, plains topminnow, plains minnow, and the northern leopard frog. All of these species are currently or have previously been classified as a sensitive species on the Region 2 Regional Forester's Sensitive Species List (the flathead chub and plainstop minnow were recently delisted). The fish species are known to occur in the Cheyenne River and in Antelope Creek, in habitats ranging from strong current rivers to shallow and slow streams. The northern leopard frog is a wetland obligate, preferring springs, slow streams, marshes, and reservoirs with rooted aquatic vegetation for egg mass attachment [See TW (1,3)].

The presence of flathead chub as a sensitive indicator species was investigated on all 5th order and greater perennial streams on TBNG (Gloss and Guenther Gloss, 2004). Flathead chub was confirmed to be present in 7 of the 24 5th level watersheds containing roads on NFS lands. Only 1 of these watersheds, Little Thunder Creek, is a Class III condition watershed, with a high road density (see **Table 4-2** under AQ (1)), and may pose significant concern for road management decisions.

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

The greatest impact of non-native species introduction from the road system occurs where Forest roads provide recreational water users, such as fisherman and boaters, direct access to surface water. There is one unimproved boat landing at Turner Reservoir, and road access to East Iron Creek, Little Thunder Reservoir, Centennial Pond and Little Powder Reservoir brings visitors to the water. Boat trailers, waders, and other fishing equipment can carry the eggs of non-native fishes, insects, mollusks, fungi, and non-native invasive plants from one body of water and deposit them in another. In addition, fishermen can introduce non-native fish to a water body by releasing unused baitfish or by stocking the water body with non-native fish.

The northern leopard frog is considered a sensitive amphibian species and rare across the State. Species of commonly introduced fish have been shown to increase predation pressure on the northern leopard frog, including the commonly stocked green sunfish (Gloss and Guenther Gloss, 2004). Road access can also increase the likelihood of the spread of disease through more frequent recreation activity. Ranaviruses can be introduced by transplanted bullfrogs, and chytrid fungus can be transported on the boots of recreationers passing from one pond to the next, by fish stocking, or also by transplanted bullfrogs (Smith, 2003). Both ranaviruses and chytrid fungus can eliminate entire local populations of leopard frogs.

Tamarisk, or saltcedar, is an aquatic plant that displaces native vegetation, such as cottonwoods, willows, and many species of grasses, forbs, and shrubs. Tamarisk can have a significant effect on water flow along drainages due to its large uptake of water. High densities of tamarisk can congest river channels, reducing channel widths and creating potential flood hazards. In the TBNG Watershed Condition Assessment (Gloss et al., 2003), the opportunity to control the early stages of tamarisk invasion was cited as a restoration reason for four of the recommended priority watersheds. These watersheds include Little Powder River – Spring Creek, Lower Antelope Creek, Upper Cheyenne River, and the Lower Dry Fork Cheyenne River.

Higher maintenance level roads that terminate at a water body are likely used as access routes for recreational use of that water body. Therefore, these roads, by simply providing access, increase the potential for introduction and spread of invasive aquatic plant and animal species which potentially prey on, compete with, or spread disease to native communities of the water body.

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

Although several streams on the TBNG support populations of fish and/or amphibians that are considered sensitive to aquatic habitat degradation, there are no known areas of exceptionally high aquatic diversity or productivity on the grassland. However, the TBNG Watershed Condition Assessment singled out the Little Powder River – Spring Creek watershed as a recommended priority watershed based on aquatic species diversity and relative high quality of water (Gloss et al., 2003). A portion of the Cheyenne River has also been designated in the Grassland Plan as a Special Interest Area in part to due the unique aquatic and riparian species and habitat in the area (See TW4). Road management decisions in these areas should consider the potential effects to these unique aquatic and riparian habitats.

TERRESTRIAL WILDLIFE (TW)

TW (1) and TW (3): What are the direct and indirect effects of the road system on terrestrial species habitat? What are the direct and indirect effects on wildlife species?

<u>General Effects</u>

Road construction into a new area causes terrestrial habitat loss, and can result in habitat and population fragmentation. Normally, direct habitat loss within the road right-of-way is minimal compared to the amount of available habitat across a landscape. However, when considering the impacts a road may have on habitat use, fragmentation, and potential effects on animal movements, overall habitat losses from a road expand well beyond losses within the immediate road corridor. As an example, a study of grassland birds in Massachusetts found a dramatic reduction in bird density and species number extending 1 kilometer away from a heavily used highway (Forman and Deblinger, 2000).

Roads dissect habitat and increase the number of habitat patches, increase the amount of edge habitat within an area, decrease the amount of interior habitat, and increase the distance between suitable interior habitat patches (Reed et al, 1996). Roads in the grasslands also have the effect of increasing the diversity of habitats in an area by inducing the establishment of new invasive species along the road corridor or creating new habitat for established species such as the prairie dog. Habitat dissection effects are disruptive for interior species and for species that require a diversity of habitats, some of which may be less accessible due to road avoidance effects.

Roads often restrict or modify animal movements and can sometimes result in population isolation, an increase in inbreeding and loss of genetic variability, and potential extinction of local populations. For larger animals, impacts on movements are best addressed by looking at the intensity of the species' road-avoidance behavior relative to the overall road density of an area. In contrast, a single road can limit movements of smaller mammals by acting as an effective barrier to population dispersal. These effects are mostly observed with larger, wider roads.

Roads can also act as corridors for animal movements or promote population dispersal of edge-dwelling species into areas that were previously inaccessible or inhospitable. Predators such as swift fox and coyotes often utilize roads for foraging (Forman et al, 2003), and as a consequence, predation is often higher along the road corridor. Increased predation along the road corridor has been observed for sage grouse and baird's sparrows. However, evidence suggests that the effects of road associated edges in grasslands may be less distinct than those observed with roads in other habitats (Forman et al, 2003). In one study of nest predation in tall grass prairie grasslands in Missouri, proximity to roads did not influence nesting success of Henslow's sparrows or Dickcissels while nest proximity to forested edges did (Winter et al, 2000). Many species benefit by the creation of edge habitat due to an increased variety of vegetation types and food.

These species are typically habitat generalists, with no population risks or sensitivity. Many small rodents appear to be either unaffected or positively influenced by the presence of roads (Forman et al, 2003). In contrast, species that are adversely affected by increased edge tend to be habitat specialists (such as the sage grouse and baird's sparrow) are more sensitive to edge associated impacts, and often have a higher conservation concern.

Traffic on roadways can also increase direct wildlife mortality and degrade wildlife habitat through increased human activity. Small, slow-moving animals are especially vulnerable to mortality on roads. Edge species drawn to roadsides also experience higher road-kill rates. Predators that are drawn to these areas and forage along the road corridor often experience increased mortality from vehicular trauma (Black et al, 1997). However, wildlife mortality is typically more evident on roads with high use and high traffic speeds. Road use results in increased human activity both on and off the road in adjacent areas. Human activity can result in a range of effects to wildlife from limiting wildlife movements, to breeding disturbance, to habitat alteration through invasive species establishment.

<u>Species Group Discussions</u>

The discussion and analysis presented below is primarily focused on potential impacts of the road system on selected groups of USFS Region 2 sensitive species and species of local value, providing information and discussion pertinent to question TW (1). At the same time, due to the broad scope of habitats, feeding habits, and animal families covered by the selected individuals from the sensitive species list, the analysis presented here also addresses road associated impacts to major habitats TW (3). These questions were combined due to the inherent link between road associated effects on wildlife and their associated habitats.

Both direct and indirect effects of the road system are discussed below with respect to major species groupings and their associated habitats.

Ungulates

Ungulate species at TBNG include elk, antelope, mule deer, and white tailed deer. Primary road effects on this group of species can include increased mortality along the road corridor, disturbance impacts, habitat fragmentation, and limitations on dispersal and movement patterns.

Numerous studies have shown that ungulates are sensitive to disturbance caused by roads. Elk were shown to avoid large open areas near roads open to vehicular traffic (Lyon, 1983; Rowland et al., in press; Ager et al., in press), with avoidance increasing with increasing traffic volume. Lyon (1983) showed that elk habitat effectiveness can be expected to decrease by at least 25 percent with a density of 1 mile of road per square mile of land (mi/mi^2), and by at least 50 percent with a density of 2 mi/mi^2. Elk habitat at TBNG is primarily focused in the Broken Hills, Cellar-Rosecrans, and Hilight Bill geographic areas. Both year-long and crucial winter habitats are found in this variable topography terrain bordered by areas of high road density due to coal, oil, and gas development. Due to the sensitivity of elk to disturbance, it is possible that the adjacent areas of high road density and land use are limiting elk use and movement in these areas. Categorization of road densities across the TBNG with respect to the 1 mi/mi^2 and 2

mi/mi^2 categories reported by Lyon (1983) supports this suggestion, showing that the majority of the grasslands fall within the 50 percent reduced habitat effectiveness category.

At the same time, it should also be noted that the availability of variable topography terrain sought by elk for winter habitat and refuge is localized in the Broken Hills geographic area and may on its own have limiting effects on elk habitat use and dispersal. Elk do use flat open spaces with few roads. Where topographic relief is higher, elk tend to tolerate a bit more road use. Currently, only 1 mile of USFS maintenance level 3 road (Philips Road) passes through an area considered crucial winter habitat for elk at TBNG. An additional 13 miles of USFS maintenance level 3 road traverse areas considered to represent both winter and year-long habitat for elk, and 19 miles pass through areas used as year-long habitat. Differences in USFS maintenance level 3 road mileage observed within these habitat calculations may be, in part, due to differences in the relative acreage of each habitat category. For example, crucial winter habitat occupies the least acreage and therefore, assuming an even distribution of maintenance level 3 roads across the landscape, it is not surprising that fewer road miles are found within this category. Similarly, the greatest number of road miles are found within the year long habitat category which covers the greatest acreage. However, an assessment of overall road density[1] within each habitat category shows that road density also varies between these categories, with the lowest occurring in crucial winter habitat (1.1 mi/mi^2), and higher road densities observed in winter/year long and year long habitat categories (1.98 mi/mi^2 and 1.65 mi/mi^2, respectively). Of the road mileage listed above for all habitat categories, 80 percent are considered to pose a high risk to wildlife by the IDT.

Antelope are found much more widely dispersed throughout TBNG, with year-long and wintering habitats located in areas with varying degrees of road density. Though antelope are also found to be sensitive to open roads with traffic (Bright and van Riper, 1999) approximately 90 percent of the USFS maintenance level 3 road system passes through antelope habitat, with roughly $1/3^{rd}$ of that road mileage in areas characterized as winter/year-long habitat and the rest in areas characterized as year-long habitat.

White-tailed deer habitat is found in the northern portion of TBNG (north of Upton and Osage, and in the Spring Creek geographic area), and in more southern portions of TBNG in major riparian zones (Dry Fork of the Cheyenne River, Antelope Creek, Cheyenne River, Little Thunder Drainage and in areas of reclamation associated with coal mines). Mule deer habitat is spread more evenly throughout TBNG. Both white-tailed deer and mule deer share the areas north of Upton and Osage and in the Spring Creek geographic area for crucial winter habitat. Mule deer have also been shown to utilize reclaimed mine land (Medcraft and Clark, 1986). In general, mule deer and white-tailed deer are less sensitive than elk to disturbance from roads, but increased road densities can result in road mortality impacts (Reed, 1988), increased hunting pressure, and decreased habitat effectiveness of wintering grounds.

In general, deer collisions would be considered less common in grasslands when compared to mountainous or forested regions due to higher visibility provided by the open terrain and lower traffic volumes (Forman et al., 2003). Due to a gentle topography, roads generally do not follow stream courses or riparian zones at TBNG. As a result, potential impacts of the road system on

[1] Roads of all jurisdictions and maintenance levels were used for this calculation.

white-tailed deer habitat in the non-winter range habitats at TBNG are generally limited, occurring primarily where roads cross major riparian zones.

In contrast, in areas north of Upton and Osage and in the Spring Creek geographic area, crucial winter habitat for both white-tailed and mule deer (typically areas with forested cover) have notably high road densities. Approximately 20 miles of USFS maintenance level 3 roads north of Upton and Osage, and 14 miles of USFS maintenance level 3 roads in the Spring Creek geographic area have the potential to affect winter white-tailed deer habitat. These factors were taken into consideration when assigning a relative wildlife risk to roads in these areas (Chapter 5). Four roads, specifically York, Arledge, East Upton, and Clay Spur roads, were given high wildlife risk rankings in these areas, primarily due to potential impacts on crucial winter habitat for white-tailed and mule deer.

Upland Game Birds

Though a variety of upland game birds are found at TBNG, sage grouse (a management indicator species), sharp tailed grouse, and to a lesser extent, wild turkey are the major focus for monitoring and management concerns. Primary road effects on this group may include direct loss of suitable habitat, disturbance impacts, habitat fragmentation, and modification of habitat through invasive species establishment and spread.

Sage grouse are habitat specialists that utilize various seral stages of sagebrush and meadows or openings near sagebrush for their breeding, brooding, and feeding habitats (USFS, 2001b). Breeding and display areas, or "leks," are crucial for management of this species may be an approximation of the center of the nesting habitat in a given area. Noise disturbance interferes with the mating ritual, or "dance", on leks. Roads and road-related activities, such as recreation and commercial use, contribute to this noise disturbance. Lek site identification and protection is crucial for management as approximately 2/3rd of hens will nest within 3 miles of the lek site (WGFC, 2003).

Changes in land-use, including mineral resource development and associated road construction, are identified as major causes of the loss or degradation of sage grouse habitats (Braun, 1998). Roads destroy sagebrush habitat directly along the road corridor. Vehicular traffic and associated uses further isolate fragmented habitat patches through avoidance behavior and mortality along the road corridor (both from increased predation and roadkill). Roads and land-disturbing activities promote the development of invasive species, which can affect the quality of sagebrush, grass, and forb habitat. Research suggests that road-related disturbances during the breeding season may cause sage-grouse leks to become inactive over time, reduce the number of hens that initiate nests, and increase the distance hens will move away from a lek to nest (WGFC, 2003; Lyon, 2000).

Sharp tailed grouse on the TBNG use similar habitat as the sage grouse (sagebrush and meadows, etc.), but also use major riparian areas with cottonwoods, willows, and deciduous shrubs during the winter for feeding, roosting, and escape cover. Major effects on this species that are potentially associated with road use and access include those listed above for the sage grouse, as well as any impacts road construction or use may have on forested riparian areas.

Nicholoff (2003) suggests that vegetation manipulation or disturbance that results in the loss of height, canopy cover, or density of deciduous trees or shrubs within 100 meters of streams, including seasonally dry and intermittent secondary drainages, should be avoided. In general, road impacts on canopy cover are minimal on the TBNG, and only occur where roads cross streams [Also see AQ(11) and discussion of riparian area bird species under *Migratory Songbirds and Others* below].

Due to the sensitivity of sage grouse and sharp tailed grouse to habitat alteration and disturbance, the IDT conducted an assessment of USFS maintenance level 3 road mileage found within 2 miles of 146 identified leks. Based on this analysis, approximately 78 miles of USFS maintenance level 3 road (28 roads in total) pass within this buffer distance. The majority (77 percent) of these roads were rated high for road-associated wildlife risk, while the remaining roads fell within the moderate risk category due to their limited mileage within the buffer and/or limited potential for disturbance of the lek site.

Wild turkey are habitat generalists, and may utilize ponderosa pine forest communities, open grasslands, and woody riparian areas. Heavily used roads can be detrimental to turkey populations, resulting in avoidance or abandonment of adjacent habitat (Wright and Speake, 1975; Still and Baumann, 1989). In addition, roads can provide easy access and promote higher levels of legal and illegal harvest, as well as crippling loss (Holbrook and Vaughan, 1985). Conversely, low volume roads can be beneficial to wild turkeys by serving as travel corridors and feeding areas providing insects, seeds, fruit, and other food items.

Raptors

A variety of raptors are found at TBNG, including both year-long and migratory species of hawks, eagles, falcons, vultures, and owls. Typical road-related impacts on this species group include disruption of nesting sites and direct injury and mortality to raptors hunting along high volume roads from vehicles. Road kills primarily occur along State highways and major public transportation arteries, which are largely under the jurisdiction of County or State agencies, and are not considered a major problem for management of the comparably low volume roads of the TBNG road system.

Both nesting and winter roosting sites have been observed for bald eagles on the TBNG. Bald eagles typically nest in the tops of large trees adjacent to large bodies of water. In Wyoming, groves of mature cottonwoods found along streams and rivers, and tall trees among conifer forests are commonly used for nesting (BLM, 2003). Though nest sites are most commonly found along major water bodies or riparian areas of major streams or rivers (USFS, 2001b), winter roost sites may be found in upland areas. Besides the distance to nearest water, other features that influence nest location can include diversity, abundance, and vulnerability of prey base; presence and proximity of shallow water; and absence of human development and disturbance. On the TBNG, wintering eagles are found near prairie dog colonies and sheep allotments (Byer, 2004).

Habitat loss for this species often involves physical disturbance associated with development and other human activities. This disturbance can deter eagles from otherwise suitable habitats, flush adults from nests exposing eggs or young to adverse weather conditions or deprive them of food, and decrease hatch rates and young survivability. Human activities near active communal winter roosting areas can cause eagles to abandon these habitats and expend energy finding other suitable roost areas. The additional energy used and added stress can lead to general deterioration in health and possibly affect survivability and reproductive success (BLM, 2003).

As a result of the sensitivity of bald eagles to disturbance from human activities, the RAP IDT assessed the number and mileage of those roads falling within 1 mile of any known bald eagle roost site or nest. Based on this analysis, 1.7 miles of road (2 roads in total) passed within a mile of two known bald eagle sites. Due to a recent mass failure on one of these roads, traffic on the portion of concern is now minimal. There are no plans restore traffic on that portion of the road. The other road in question is primarily a moderate use road for rangeland access and limited recreation use during the hunting season.

The ferruginous hawk is a raptor species found at TBNG that is considered highly susceptible to human disturbance during nesting (Nicholoff, 2003). This species is found across Wyoming in open basin and grassland habitats, and requires large tracts of relatively undisturbed habitat - areas normally associated with low levels of grazing (Nicholoff, 2003; DeGraaf et al., 1991). Current population declines in this species are due to conversion of native prairie habitats to other land uses and disturbance of nesting birds. Because this species rotates nesting sites, recycling nest sites anywhere from every year to every seven years, road impacts on known nesting sites are a major concern for management of this species. Based on one source of USFS-compiled bird information, 186 ferruginous hawk nests are found on the TBNG, 17 of which (nearly 10 percent) fall within ¼ mile of USFS maintenance level 3 roads. USFS roads 944 (Jacobs Road), 1109, and 934.A each pass within ¼ mile of more than 1 known ferruginous hawk nest.

The burrowing owl is a ground-nesting owl that utilizes some of the same habitats as the ferruginous hawk (DeGraaf et al., 1991), but with a greater focus on areas with colonial burrowing mammals, such as the prairie dog. This owl uses abandoned burrows created by burrowing mammals as nest sites. Populations of this species are declining primarily due to widespread elimination of burrowing rodents, notably prairie dogs and ground squirrels. In addition, like the ferruginous hawk, the burrowing owl is sensitive to disturbance. The Wyoming Bird Conservation Plan suggests leaving habitat undisturbed within ¼ to ½ mile of known nesting sites, and limiting disturbance until nesting ends in late July (Nicholoff, 2003). Currently, none of the USFS maintenance level 3 roads on the TBNG fall within ½ mile of any known burrowing owl sites despite numerous areas on the grasslands with prairie dog colonies. This could potentially suggest that disturbance, often brought to an area by resource development and road use, is currently having adverse effects on the nesting habits of burrowing owls on the grasslands. At the same time, it should be noted that construction of roads often leads to the spread or new development of prairie dog colonies (see *Small Mammals* discussion below). Thus, in some instances, particularly along low maintenance level/low use roads where disturbance effects would be minimal, a road may promote habitat characteristics favored by this species.

Short-eared owls are also ground-nesting raptors dependant on an abundant population of small mammals. Unlike burrowing owls, they only rarely nest in excavated burrows, preferring slight depressions on the ground, sometimes in small loose colonies (Anderson, 1991). Fragmentation of short grass prairie habitat is of primary concern for this species, since this effect can lead to fluctuations in small mammal habitats. Currently, there is little information available concerning the estimated population and spatial use of this species at TBNG. However, short-eared owls tend to cycle with their prey populations.

The Northern goshawk is a forest habitat generalist that uses a wide variety of forest conditions. On TBNG, nests are primarily found in mature, dense ponderosa pine stands, and are often found near a forest opening or road (Byer et al., 2000; Kennedy, 2003). Human disturbance associated with forest management and other activities may affect goshawks and can cause nest failure, especially during incubation (Kennedy, 2003). However, the USFWS (1998) suggests that disturbance in general "does not appear to be a significant factor effecting the long-term survival of any North American goshawk population." Though the presence of this species on the TBNG is noted (Byer et al., 2000), no information is available concerning its distribution. Potential habitat for this species is found in the Broken Hills geographic area, Upton Osage geographic area, and in the Spring Creek geographic area. Although these areas have relatively high road densities for the TBNG, the majority of roads accounting for this high density are low volume dirt roads. In general, these roads at current use levels are not likely to adversely affect Northern goshawk habitat, however, their increased use during such operations as timber harvest and oil and gas development, may.

The merlin is commonly found in open woodlands, savannah, grasslands, and shrub-steppe habitats. It often nests in large ponderosa pine, but also in other conifers, and in cottonwood in open woodlands within a short distance of open sagebrush/grassland for foraging. Habitat for this species can be found in pine forest communities and along woody draws and major riparian areas. This species is sensitive to disturbance particularly from oil and gas operations (USFS, 2001b), and thus, roads utilized for oil and gas development passing through suitable habitat for this species may reduce habitat effectiveness for this species. Three locations have been noted for this species, two in the Broken Hills Geographic Area and one observation was recorded in the southwestern corner of the TBNG along State Highway 59. All three recorded sites are greater than ½ mile from any USFS maintenance level 3 roads.

Migratory Songbirds and Others

TBNG provides important habitat for a variety of songbird, waterfowl, and shorebird species (USFS, 2001b). Migratory songbirds, shorebirds, water birds, and waterfowl utilize sage brush habitats and riparian areas extensively, and several of the priority neotropical migrants are inhabitants of coniferous forest available on portions of the TBNG. [Although road use and management likely effect waterfowl and shorebirds on the TBNG, no sensitive waterfowl or shorebirds[1] were identified for detailed discussion for this iteration of the TBNG RAP.]

[1] This excludes the mountain plover and long billed curlew, which are technically considered shorebird species although their habitats are not considered typical shorebird habitats.

Several birds on the sensitive species list are of particular importance when addressing road-related impacts on upland birds in shrub-steppe habitats. These include the McCown's longspur, sage sparrow, Brewer's sparrow, grasshopper sparrow, and the loggerhead shrike. Habitat, in general, for these species is dominated by sagebrush with an interspersed grass component (Nicholoff, 2003). Major road-associated effects to this habitat include direct destruction of habitat from mineral-development related road construction, increased recreational use of road accessible areas, and impacts from all terrain vehicle (ATV) user-created roads. Driving vehicles off-road across sagebrush habitats destroys vegetation, contributes to soil erosion, and can directly destroy nests and nestlings (Nicholoff, 2003). Due to the ground-nesting habits of the McCown's long spur and grasshopper sparrow, these species would most likely be impacted by nest destruction from illegal off-road vehicle use in sagebrush habitat. Road construction and use also result in opportunities for weed invasion, roadkills, and fragmentation of sagebrush habitat. Noxious weed invasion can alter vegetation characteristics that are especially crucial for sagebrush obligates, including the sage sparrow, Brewer's sparrow, and sage grouse (see *Upland Game Birds* above). Sagebrush obligate species, such as the sage grouse, sharp-tailed grouse, and sage sparrow are particularly sensitive to habitat fragmentation from road construction and mineral development due to their requirement for large areas of sagebrush habitat. These species are typically more productive in large stands of habitat than in small stands, and evidence suggests that their numbers decline with increasing disturbance (Dinsmore, 2003; Nicholoff, 2003; USFS, 2001b).

The long billed curlew and mountain plover are sensitive upland bird species found on the TBNG that inhabit areas of shortgrass prairie. The long billed curlew utilizes a complex of short grass prairies, agricultural fields, wet and dry meadows and prairies, and grazed mixed-grass and scrub communities (Nicholoff, 2003). This species is sensitive to the effects of fragmentation from land use conversion and the disturbance of its habitat during the breeding season (April through July). Increased recreational use of waterbodies with road access may effect this species which is sensitive to disturbance during the nesting period (this species often nests on the ground near water). The mountain plover inhabits areas of shortgrass prairie, typically in association with areas of bare ground, such as those found in prairie dog colonies. Although this species is adapted to many natural forms of disturbance (such as heavy grazing, fire, and disturbance caused by prairie dog activities) it is sensitive to oil and gas development, recreational activities, eradication of prairie dogs, and habitat conversion (Nicholoff, 2003). Due to the particular sensitivity of the mountain plover to habitat alteration and disturbance associated with mineral development operations and recreational use, the IDT included an assessment of USFS maintenance level 3 road mileage found within identified mountain plover habitat. Based on this analysis, 2 total miles of USFS maintenance level 3 road (5 roads in total) passed through identified mountain plover habitat. All of these roads were rated high for wildlife risk due to the sensitivity of the mountain plover to disturbance and habitat modification effects. Four out of 5 of these roads are also considered to have an overall high value to the USFS for range, recreation, or mineral resource values. Several of these roads currently have marked low speed zones to protect mountain plovers from road-associated mortality and disturbance.

Numerous wetland species inhabit the abundant constructed ponds and dugouts, as well as natural and seasonal wetlands at TBNG. Sensitive species falling within this category include the black tern and American bittern. Road associated effects on the black tern and American bittern may include those associated with disturbance from recreation use and impacts from road derived drainage that flows into wetland habitat. These species prefer shallow, open water areas with some emergent vegetation for nesting and feeding. Water level fluctuations from recreational uses (wading fishermen, boat wakes, etc.) can result in flooding or disturbance of nests (particularly for the floating nest of the black tern) (Nicholoff, 2003). Excess runoff or siltation from failing or undersized road drainage structures may modify water levels or decrease the abundance of emergent wetland fringe. Road associated impacts to amphibian species or aquatic communities upon which these species depend, may also adversely effect these species (Nicholoff, 2003).

Other species of concern on the TBNG include the yellow billed cuckoo (Nicholoff, 2003). The yellow billed cuckoo is a riparian obligate species that prefers extensive areas of mature deciduous forests near water, and requires low, dense, shrubby vegetation for nest sites. On the TBNG, this habitat is primarily found along major stream courses with cottonwood riparian forest stands. The yellow billed cuckoo is sensitive to habitat fragmentation (Nicholoff, 2003), the loss of cottonwood riparian cover from road construction, and the potential for increased spread of exotic invasive species, such as the tamarisk, into riparian zones (Bennett and Keinath, 2001). Due to the potential for roads to affect riparian areas and wetlands as described above, the IDT utilized the presence of road mileage within 300 feet of major riparian zones as a factor for assigning a relative wildlife risk. Based on the analysis, approximately 10 miles of 21 different USFS maintenance level 3 roads (approximately 5 percent) passed through riparian areas at TBNG. The majority of these roads (60 percent) were ranked as high for potential wildlife risk, while all but 1 of the remaining roads were rated as moderate.

Amphibians and Reptiles

Typical road-related impacts on this species group may include disruption of nesting sites by traffic or illegal off-road vehicle use, reduced dispersal, population isolation, and direct injury or mortality of reptiles or amphibians either crossing the road or 'sunning' in the road travelway (Forman et al., 2003). Amphibians and reptiles that must migrate to breed or hibernate, including many species of salamanders, frogs, toads, snakes, and turtles, often incur the greatest population losses of all animal groups from roadkill mortality. Significant losses in amphibian populations can occur during mass migrations to breeding ponds and other wet habitats. The presence or absence and density of entire local amphibian populations can be affected by increased mortality due to traffic and higher predation rates near roads (Forman et al., 2003).

The Black Hills redbelly snake is a small, semi-fossorial snake that primarily inhabits mesic communities, such as streams, springs, ponds, wet meadows, and any other wet areas. Studies of redbelly snakes have revealed little, and as a result, little is known about the factors putting them at risk (Smith and Stephens, 2003). However, Smith and Stephens (2003) identified three potential road-related factors that put Black Hills redbelly snakes at risk, including habitat loss, habitat modification, and possible contamination of habitats by pesticides or other environmental contaminants. Roads have the potential to modify habitat for this species when crossing riparian areas or other mesic habitats, and can cause the potential contamination of prey or habitat due to oil from traditional vehicles, off-road vehicles, or road treatments for ice or dust abatement [See AQ (5)].

The northern leopard frog is considered a sensitive amphibian species and rare across the State. Northern leopard frogs are wetland obligates, using a wide variety of aquatic habitats from springs to slow streams, marshes, reservoirs, and lakes. Road impacts on this species may include direct impacts, such as mortality on roads by automobiles and limitations on movement or habitat use from blocked culverts (during tadpole stage); or indirect impacts, such as those associated with pollution from road runoff, transmission of disease, and potential for the introduction of predators (Smith, 2003). Road mortality effects on amphibians are well-known and documented (Forman et al., 2003), and are most likely to occur during the summer as adults move more frequently into upland areas for food. Road access to leopard frog habitat increases the likelihood of the introduction of predators of the leopard frog. The most notable of these species is the American bullfrog, which has been well-known to eliminate entire local populations of other ranid frogs (Smith, 2003). Species of commonly introduced fish also have been shown to increase predation pressure on the northern leopard frog, including the commonly stocked largemouth bass, green sunfish, and rock bass (Smith, 2003). Road access can increase the likelihood of the spread of disease through more frequent recreation activity. Ranaviruses can be introduced by transplanted bullfrogs, and chytrid fungus can be transported on the boots of recreationists passing from one pond to the next, by fish stocking, or also by transplanted bullfrogs (Smith, 2003) (see also AQ 10 and TW2). Both ranaviruses and chytrid fungus can eliminate entire local populations of leopard frogs. Lastly, frogs and other amphibians are highly susceptible to changes in water quality due to their reliance on aquatic habitats for critical phases of their life cycle and the high permeability of their skin. Studies have shown that road runoff agents, such as motor oil and solvents, can kill some amphibians. These chemicals can leave a roadway and pass into nearby frog ponds during rain and snowmelt (Smith, 2003).

Small Mammals

A variety of small mammals are found at TBNG, varying in size, habitat preference, food preference, and distribution across the landscape. Not surprisingly, the effect of roads on small mammals and their habitat use is also varied. Road avoidance behavior, habitat fragmentation, habitat creation, increased predation along the road corridor, increased mortality from roadkill along the road corridor, and impacts on movement and dispersal patterns are common associated impacts on small mammal populations.

Prairie dogs are considered an ecological “keystone species,” since many other wildlife species depend on the unique habitat created by their foraging and burrowing activities. The black-footed ferret is probably the only truly obligatory predator of prairie dogs, while the swift fox and ferruginous hawk are considered to be generalized prairie dog predators. The mountain plover and burrowing owl are believed to be prairie dog habitat dependent species (Van Pelt, 1999; May, 2001).

Road impacts on prairie dogs are varied, with some factors of road construction and development improving habitat opportunity for the species, and other factors, primarily associated with road usage, having potentially adverse effects on populations. Road construction efforts result in disturbed soil conditions along the road right-of-way that are favored by prairie dogs for constructing burrows. At the same time, increased access to areas generally increases exposure of colonies to hunting pressure. Currently, there are 72,500 acres of the TBNG closed to hunting of black-tailed prairie dogs year-around. However, the relatively high road density and efficient access to these areas makes this closure difficult to enforce.

Since 1997, black-tailed prairie dogs have been significantly reduced on the TBNG by an epidemic of the sylvatic plague. The plague is primarily spread by ground squirrel fleas in prairie dogs, but numerous other species of mammal can carry plague, including dogs, cats, coyotes, bobcats, or rabbits. Because numerous hosts have the potential to spread fleas that carry the sylvatic plague, the determination of a specific vector is often difficult. Nevertheless, it may be suggested that increased access and hunting opportunity provided by the road system may allow for additional opportunities for transmission of the plague from one area to the next.

As described above, the black-footed ferret is probably the only truly obligatory predator of prairie dogs (Van Pelt, 1999; May, 2001), and therefore, potential adverse and beneficial effects of roads on prairie dogs are also an important consideration for the black-footed ferret. However, due to the often higher concentrations of black footed ferret near roads and relatively large home ranges (approximately 20 miles), road mortality from vehicle collisions is also a concern. In studies in western Kansas and Canada, vehicular trauma was a significant cause of death for black-footed ferrets, especially in young of the year (Black et al., 1998, Sovada et al., 1998).

To address these concerns and provide a relative estimate of the exposure of known prairie dog colonies to the TBNG road system, the IDT assessed the number of miles of USFS road passing through known prairie dog colonies. Approximately 12 miles of road (10 different roads with 10 USFS maintenance level 3 miles and 2 USFS maintenance level 2 miles) passed through known prairie dog colonies, accounting for roughly 5 percent of the USFS maintenance level 3 road mileage. Not surprisingly, all of these roads were considered high risk to wildlife due to potential effects on prairie dogs and their numerous associated species (Black et al., 1998).

Bats

Two bats of particular importance on the TBNG include the fringed bat (*Myotis thysanodes*) and Townsend's big-eared bat *(Corynorhinus townsendii)*. Although hibernacula occurrence on the TBNG is unknown, both species have been observed in the area during recent surveys. Summer and maternity roost sites for the fringed bat may include buildings, caves or mine tunnels, and dense pine forests with adequate snags (Schmidt, 2003a). Summer and maternity roosts for the Townsend's big-eared bat are more commonly caves or mines and the underside of bridges (Schmidt, 2003b). Both species forage along major forested and woody riparian areas for insects.

Major road-associated threats to these species on the TBNG include those associated with disturbance of roosting sites by noise produced by off-road vehicles, firearms, or other noise producing activities (other recreational uses, mineral resource extraction operations, etc.). The Towensend's big eared bat is noted as being "extremely sensitive to disturbances in the vicinity of their roosts" (Schmidt, 2003b). Other potential road associated effect to these species may include disturbance of riparian area habitats (road cuts, recreational activities brought to riparian areas by roads, etc.), and the establishment of invasive species by these activities can alter vegetation patterns for key prey species development (Schmidt, 2003a, b).

Insects

The ottoe skipper and regal fritillary are two species of concern that have not been observed on or near the grassland (LRMP EIS, Appendix H). The ottoe skipper inhabits native tall grass prairie, whereas the regal fritillary inhabits tall grass prairie and other open sites including damp meadows, marshes, wet fields, and mountain pastures (Opler, Pavulaan, and Stanford, 1995). No information concerning road associated effects on these species was identified for this analysis other than the impacts to their habitat discussed in AQ (8, 9, 11, and 13). However, conversion of habitat associated with agricultural uses has been identified as a conservation concern for the ottoe skipper. No single cause has been attributed to the decline of the regal fritillary.

If the presence of these species is confirmed in the future, these species will be addressed in detail subsequent versions of this RAP.

TW (2): How does the road system facilitate human activities that affect habitat? How does the road system affect legal and illegal human activities (including trapping, hunting, poaching, harassment, road kill, or illegal kill levels)?

The road system provides access for a multitude of human activities, both legal and illegal, that affect wildlife habitat and species on the TBNG. These human activities can be grouped into three major categories: recreational uses, mineral resource extraction, and rangeland management.

<u>Recreational Use</u>

Recreational use on the TBNG is increased wherever roads provide access, specifically near road accessible waterbodies and areas typically used for hunting. Recreation is highest during the hunting season, and thereafter drops dramatically for the rest of the year. Roads facilitate access for legal and illegal hunting (poaching), and new roads open up areas to higher levels of hunting pressure. Effects to wildlife include direct human-caused mortality and injury from hunting or poaching activities.

Increased hunter presence and activity near roads can result in disturbance to wildlife species, damage to habitats from trampling and disturbance, alter movement patterns, and increased potential for invasive species dispersal (see question TW (1) and TW (3) for species-specific examples). Higher vehicle use during hunting season leads to ungulate movement off NFS lands onto private land where hunting pressure is lower. This fragments populations, disrupts normal distribution, and alters hunter success. Another noted road/hunting associated problem occurs when trappers put snare traps in culverts to trap predators (bobcat, coyote, fox, etc). This sometimes blocks the culvert resulting in limitations to the movement of aquatic species, alterations in local aquatic habitat, and increased maintenance needs when/if the culvert fails

(See AQ (4) for discussion of culvert impacts). Hunters entering from the roadside, where invasive species are most often established, may hike into interior areas, and in so doing, promote the spread of invasive species. The effects of poaching on wildlife are similar to those addressed for legal hunting effects, but go beyond what the State has planned for a manageable, sustained harvest.

Passenger cars and four-wheel drive vehicles are commonly used to support all forms of recreational use at TBNG. The branches, stems, and seeds of noxious weeds frequently lodge in the undercarriage or bumpers of these vehicles and travel great distances, dispersing seeds along the way. When on the road, these vehicles disperse seed and add to the potential for the establishment and spread of non-native species along the road corridor. However, perhaps of greater concern, is the tendency for illegal off-road use of these vehicles. Due to the open terrain and low vegetation of the TBNG, this can occur virtually anywhere. Illegal off-road use results in the dispersal of non-native invasive species from the road corridor into interior areas of the grassland, disturbing wildlife, destroying vegetation, and altering vegetative species composition. Illegal off-road use can also result in the permanent destruction of habitat if the route is used repeatedly, resulting in the formation of a user-created road.

The use of motorized vehicles, including snowmobiles, can reduce wildlife habitat effectiveness via noise disturbance, stress, and displacement of animals, nest abandonment, and interruption of breeding behavior. Constant disturbance can result in changes in behavior, abandonment of territory and even death of animals (USFS, 2003c). Winter motorized vehicle traffic also can disturb wildlife during critical winter periods. Winter tends to stress animals more than any other season because food is scarce and energy expenditures for staying warm and traveling through snow are high.

Roads provide access for hikers, bikers, horseback riders, and cross-country skiers. Hiking, camping, biking, and horseback riding all have the potential to trample vegetation that serves as wildlife habitat for a suite of species and to act as vectors for noxious weed dispersal (see question EF (2), and TW(1) & (3). Roads facilitate the encroachment of all of these activities into areas that would otherwise be difficult for humans to access. Therefore, the presence of roads increases the risk of vegetation trampling and noxious weed dispersal. All these activities, both on- and off-road, result in higher levels of disturbance to wildlife species than in unroaded areas. The presence of humans moving through the environment is perceived as a threat by some wildlife. Such wildlife may experience similar disturbance patterns as described in question TW (1) and TW (3). Disturbance can range from temporary displacement of individuals to abandonment of territories. Although camping is allowed, there are no developed camping areas on the TBNG, and effects from camping activities are anticipated to be similar to that described above for other forms of dispersed recreation.

To provide insight into the overall potential for recreational road use to affect wildlife on the TBNG, we compared the relative recreation value of the USFS maintenance level 3 road system with respect to the relative risks the road system poses to TBNG wildlife. This was done by cross-correlating the mileage and number of roads ranked as high, moderate, and low for recreation value with the mileage and number of roads ranked as high, moderate, and low for wildlife risk. The results of this tabulation are included in **Table 4-6**.

Table 4-6. Potential for Recreational Road Use to Affect Wildlife				
Wildlife Risk	**Recreation Value**			
		HIGH	**MOD**	**LOW**
HIGH	Miles*	90.8	27.7	13.0
	Count	13	9	11
* Note: the total length of the road is included in these mileage calculations, but not all portions of the road are necessarily a high risk to wildlife. Actual portions of the road that are a high risk to wildlife would need to be addressed in project analysis.				

Based on this cross-correlation, the greatest proportion of high wildlife risk roads are also considered high value for recreational use (approximately 70 percent). This suggests that recreation use has a generally high potential to effect wildlife sensitive roads on TBNG.

<u>Natural Resource Extraction</u>

Roads provide the primary access for conventional oil and gas, coal bed methane (CBM), and coal mining operations on the TBNG. As described under question MM (1), road use by coal mining operations is limited to providing access to mine headquarters. Due to the limited extent and focused use of this road, it does not generally affect or facilitate human activities that affect a broad range of wildlife habitats across the TBNG.

Roads are the principal means of access for conventional oil and gas and CBM exploratory operations, field development, and production operations. The effects of these operations are provided in the *Final Environmental Impact Statement and Proposed Plan Amendment for the Powder River Basin Oil and Gas Project* (BLM, 2003) and the *Porcupine CBM Project Environmental Assessment* (USFS, 2003a) and supporting documents. In summary, the following principle effects to wildlife from these operations may include: (1) increased direct mortality (including legal hunting, poaching, collision with power lines and vehicles, electrocution on power lines, and nest loss); (2) the introduction of new habitats suitable for avian and mammalian predators, and thus a potential change in predation rates on other wildlife species; (3) direct loss or degradation of habitats; (4) indirect disturbance resulting from human activity (including harassment, displacement, diversion from public to private lands, noise and dust, altered nutritional status and reproductive success, and changes in habitat effectiveness); (5) habitat fragmentation (particularly through construction of roads); and (6) changes in population levels. Species-specific examples of many of these effects as they relate to road use and development are provided under question TW (1) and TW (3).

Wildlife effects are generally greatest during the oil and gas construction phase, when the highest level of activity occurs. Wildlife may avoid areas with these activities and use other locations in response to the increased levels of human activity, equipment operation, vehicular traffic, and noise. This avoidance often results in the under-use of otherwise suitable habitats, thereby decreasing overall habitat effectiveness. Additional impacts from ground disturbance activities also result in mortality or habitat destruction impacts for some wildlife, particularly small mammals, reptiles, insects, and ground-nesting birds.

Wildlife effects during the production phase are generally lesser than those of the construction phase, and are focused primarily on wildlife disturbance impacts from maintaining the pumpjack and other well equipment. For conventional oil and gas, operators may check installations between once a day and once every four days, depending on well production. This routine activity and disturbance can result in long-term alteration of the local wildlife community, tending towards species that are either more tolerant of human presence, or more readily adapted to routine disturbance. This latter case has been shown in some raptors that are normally considered to be sensitive to human presence, but are able to habituate to routine disturbance. In contrast, species such as the golden eagle have been noted to be highly intolerant to nest disturbance during the incubation period, often abandoning nests when disturbed (Tesky, 1994). Impacts from operator maintenance of CBM wells would be significantly less than that from conventional oil and gas due to the lower frequency of visits (once every month to once every three months, see question MM (1)). However, visits to CBM wells may become more frequent (daily) during periods when air temperatures fluctuate dramatically in order to drain condensation. This could result in impacts to nesting birds in the spring.

To provide insight into the overall potential for mineral resource extraction-related road use to affect wildlife, a comparison was made between the relative mineral resource value of the USFS maintenance level 3 road system with respect to the relative risks the road system poses to TBNG wildlife. This was done by cross-correlating the mileage and number of roads ranked as high, moderate, and low for mineral resource value with the mileage and number of roads ranked as high, moderate, and low for wildlife risk. The results of this tabulation are included in **Table 4-7**.

Table 4-7. Potential for Mineral Resource Extraction Road Use to Affect Wildlife

Wildlife Risk	Mineral Resources Value			
		HIGH	MOD	LOW
HIGH	Miles*	54.4	29.5	47.6
	Count	13	10	10

* Note: the total length of the road is included in these mileage calculations, but not all portions of the road are necessarily a high risk to wildlife. Actual portions of the road that are a high risk to wildlife would need to be addressed in project analysis.

Based on this cross-correlation, approximately 41 percent of the roads considered high risk to wildlife resources are also considered high value for mineral resource development. At the same time, a nearly equivalent proportion of high wildlife risk roads are considered to be of low value for mineral resource development. This breakdown suggests that the potential for mineral resource extraction operations to impact high risk wildlife roads is variable across the TBNG, and therefore should be addressed on a more specific local area scale.

<u>Livestock Operations</u>

Roads provide the primary means of access for livestock operations on the TBNG. Rangeland use and management effects on wildlife at TBNG vary from species to species, and vary depending on the habitat grazed. Further discussion of the wide range of effects on wildlife and their habitats is provided in the TBNG LRMP and accompanying EIS (USFS, 2001a; 2001b).

If the distribution of the road system contributes to the overuse of some areas and under-use of others, then the road system itself can potentially contribute to rangeland management-induced impacts on wildlife. Although there is currently no database of information listing all of the sites in which rangeland management practices have or are currently impacting wildlife habitat (i.e., overgrazing, trampling of sensitive habitats, etc.), identifying those roads with the potential to adversely effect wildlife habitat (i.e. those roads with heavy rangeland use and sensitive wildlife habitats) can help identify areas to focus monitoring efforts.

To provide insight into the overall potential for rangeland management related road use effects on wildlife (specifically the livestock operations portion), a comparison was made between the relative rangeland management value of the USFS maintenance level 3 road system with respect to the relative risks the road system poses to TBNG wildlife. This was done by cross-correlating the mileage and number of roads ranked as high, moderate, and low for rangeland management value with the mileage and number of roads ranked as high, moderate, and low for wildlife risk. The results of this tabulation are included in **Table 4-8**.

Table 4-8. Potential for Livestock Operations Road Use to Affect Wildlife

Wildlife Risk	**Range Value**			
		HIGH	**MOD**	**LOW**
HIGH	Miles*	89.0	40.8	1.7
	Count	12	16	5

* Note: the total length of the road is included in these mileage calculations, but not all portions of the road are necessarily a high risk to wildlife. Actual portions of the road that are a high risk to wildlife would need to be addressed in project analysis.

Based on this cross-correlation, approximately 67 percent of the roads considered high risk to wildlife resources are considered high value for rangeland use (specifically, the livestock operations portion). Moreover, only one percent of the roads considered high risk to wildlife are of low importance for rangeland purposes. This suggests that rangeland road use has a high potential to affect wildlife-sensitive roads at TBNG.

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

The road system may facilitate introduction of non-native invasive species that could adversely affect unique communities or special features. This topic is addressed in question EF (2), as well as TW (1) and (3) with regard to playas. In addition, open roads may increase the incidence of human activities that could have negative impacts on characteristics of unique communities. People are often drawn to unique areas or special features, and proximity to a road allows for better access by more people. Examples of negative impacts could include the disturbance of a site or over collection of rare species. Conversely, the road system can also beneficially affect unique communities by providing access for management and protection activities. Unique communities on the TBNG are managed to preserve their characteristic features and ecological processes and to minimize disturbance.

Unique communities and special features on the TBNG include sensitive plant populations, rare plant communities, wetlands, riparian areas, and wooded draws. Additionally, Special Interest Areas (SIAs) and Research Natural Areas (RNAs) that have been designated because they contain unique wildlife and/or botanical features are considered unique communities on the TBNG.

Sensitive Plant Populations

At the start of this roads analysis process, four sensitive plant species were either documented or suspected to occur on the TBNG. **Table 4-9** lists these species along with their status, habitat association, and occurrence information, where available. Subsequently, four additional species have been added to the sensitive species list as being suspected to occur on the TBNG. The following species are not included in the table below; *Carex leptalea* (bristle stalk sedge), *Carex alopecoidea* (Foxtail sedge), *Physaria lanata* (Wooly twinpod), *Viburnum opulus* (American/Highbush cranberry), *Penstemon laricifolius* (larchleaf beardtongue). These species are only suspected to occur on the TBNG and have not been documented, but may be covered in later iterations of the TBNG RAP.

Table 4-9. Proposed, Endangered, Threatened, and Sensitive Plant Species on the TBNG.

Name	Status	Habitat	Occurrence (TBNG)
Barr's milkvetch (*Astragalus barrii*)	USFS Sensitive	Grows in low, dense mats in areas of sparse vegetation cover. Found on eroding knolls, buttes, and hilltops in thin barren soil that has eroded from sandstone or siltstone. Found in and along major drainages.	Four populations occur on the TBNG, and an additional population occurs outside, but near the TBNG. Found on eroding sandstone bluffs along Powder River.
Dakota buckwheat (*Eriogonum visheri*)	USFS Sensitive	Obligate resident of badland areas; inhabits mostly barren, actively eroding clay and shale substrates in dense clay soils that are sodium-affected and nutrient poor.	No known populations in the TBNG. Not known to occur in Wyoming.
Iowa moonwort (*Botrychium campestre*)	USFS Sensitive	Found in native, unplowed prairies; sites with some disturbance. Found in sandy grasslands, limestone prairie, and sandy soils of semi-shaded, mixed deciduous and Ponderosa pine forest. Associated with tall to midgrass prairies.	In Wyoming, known only from two occurrences in the Black Hills National Forest.
Utes ladies-tresses (*Spiranthes diluvialis*)	Federally Threatened	Inhabits moist soils in mesic or wet meadows, gravel bars, wet streambanks, and old oxbows between elevations of 4,300 to 7,000 feet.	Species occurrence unlikely or questionable. TBNG is within species' range and potential or suitable habitat may occur.

Source: Byer et al., 2000; Fertig, 2000; Anderson and Cariveau, 2003

Barr's Milkvetch

Roading currently unroaded areas, such as for oil and gas development, could cause the loss of individual plants or whole populations of Barr's milkvetch. A key road-related concern for populations of and habitat for Barr's milkvetch is the introduction and spread of non-native plant species. Roads provide vectors for the invasion of non-native plant species, which can out-compete Barr's milkvetch and reduce population numbers. In addition, the road system provides access to and increases the potential for illegal off-road ATV use, which can directly damage or destroy Barr's milkvetch plants and alter potential habitat for the species.

Dakota Buckwheat

This species is not known to occur within the TBNG or within the State of Wyoming. While suitable habitat could exist for the species in the Broken Hills, Upton Osage and Spring Creek geographic areas on the TBNG based on suitable habitat, the distribution of this species is uncertain, and road-related effects are unknown.

Iowa Moonwort

There are no known populations of this species on or near the TBNG. However, habitat for this species may occur on the TBNG. Since this species prefers areas of mild disturbance, the road system could have the indirect beneficial effect of providing access to areas for activities that create a mild disturbance regime, such as grazing and prescribed burning. In addition, decommissioning and closure of temporary roads, such as those used for oil and gas activities, could provide suitable habitat for the species. One of the Wyoming populations is located on an old roadbed in an open, grassy swale (Anderson and Cariveau, 2003).

Utes Ladies-Tresses

There are no known populations of this species on the TBNG. However, potential habitat for this species does occur in the TBNG in wetlands and riparian areas. Twenty-one of the 69 USFS maintenance level 3 roads on the TBNG have road miles located within major riparian areas. Of the 194 miles of USFS maintenance level 3 roads, the IDT identified 10.6 miles of road within 300 feet of a riparian area, 10.6 miles of road within 300 feet of a water body, and an overall average of approximately 2½ USFS maintenance level 3 road stream crossings per road mile. Road-related impacts on these habitat types are discussed in general under questions AQ (4), (6), (8), (9), and (11). More specifically, roads can introduce and spread non-native plant species, such as the Canadian thistle, along travel routes and thereby reduce the quality of habitat for Ute ladies' tresses. In addition, populations located downstream of road associated erosion or sediment sources may degrade habitat for this species downstream.

Rare Plant Communities

Rare plant communities known or expected to occur on the TBNG based on the LRMP EIS include:

Western Wheatgrass - Spikerush Herbaceous Vegetation
Eastern Cottonwood / Western Snowberry Woodland
Boxelder / Chokecherry Forest
Silver Sagebrush / Needle-and-thread Shrub Herbaceous Vegetation
Silver Sagebrush / Prairie Sandreed Shrub Herbaceous Vegetation
Prairie Sandreed – Needle-and-thread Herbaceous Vegetation
Bluebunch Wheatgrass – Sideoats Grama Herbaceous Vegetation
Greasewood / Bluebunch Wheatgrass Shrubland
Birdfoot Sagebrush / Western Wheatgrass Dwarf-shrubland
Gardner's Saltbush / Western Wheatgrass Shrub Herbaceous Vegetation
Eastern Cottonwood / Western Wheatgrass Woodland
Prairie Cordgrass Western Herbaceous Vegetation
Silver Sagebrush / Western Wheatgrass Shrub Herbaceous Vegetation
Black Greasewood / Alkali Sacaton Sparse Vegetation
Western Wheatgrass – Green Needlegrass Herbaceous Vegetation
Rocky Mountain Juniper / Big Sagebrush Woodland
Ponderosa Pine / Sun Sedge Woodland
Ponderosa Pine / Western Wheatgrass Woodland
Ponderosa Pine / Little Bluestem Woodland
Little Bluestem – Sideoats Grama, Blue Grama – Thread-leaf Sedge Herbaceous Vegetation
Three-square Bulrush Herbaceous Vegetation
Western Wheatgrass Herbaceous Vegetation
Prairie Cordgrass– Three-square Bulrush Herbaceous Vegetation

Existing roads within the vicinity of, or passing through, areas containing rare plant communities may directly affect the condition of these communities and their long-term viability. Potential road-related effects include: changes in hydrological processes from road runoff, which could affect vegetative composition; introduction and spread of non-native/noxious plant species that can out-compete desired vegetation; adverse effects on botanical features from the control of non-native plant species alongside roadways; adverse effects associated with public access to these areas, such as trampling and collection; increase in the potential for illegal off-road ATV use, which could damage or destroy these rare communities; and increased access to these areas for monitoring and resource management purposes. Building roads in areas containing rare plant communities could destroy these communities or further exaggerate the above-listed effects.

Wetlands

Road-related effects on wetland habitats on the TBNG are discussed under question AQ (8).

Wooded Draws and Riparian Areas

Wooded draws are areas where an overstory of wooded vegetation occurs in small drainages in a grassland setting. Predominant vegetation in these areas is green ash/chokecherry/snowberry habitat (Byer et al., 2000), and is a result of higher moisture conditions than in surrounding areas. Surface water, if any, running through the area is usually short-term (USFS, 2001a). Woody draws create habitat for many animal species, offering shade, wind protection, and forage for livestock and wildlife. Road-related impacts on wooded draws are similar to those described for riparian areas under questions AQ (4), (6), (9), and (11), and for reduced wildlife habitat effectiveness as described in TW (1) and (3).

Special Interest Areas (SIAs) and Research Natural Areas

SIAs are managed to protect or enhance areas with unusual characteristics, including scenic, historical, geological, botanical, zoological, and paleontological features. There are 7 designated SIAs on the TBNG, only 2 of which emphasize natural/ecological features. These include the Cheyenne River Zoological SIA and the Cow Creek Historic Rangeland SIA. The Cheyenne River SIA, a 5,980-acre site, provides special habitat for the prairie dog, mountain plover, and black-footed ferret, along with potential habitat (along the Cheyenne River) for the Ute's ladies' tresses and bald eagle. The Cow Creek Historic Rangeland SIA, a 14,170-acre site, features naturally appearing rangelands that function in a self-sustaining ecological manner (USFS, 2001a). **Table 4-10** presents the existing road density within these SIAs based on available GIS data. In general, the majority of these roads pass through the SIA, rather than running tangential to the SIA boundary.

Table 4-10. Road Density within TBNG Ecological SIAs

SIA Name	Square Miles	Miles of Road*	Road Density (miles/miles^2)
Cheyenne River Zoological	9.2	12.2	1.3
Cow Creek Historic Rangeland	21.8	27.6	1.3
*Includes roads of all maintenance levels and all jurisdictions			

RNAs are selected to provide a spectrum of relatively undisturbed areas representing a wide range of natural variability within important natural ecosystems and environments or areas with special or unique characteristics or scientific importance. There are 2 designated RNAs on the TBNG: Rock Creek RNA and Wildlife Draw RNA. Principal distinguishing features of the Rock Creek RNA, a 590-acre area, include rolling hills, vegetation of the big sagebrush/needle-and-thread plant association and the needle-and-thread/blue grama plant association, draws supporting the silver sagebrush/western wheatgrass plant association, and known populations of Barr's milkvetch, a Forest sensitive species. Wildlife Draw, a 640-acre area, is vegetated entirely with grasslands and sagebrush shrug-steppe, and has three draws containing ephemeral streams and the silver sagebrush/western wheatgrass association. **Table 4-11** presents the existing road density within these RNAs.

Table 4-11. Road Density within TBNG RNAs			
RNA Name	**Square Miles**	**Miles of Road***	**Road Density (miles/miles^2)**
Rock Creek	0.9	1.1	1.2
Wildlife Draw	1.0	0.6	0.6
*Includes roads of all maintenance levels and all jurisdictions			

Roads in SIAs and RNAs may degrade the habitat supporting the unusual botanical or zoological features for which they were designated. This habitat degradation could include: sedimentation in riparian areas; introduction and spread of non-native/noxious plant species that can out-compete desired botanical features; adverse effects on botanical features from the control of non-native plant species alongside roadways; adverse effects associated with public access to these areas, such as trampling and collection; increase in the potential for illegal off-road ATV use, which could damage or destroy unique botanical features; and any of the numerous road effects on wildlife described under TW (1), (2), and (3). On the other hand, the road system provides access to these areas for resource management and protection, as well as for research and monitoring activities.

Building roads in unroaded portions of the SIAs and RNAs could remove the habitat supporting the unusual botanical or zoological features for which these areas were designated. However, the TBNG LRMP (USFS, 2001a) addresses each of these special management designations and provides direction and guidelines to protect the unique features they contain, including restrictions on motorized use and road development.

ECOSYSTEM FUNCTIONS AND PROCESSES (EF)

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

An inventory of areas essentially roadless and undeveloped in character has been completed for the TBNG and is provided in Appendix C of the Northern Great Plains Management Plan Revision Final Environmental Impact Statement (2003). Six areas of the TBNG totaling 58,610 acres met the roadless inventory criteria: Cow Creek, H A Divide, Red Hills, Duck Creek, Downs, and Miller Hills. These areas are natural in appearance and their ecological processes remain intact. A description of these areas is provided in **Table 4-12**, along with the number of miles of USFS maintenance level 3 roads present in each.

Table 4-12. Inventoried Roadless Areas on the TBNG

Name	Description of Area	Miles of USFS Maintenance Level 3 Road
Cow Creek	One of the highest scenic areas on the TBNG, affording spectacular views of the surrounding plains. Buttes, grassland, scattered Ponderosa pine, and cottonwood bordered drainages including Deer Creek, Bobcat Creek, Coal Draw, and Piney Creek characterize the landscape.	0
H A Divide	A large mesa with mixed-grass prairie, blended with sagebrush, cottonwood, greasewood, ponderosa pine, and Rocky Mountain juniper.	0.9
Red Hills	A remote area characterized by red scoria escarpments and buttes dissected by drainages. Rich in plant and animal diversity and frequented by elk.	0
Duck Creek	This area lies within an unglaciated portion of the Missouri Basin and is characterized by grassy lowlands, woody draws, rolling hills, rocky shale and limestone escarpments, and mesas.	0
Downs	This area lies within an unglaciated portion of the Missouri Basin and is characterized by open country of rolling to undulating hills, rocky escarpments and buttes, dissected and incised drainages flowing mostly to the east and south. The Downs is an outstanding area of badlands that is unique to TBNG.	0
Miller Hills	This area lies within an unglaciated portion of the Missouri Basin and is characterized by rolling hills and badlands rising into shale and sandstone escarpments and flat-topped mesas.	0

Source: USFS, 2001b

Roading of these currently unroaded areas could cause adverse impacts to ecological processes, rare plants, wildlife, and wilderness qualities. Ecological processes, such as seasonal flooding, could be impacted by roads. Roads can alter hydrological processes of streams, as discussed previously. Vehicles may cause mortality or damage to the federally threatened Ute ladies-tresses (*Spiranthes diluvialis*), a perennial forb in the orchid family dependent on riparian habitat. Roads can negatively affect populations by introducing non-native plant species along travel routes, by habitat fragmentation, and by loss of suitable habitat to disturbance (USFS, 2001b) [For discussion of exotic species introduction and effects see EF(2)] . Other sensitive species with potential habitat in this area include Barr's milkvetch (*Astragalus barrii*), Dakota buckwheat (*Eriogonum visheri A. Nels.*), and Iowa moonwort (*Botrychium campestre*). A more detailed discussion of road-related impacts on proposed, endangered, threatened, and sensitive plant species is included under question TW (4). Adverse impacts to wildlife could also result as discussed under TW (1), TW (2), and TW (3). Roads would also reduce the opportunity for solitude and serenity and the natural appearance and integrity of the area.

EF (2): To what degree do the presence, type, and location of roads increase the introduction and spread of exotic plant and animal species, insects, diseases, and parasites? What are the potential effects of such introductions to plant and animal species and ecosystem function in the area?

Roads provide a primary corridor for the transport and spread of noxious weeds. Roads may influence the spread of exotic plants through direct transport via vehicles or indirectly by altering habitat and creating early seral, bare soil, or patchy ground cover that favors weedy species. Noxious weeds can alter vegetation composition, and in doing so, modify habitat quality for some species. Invasive species such as crested wheat and cheat grass can outcompete native species and quickly take over large areas. Because these species are often not utilized by native wildlife for forage, they represent a direct loss of suitable forage for many native wildlife. Noxious weed invasion can also directly alter the structural habitats. For example, noxious weed spread in areas of bare ground preferred by prairie dogs and mountain plovers can result in a reduction in suitable habitat for these species. Noxious weeds competition with rare plants, can result in a reduction of population numbers and habitat quality for these species.

The TBNG does not have a current inventory of noxious weed species and infestation levels. Noxious weeds known to exist on the TBNG include black henbane, Canada thistle, common St. Johnswort, dalmation toadflax, hoary cress, hounds tongue, leafy spurge, meadow thistle, musk thistle, oxeye daisy, spotted knapweed, yellow toadflax, and tamarisk. From the available GIS data, Canada thistle appears to be the most common and widespread. Twenty-seven roads on the TBNG were identified as high risk for noxious weeds (see **Table 4-13**).

Table 4-13. Roads Rated High Risk for Noxious Weeds*

Road ID	Approx. Total Road Miles	Road ID	Approx. Total Road Miles
1105	1.2	914.03	14.2
1105.A	1.8	918	6.0
1246	1.7	923.02	10.3
1247	2.6	924	3.2
1257.C	1.9	926	3.9
1263.H	3.4	933	10.6
1269	3.2	934	4.5
13.38	8.3	937	9.6
13.40	0.6	938	5.8
1423	2.0	942	14.9
1618	2.3	959	3.9
1619	4.8	968	2.4
900	4.5	973	6.9
913	8.0		
*USFS maintenance level 3 roads only			

Locations of weed-infested areas on the TBNG were obtained from GIS data. It should be noted that this layer is incomplete. In the northeast corner of the Spring Creek Unit, USFS Roads 1021 and 1019 bisect a large area of Canada thistle and meadow thistle. In that same unit in the southwest corner, USFS Roads 1247, 1027, and 1024 pass through smaller areas of Canada thistle. The largest area of leafy spurge on the TBNG is located in the northwestern tip of the Fairview Clareton geographic area and is bisected by USFS Road 1203. Not all of these roads were considered high risk because they did not meet all the high risk evaluation criteria.

Tamarisk, or saltcedar, has become an increasing problem in riparian areas of the TBNG and competes with native cottonwoods and willow. Antelope Creek is one of the major drainages of concern where activities to control the spread of tamarisk are ongoing (Staton, 2004). Road-stream crossings are suggested to act as dispersal mechanisms for tamarisk seeds, although infestations of tamarisk at TBNG do not appear any greater at stream crossings (Staton, 2004).

Refer to questions TW (1) and TW (3) for more information about exotic animal diseases, and to question AQ (13) for issues pertaining to aquatic species.

EF (3): How does the road system affect ecological disturbance regimes in the area?

Historically, the primary ecological disturbance processes in the area were fire, drought, and herbivory, with floods, wind, blizzards, and insects/diseases playing a somewhat smaller role. These processes have occurred at varying frequencies and intensities over time, influencing the composition and structure of the ecosystems. While roads do not directly affect the majority of these processes they can alter the natural pattern of fire on the landscape. [For a discussion of herbivory and road use see *Rangeland* under TW(2); for a discussion of insects and diseases see TW(1, 3), AQ(13), and EF(4); for a discussion of overall hydrologic effects of the road system see, AQ(1 and 9)].

As the level of human activity increases so does the chance for wildfire. Roads facilitate access to otherwise remote locations in the TBNG, and thereby increase the likelihood of wildfire in these areas. A spark from a carburetor, cigarette, match, campfire, stove, or flare could start a fire that would not have occurred without the increased access allowed by roads.

Though fire is a natural disturbance, the frequency and magnitude of fires is likely much different than the normal disturbance regime experienced by the grasslands in the absence of roads and road-related activities. An estimated 9 wildfires occur at TBNG on average each year, burning approximately 3, 500 acres (USFS, 2001b). Any such burn transforms the vegetation in the affected area from a relatively complete sagebrush, grassland, or forest to a landscape with a patchwork of burned, semi burned, and unburned areas.

Due to the increased risk of accidental ignition associated with roaded areas, the fire ignition frequency in these areas is likely higher than it would be without the road system. However, at the same time, the abundance of roads provides easy access and fuel breaks for fire control, and therefore, many of these fires do not consume as much area as they would under natural conditions. The overall result, is that areas that are heavily roaded are more frequently burned than what would occur naturally (though on a smaller spatial scale), and those areas that are relatively unroaded are less frequently burned than would occur naturally. This change in the frequency and distribution of fire can change the vegetative landscape, altering the natural disturbance and renewal patterns required for many vegetation communities and their associated wildlife.

EF (4): To what degree do the presence, type, and location of roads contribute to the control of insects, diseases, and parasites?

Question EF (2) describes how roads contribute to the introduction and proliferation of exotic plant and animal species on the TBNG. Roads also provide land managers access to areas infested by insects, diseases, and parasites for efficient sampling, monitoring, and ground-based treatment/suppression activities. The entire road system on the TBNG (including local roads and maintenance level 1 and 2 roads) provides the means to access areas for early detection of insect, disease, and parasitic infestations and outbreaks. These roads then become the primary means of access for management operations associated with the control of insect and disease spread. The TBNG road system currently provides sufficient access in most areas to inventory insects and diseases and to treat infestations, if necessary. Overall, the benefits of roads with regard to exotic plant species control and monitoring are outweighed by their detrimental effects.

There is no data available for the TBNG to assess current insect and disease levels. While grasshoppers are also a concern on the TBNG (to livestock grazing permittees and adjacent landowners), grasshopper damage control is typically conducted via aerial spraying (USFS, 2001b), and is not affected by the road system.

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

Noise effects on recreation are discussed under question UR (3) and RR (3). Adverse effects of noise on different species of wildlife from developing, using, and maintaining roads vary with the intensity and duration of the disturbance and the species in question. Effects can range from temporary avoidance of the area during construction and/or maintenance activities to long-term effects, such as extirpation of a species, shifts in home range, and altered reproductive success associated with road activity.

Adverse noise effects on wildlife associated with road activity on the TBNG are anticipated to be higher in more heavily used areas and areas in which larger, noisier vehicles are the predominant users of the road system. These areas include areas with high existing and potential oil and gas mineral development, and to a lesser extent, access points to rangelands and popular recreation areas. Roads that are high value for all three of these activities would have the largest potential to adversely affect wildlife due to noise from their use over the long-term. These issues are more fully addressed in questions TW (1) and TW (3), and individual risk and value ranks for each road can be found in Appendix A.

ATV use on the TBNG also generates noise, which has the potential to adversely affect wildlife. Illegal off-road ATV use has a greater potential to affect wildlife, since this use could occur anywhere in the TBNG, not just alongside or nearby road corridors. This issue is addressed in TW (2).

ECONOMICS (EC)

EC (1): How does the road system affect the Agency's direct costs and revenues? What, if any, change in the road system will increase net revenue to the agency by reducing cost, increasing revenue, or both?

The TBNG road system includes a mixture of public roads under State or County jurisdiction; private roads; USFS roads maintained for either public or non-public use; and uninventoried roads that may be associated with oil, gas, or mineral exploration or 'user created' roads (unplanned travelways that essentially become roads due to repeated vehicular traffic). Generally, uninventoried roads are not required for the majority of TBNG resource management activities and are not considered part of the transportation system of the TBNG. The road system supports public access to the TBNG for recreation, industrial, and rangeland operations, as well as resource management activity. In addition, the public lands of the TBNG are heavily interspersed with private inholdings, providing transportation for a number of local businesses, travel and commuting routes for local residents, and several school bus routes.

The road system has a direct link to the economic exploitation of the mineral resources on the TBNG. As part of the mineral extraction lease agreements, roads that are constructed to provide access to production sites are maintained by private operators during the lease period. At lease termination, these roads are turned over to the USFS and become part of the USFS-maintained road system. Roads created in this manner comprise the bulk of the current TBNG road system. Other road users on the TBNG often find additional uses for roads constructed by oil and gas development efforts during the lease period.

In order to maintain the TBNG transportation system, the USFS incurs costs associated with planning, construction, and maintenance of roads; decommissioning roads; and mitigating unacceptable environmental effects. Currently, the USFS actively maintains approximately 194 miles of maintenance level 3 roads at a total approximate annual expenditure of $250,000 equating to an approximate average of $1,290 per road mile. These maintenance expenditures are only sufficient to maintain a portion of the road system, and in many cases, to a standard below that intended for the road. In order to bring the road system up to its objective standard, a series of major road improvements are also considered part of the road maintenance budget. These 'deferred' maintenance items for the TBNG road system currently total $1,531,369, or an average of $7,893 per road mile. Although these numbers are rough estimates at best [INFRA database entries for road maintenance needs are currently incomplete (Ormseth, 2004)], inadequate maintenance can contribute to environmental damage and affect the accessibility of TBNG resources and the revenues associated with their use.

Revenue generation that is either directly or indirectly dependent on the TBNG road system includes receipts from royalties on the sale of commodities, recreation user fees, and special use agreements. Grazing user fees are paid by ranchers who are users of the road system. Oil and gas royalties paid by operators who use both USFS and private roads to monitor production sites return an estimated $60 million per annum to the Federal government, with $30 million of that returning to the State of Wyoming. Mineral extraction revenues also include fees paid by coal mine operators. Two licensed guide/outfitters also operate in the TBNG, however no revenue from their activities comes back directly to the district to pay for costs.

The Rocky Mountain Region 2 Road Analysis Supplement to FS-643 groups roads to be considered at the forest plan scale into three categories: 1) roads that will always be open for obvious reasons; 2) roads that will be closed due to serious resource damage or annual budgetary constraints; and 3) roads that do not fall into either of the first two categories. This last category, the largest of the three categories, includes roads for which an economic evaluation would not be appropriate at the forest plan scale.

Table 4-14. Relative Cost of USFS Maintenance Level 3 Roads by Value

Costs Relative to Mineral Resource Value			
Relative Cost	**Mineral Resource Value**		
	HIGH	MOD	LOW
HIGH	12.6%	9.2%	23.9%
MOD	15.2%	3.8%	6.1%
LOW	15.1%	6.3%	7.7%

Costs Relative to Recreation Value			
Relative Cost	**Recreation Value**		
	HIGH	MOD	LOW
HIGH	31.8%	10.4%	3.5%
MOD	14.5%	5.6%	5.1%
LOW	13.0%	8.6%	7.5%

Costs Relative to Range Management Value			
Relative Cost	**Range Management Value**		
	HIGH	MOD	LOW
HIGH	29.7%	15.8%	0.2%
MOD	11.2%	13.4%	0.5%
LOW	10.4%	15.6%	3.0%

Evaluation of individual roads and road segments for this analysis was accomplished through the development of the Road Valuation and Risk Assessment criteria presented in Chapter 5. Application of these criteria allowed for the differentiation between those roads that represent a high potential return on investment (roads with high value and low cost) from those for which the return on investment would be low (roads with low value and high cost). Of special importance is the identification of roads that may involve substantial cost for maintenance, but which do not meet current or anticipated requirements for access or resource management.

Maintenance costs remain a key issue in the roads analysis process for most of the TBNG road system. The current level of road maintenance funding is considered adequate to complete only a small portion of the necessary maintenance each year.

The Road Valuation and Risk Assessment determined that 89 miles (or 46 percent) of roads receiving USFS maintenance fall within the high maintenance cost category; 46 miles (or 24 percent) are at moderate cost, and 57 miles (or 30 percent) are low cost. Of the road miles that were considered high cost to the USFS, only 13 percent were considered of high value for resource extraction use (see **Table 4-14**). In contrast, nearly one-third of the roads considered high cost to the USFS were considered high value for either (or both) recreation and rangeland uses. The comparatively low percentage of high cost/high mineral resource value road miles is partly due to the fact that a portion of the maintenance costs for these roads is incurred by the private companies responsible for mineral resource extraction.

The high level of commercial activity on the TBNG also greatly influences the cost and difficulty of maintaining roads. The TBNG includes approximately 250 grazing users, who routinely share the transportation system with private mineral resource developers and recreational users of the TBNG. In many cases, roads that were originally constructed for the purpose and standards suitable for oilfield access continue to be maintained after mineral extraction operations to support uses that arose during the mineral resource development period (typically rangeland access or recreation). The USFS then assumes the maintenance cost associated with maintaining the road at its original standard. This unanticipated maintenance expenditure can cause rapid increases in the maintenance burden of the road system as oil and gas leases expire.

Existing maintenance agreements, incorporated as part of road use and special use permits for the TBNG, would assist in reducing USFS maintenance costs of the road system. However, the resources necessary to manage these permits and conduct the necessary monitoring and enforcement activities must also be taken into consideration. This potentially leads to jurisdictional confusion and the possibility that some roads receive more attention than is required for adequate maintenance while others may go without any maintenance in a given year. An improved management strategy for commercial activity on the TBNG would also greatly assist in the management of the road system.

EC (2): How does the road system affect the priced and non-priced consequences included in economic efficiency analysis used to assess net benefits to society?

Based on the guidance provided in the *Region 2 Road Analysis Supplement to FS-643*, a detailed analysis of this question is more appropriate at the subforest or individual project scale. However, some general observations can be made.

Determination of the net effect of the road system involves the identification of both market and non-market values associated with the resources on the TBNG. Market value is an expression (usually, but not always in monetary terms) of the outcome of the production, consumption, or exchange of goods or services. Non-market values are generally an expression of some intrinsic benefit associated with experience or use and are usually represented in non-monetary terms. Non-market values can be further subdivided into values associated with active use of TBNG resources and those associated with passive use of TBNG resources. Active-use value normally applies to goods or services that are used in association with some specified activity, such as recreation. Passive values include things that are appreciated without actually using them, such as a scenic landscape, or are valued for preservation, such as cultural resources.

Management decisions affecting the TBNG road system are based on a rational evaluation of the cost of the chosen practice as compared with its net benefit. These normally include decisions to build new roads, to rebuild or perform maintenance on some roads and not others, or to decommission or temporarily close roads that are no longer required. In determining the economic efficiency of these decisions, both market and non-market values must be considered.

In addition to affecting access to mineral and other TBNG resources, and thereby affecting the costs associated with their extraction, these decisions may affect users of dispersed recreation resources in the TBNG and commuting and transportation patterns for workers, businesses, and other residents of the local and surrounding areas. The type of recreation available depends in large part upon whether or not there are roads present, and the extent to which the roads are open to vehicular traffic. The TBNG road system also serves several school bus routes for districts in the local communities.

For three of the counties surrounding the TBNG (Weston, Campbell, and Converse County), coal, oil, natural gas, ranching, and recreation tourism represent the primary economic activities. The road system of the TBNG directly supports mineral extraction economies in the surrounding area. Campbell County is the State's largest producer, accounting for approximately 25 percent of the State's total oil production, 95 percent of the State's coal bed methane production, and approximately 30 percent of the State's coal production (USFS, 2003a). Mining activities are less important to Weston and Converse counties. However, in the 3 counties combined, mining and related industries account for a total income of approximately $396 million (BEA, 2000).

The market consequences of the TBNG road system are relatively direct and can be readily quantified. However, non-market values are more difficult to determine. In most situations, these values are dependent on the inherent qualities of the TBNG and the perceptions of recreational users of the TBNG. Understanding of these values is important, especially as new users find new opportunities in the TBNG. For example, train-spotting sites have recently become a popular destination for some users of the TBNG. Increasingly, the aesthetic qualities of the natural environment have become more important to recreational users of the TBNG, supplanting the more traditional commodity use and production values expressed by longer-term users (see *Social Issues* below).

A more detailed analysis of these values and benefits is appropriate at the subforest or project scale. At this more narrow scale, it is possible to quantify certain economic outcomes as a comparison between alternative conditions. Where non-market values are concerned, analysis is confined to qualitative description.

EC (3): How does the road system affect the distribution of benefits and costs among affected people?

This question addresses the extent to which the TBNG road system services both the USFS and other users, including those engaged in economic production activities related to mineral and other natural resources. Based on the guidance provided in the *R2 Road Analysis Supplement to FS-643*, a detailed analysis of this question is more appropriate at the subforest or landscape scale. However, some key issues can be identified at the forest plan scale for this analysis.

The condition and availability of the road system is a major factor in determining who uses the TBNG, how much it is used, and what areas are accessible for use. In addition to providing access to activities specific to and located on the TBNG, the road system also augments transportation routes available to local residents and ranchers supporting the general requirements of their daily lives (i.e. providing additional access routes to schools, groceries, hospitals, etc.) throughout the year. The system serves communities in the immediate vicinity of the TBNG and in the surrounding counties of Campbell, Converse, and Weston, which together contain a total population of 52,364 people (USCB, 2003).

Local residents and communities also benefit indirectly from economic activities associated with the TBNG and supported by its road system. These benefits include employment and income derived from the various natural resource extraction and grazing operations located on the TBNG. Also supported are businesses that depend on forest access, such as recreation guides and outfitters. The impact of the TBNG is reflected as a part of the Mining, Agriculture, Recreation, and Accommodation and Food Services sectors of the local economy. Together, these 3 sectors account for approximately 33 percent of the total employment in the 3-county area (Campbell, Converse, and Weston County) surrounding the TBNG.

Recreational uses of the TBNG depend heavily on access provided by the road system. Changes in accessibility resulting from new construction, creation of unauthorized roads, deferred maintenance, or closure/decommissioning can alter visitor use patterns and may affect the distribution of recreational opportunities available to various user groups and segments of the local residential community.

The question of jurisdiction and the extent to which maintenance responsibilities are borne by non-USFS entities are important considerations for the analysis of the distribution of costs associated with the TBNG road system. Jurisdiction is primarily divided between the USFS and the local counties. However, actual jurisdiction depends on where the road is located. Of importance are those roads that pass through multiple jurisdictions resulting in some confusion as to the identification of the responsible entity. In these instances, identification of the responsible entity and/or cooperative agreements are required. The key question is the extent to which the correct entity (public or private) is assuming responsibility for maintenance.

COMMODITY PRODUCTION (TM, MM, RM, SP, SU, WP)

Timber Management (TM)

TM (1), TM (2), and TM (3): How does the road spacing and location affect logging system feasibility? How does the road system affect managing the suitable timber base and other lands? How does the road system affect access to timber stands needing silvicultural treatment?

Approximately 30,900 acres on the TBNG are considered forested. Some of these forests, primarily ponderosa pine interspersed among the grasslands, are suitable for timber harvest; however, management of this timber is primarily conducted to improve habitat conditions rather than to produce timber product. Timber production from these sites is estimated at 2 thousand board feet per acre.

The road system on the grasslands is generally considered adequate for supporting the minimal timber management operations that occur. This was not brought up as a major concern by the IDT and does not warrant detailed analysis at the National Grassland level.

Minerals Management (MM)

MM (1): How does the road system affect access to locatable, leaseable, and salable minerals?

The USFS administers its minerals program to achieve the following:

- Encourage and facilitate orderly exploration, development, and production of mineral resources from the TBNG; and
- Ensure that exploration, development, and production of mineral resources are conducted in an environmentally sound manner and that these activities are integrated with planning and the management of other National Forest resources (FSM 2802).

Mineral resources are separated into three categories: locatable, leasable, and saleable.

Locatable minerals are those deposits subject to location and development under the General Mining Law of 1872 (as amended). The USFS does not manage the mineral resources on National Forest System lands. That authority rests with the Secretary of the Interior. USFS authority is directed at the use of the surface of National Forest System lands in connection to the operations authorized under the United States mining laws (30 U.S.C 21-54), which confer a statutory right to enter upon the public lands to search for minerals. USFS regulations at 36 CFR 228 provide that operations shall minimize adverse environmental impacts to the surface resources, which include the following:

- Using all practicable measures to maintain and protect wildlife habitat affected by an operation.
- Reclaiming surface disturbances, where practicable.
- Rehabilitating wildlife habitat.

Throughout the TBNG, those with mineral rights have access allowing them to work their claims, and these routes may be closed to the general public. Arterial and collector roads, as well as some local roads are used to access individual claims, and access is addressed on an individual basis. The vast majority of roads constructed into mining claims are intended to be temporary. Where reconstruction/ construction and reclamation of roads are necessary for access, bonding is required as part of Operating Plans or Notice of Intent.

Leasable minerals are federally owned fossil fuels (oil, gas, coal, oil shale, etc), geothermal resources, sulfur, phosphates, and uranium. These minerals are subject to exploration and development under leases, permits, or licenses issued by the Secretary of the Interior, with USFS consent. The 1920 Mineral Leasing Act (as amended) and the 1989 Federal Onshore Oil and Gas Leasing Reform Act provide the authority and management direction for Federal leasable minerals on National Forest System lands.

Conventional Oil and Gas

The road system is the primary means of access for oil and gas exploration and extraction operations. Based on projected demand, a total of 230 conventional oil and gas wells are expected to be drilled through 2010 over the entire TBNG. Typically all of TBNG is leased for oil and gas. In those instances where leases expire, they are re-offered for oil & gas lease sale. Road access to support this current and future demand is planned and developed on a large grid and on an individual basis. On average, for each well drilled, 0.35 miles of road construction is required (Holm, 2001). In general, existing arterial and collector roads are utilized to access the general location for new road development and are sufficient for that purpose. Transportation plans are generally developed as part of each leasable activity.

To address the relative value of the road system for conventional oil and gas uses, the IDT assessed the density of actively producing oil and gas wells in the vicinity of each maintenance level 3 road, and/or whether the road provided access to a series of lower maintenance level roads supporting oil and gas wells or associated facilities (compressor facility access). Those roads providing direct access to a field of oil and gas wells or acting as the primary access route to numerous lower maintenance level roads that served oil and gas facilities were rated 'high' for oil and gas value. Those roads servicing one or only a few producing oil and gas wells were considered 'moderate' value. Those roads servicing no producing oil and gas wells were considered to be of 'low' value for oil and gas operations. Based on this analysis, out of 69 maintenance level 3 roads, 27 (or about 39 percent) are rated as high for mineral resource value, 14 (20 percent) are rated as moderate, and 28 (41 percent) roads are rated as low.

Coal Bed Methane (CBM)

Coal bed methane (CBM) development operations are a major concern for management of the TBNG road system. CBM production affects the road system in two major ways: 1) an increased need for roads for CBM field development, and 2) impacts of altered hydrology on road drainage systems.

CBM production demands are described for the entire Powder River Basin in the Final Environmental Impact Statement and Proposed Plan Amendment for the Powder River Basin Oil and Gas Project (BLM, 2003). Under the proposed action, approximately 7,135 miles of new improved roads and 10,619 miles of two-track roads would be developed to support CBM operations and facilities in the Powder River Basin. Based on an estimate of 369 wells and 0.35 miles of road required per well, an estimated 129 miles of new road would be constructed on TBNG lands. Though private companies would pay the costs associated with construction, maintenance, and reclamation of the proposed new resource roads, additional expenses will be incurred by the Forest Service in order to maintain the existing arterial road system. The estimated average daily traffic attributable to project related vehicles is more than a 25 percent increase over the existing average daily traffic counts (BLM, 2003).

In general, demand on the road system for CBM field development is similar to that required for a conventional oil and gas field, except smaller equipment is used. Drilling and installation of the new well heads requires numerous trucks carrying drill rigs and other equipment to travel into and out of the field on the current road system. However, in contrast to conventional oil and gas operations, traffic volumes experienced after the development phase (during gas production) are significantly less. Unlike oil and gas, where operators may check the installations between once a day and once every three to four days, maintenance traffic for CBM installations may only be required between once a month and once every three to four months (Reddick, 2004a). However, visits to CBM wells may become more frequent (daily) during periods when air temperatures fluctuate dramatically in order to drain condensation. As a result of the comparatively low road use requirements of CBM production, maintenance level 3 roads are only required to access the field, not every well. Access roads to wells are typically observed as two-track roads, and sometimes are barely visible (T. Gaul, personal observation) traversing from the main field access road to the wellhead. Thus, demands on the transportation system are significantly lower for CBM operations than for conventional oil and gas development. More detailed analysis of the future demands of CBM development on the overall structure and function of the TBNG road system will be required as individual coal bed methane project proposals are assessed.

Coal

Approximately 28,780 acres of TBNG land are currently under permit for coal production. Coal mining traffic demands are primarily limited to the transport of personnel and supplies into and out of the mine office. Coal produced from the mine is transported out of the mine by rail. Thus, coal associated traffic volume demands on the road system are generally minimal for the TBNG.

However, coal mines have a different effect on the road system that are of greater concern for transportation system management. Coal mines frequently ‘mine through’ a road that crosses an area permitted for coal extraction. These roads must then be either relocated, if the transportation value of the road is high, or closed, if the costs of relocating the road do not support its value to the transportation system. In some cases, if a County road is planned to be mined through, a right-of way may be required on USFS lands, and visa versa.

To address the potential for this to occur to USFS maintenance level 3 roads, the IDT identified those roads that pass through areas under permit for coal mining. Currently, nine USFS maintenance level 3 roads pass through areas under coal permit. Three of these roads are considered to have a high overall value to the TBNG transportation system and their replacement value will be evaluated on an as-needed basis. (see **Table 4-15**).

Table 4-15. Roads Within Coal Permit Areas By Overall Transportation Value			
Road ID	**Road Name**	**Miles within Coal Permit Area**	**Overall Road System Value***
973	Phillips Road	0.9	HIGH
1618	Beckwith Road	1.6	HIGH
934	Payne Road	3.1	HIGH
1109	(Unnamed)	0.1	LOW
1121.E	(Unnamed)	0.1	LOW
934.G	(Unnamed)	0.2	LOW
934.D	(Unnamed)	0.4	LOW
934.J	(Unnamed)	0.4	LOW
1619	Corder Creek Road	1.3	LOW
* See Chapter 5 for Overall Value Assessment			

<u>Salable Minerals</u>

Salable minerals include mineral materials, otherwise known as "common varieties," which generally include deposits of sand, gravel, clay, rock, or stone used for a number of purposes including road surfacing, construction materials, and landscaping. The road system is generally adequate for the access needed for these operations due to the comparatively lower level of these activities on the TBNG.

<u>Road Maintenance Costs Relative to Natural Resource Extraction</u>

An additional note should be made regarding the maintenance costs incurred by the maintenance of roads that are primarily used for mineral resource extraction. Although the tendency is to suggest that maintenance costs to the USFS are high on those roads that are highly valued (heavily used) by oil and gas development and operations, evidence suggests that this is not necessarily the case (see **Table 4-14** under question EC (1)) Correlating the high mineral resource value roads with respect to their costs suggests that only 30 percent of maintenance level 3 roads considered to have high value for mineral resources fall within a high overall maintenance cost category (for a discussion of maintenance cost category breakdowns see Chapter 5). At the same time, 50 percent of the maintenance level 3 roads considered high value to mineral resources are considered to be relatively low cost to the Federal Government. The reason for this is that many of the roads that are directly accessing mineral resource operations are maintained by the private mineral resource developer as a part of their lease agreements. Those roads that *are* both highly valued by mineral resource developers and are high costs to the government are generally those roads that serve a main arterial function and are the primary means for accessing a range of TBNG uses.

Range Management (RM)

RM (1): How does the road system affect rangeland management?

There are approximately 532,100 capable rangeland acres on the TBNG, of which 532,060 acres are suitable for grazing. The road system on the TBNG is the primary means of access to these areas, allowing ranchers to efficiently access their range allotments. Increased development of the road system, primarily to support oil and gas extraction, has provided multiple access routes to rangeland areas. These roads, originally designed to maintenance level 3 standards, are often used by ranchers to transport cattle, hay, and other materials during and long after oil and gas operations cease. In some cases, after their usefulness for oil and gas operation no longer exists, these roads continue to be maintained to maintenance level 3 standards, which may not be necessary given the amount of use required by the rangeland user.

The road system also provides access for range managers to monitor vegetation, monitor and control noxious weed spread, survey for sensitive plant and animal species, and identify conditions or sites where rangeland use may be impacting natural resources or rangeland infrastructure. This access is crucial for ensuring proper maintenance of rangelands, and ensure rancher compliance with the standards and guidelines set forth in the LRMP.

Based on a road-specific analysis conducted by the Roads Analysis IDT, the majority of maintenance level 3 roads (approximately 80 percent) are used by ranchers for rangeland access at some level. This system of roads, and the network of lower maintenance level roads that stem from it, currently provide more than adequate access for range management purposes. Of the maintenance level 3 roads on the TBNG, approximately 100 miles (52 percent) are rated as having a high value for rangeland management. These roads provide primary access to large areas with a high density of active range allotments and receive frequent traffic from ranchers. In addition to these, approximately 84 miles (or 44 percent) of USFS maintenance level 3 roads on the TBNG are rated as having a moderate value for rangeland management. These roads provide access to areas with few active range allotments, and may not necessarily need to be maintained to maintenance level 3 standards for rangeland management purposes.

Water Production (WP)

WP (1): How does the road system affect access, construction, maintaining, monitoring, and operating water diversions, impoundments, and distribution canals or pipes?

The road system provides the primary means of access to windmills, wells, stock ponds, and dams on the TBNG for construction, maintenance, monitoring, and operation. These water production facilities are primarily used for rangeland management purposes and increasingly for coal bed methane development (see MM1). As shown in **Table 4-16**, only about 24 percent of water production sites are located within ½ mile of a USFS maintenance level 3 road. Access to the majority of water production sites is directly provided by lower maintenance level roads, which are sufficient for this purpose.

Table 4-16. Water Production Sites in the Vicinity of Maintenance Level 3 Roads			
Site Type	**Total No. of Sites on TBNG**	**Sites within ¼ Mile of USFS Road***	**Sites within ½ Mile of USFS Road***
Artesian Well	26	5	8
Dam	258	33	56
Dugout	26	5	10
Well	59	10	13
Windmill	57	8	13
Total	**426**	**61**	**100**
*Includes maintenance Level 3 roads only.			

Due to the direct correlation between the water production and rangeland, access to water production sites was used by the IDT as a factor for rating each maintenance level 3 road for rangeland value.

USFS R2 Roads Analysis guidance suggests that this question is best addressed at the subforest scale.

Special Products (SP)

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

Special forest products on the TBNG include mushrooms, firewood, floral products, rocks, and medicinal plants. Some ponderosa pine is interspersed among the grasslands on the TBNG, primarily located in the Broken Hills geographic area (central portion of the TBNG), the Weston Hills portion of the Spring Creek geographic area (northwest corner of the TBNG), and the Upton Osage geographic area (northeast corner of the TBNG) (USFS, 2001a). Personal-use firewood permits are available for collection of this wood (USFS, 2001b).

The road system on the TBNG provides the primary means by which commercial harvesters and individuals access and transport special forest products. Since the majority of collection is conducted manually, collection tends to take place in close proximity to a road. The existing road system on the TBNG provides sufficient access for collecting and transporting special forest products. Any foreseeable changes in the area transportation system are expected to maintain adequate access for these types of activities.

USFS R2 Roads Analysis guidance suggests that this question is not normally a forest-scale issue, and is best addressed if raised during project scoping.

Special Use Permits (SU)

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

Special use agreements (permits and easements) exist for all instances of commercial uses of the road system, including utility corridors, power lines, pipelines, minerals, range use, and water production sites. Road systems located on National Forest lands directly influence the management of all special uses to access, construct, and maintain privately owned lands and facilities on or adjacent to the TBNG. According to the most recent data available on special uses from the USFS Infra Report database, there are currently 198 special use agreements issued on the TBNG. **Table 4-17** provides a breakdown of some of the special use types.

Table 4-17. Breakdown of Special Uses on the TBNG

Special Use Agreement Type	No. of Permits on the TBNG
Outfitters and Guides	2
Rangeland	20
Research and Surveys	5
Minerals	14
Oil and Gas	41
Power Line	23
Airport (Town of Upton)	1
Railroad Right-of-Way	4
Department of Transportation Easement	32
Forest Road and Trail Act Easement	3
Federal Land Policy and Management Act Permits and Easements	9
Water Transmission Pipeline	2
Water Diversion or Impoundment	3
Well, Spring, or Windmill	29
Stock Water	10
TOTAL	198

Source: USFS, 2004

As shown in **Table 4-17**, there are currently several power lines traversing portions of the TBNG. One power line runs north-south through the eastern portion of the Hilight Bill geographic area, in the southwestern portion of the TBNG. This line is the source for several shorter connecting power lines. In total, power lines in the Hilight Bill Geographic Area cross the maintenance level 3 road system on NFS lands in eight different locations. In the northern portion of the TBNG, three power lines transverse the Upton Osage geographic area, crossing maintenance level 3 roads in two locations on NFS lands. Two very short power lines are also located within the Fairview Clareton geographic area, but do not intersect USFS jurisdiction maintenance level 3 roads. In general, power line corridors tend to intersect lower maintenance level and County roads at a much greater frequency than USFS jurisdiction maintenance level 3 roads. Thus, the County and local USFS road system provides a significant portion of the access required for power line maintenance. Together, the current County and USFS road system (all maintenance levels and jurisdictions) provide ample access to power line corridors on the TBNG.

Special use permits or other formal agreements are required for private land owners that have exclusive use on NFS roads to access their property. Despite this requirement, there are numerous private land inholdings (private land areas completely surrounded by National Forest System lands) scattered throughout the TBNG that do not have documented easements on NFS roads for their primary access. While use of open roads is allowed, any additional work needed to provided year-round access to private lands would require a permit for the individuals to undertake this work. (Many landowners find they need these easements when transferring property or establishing title.) There have not been any instances of the USFS taking action against any adjacent or intermingled landowners using the NFS road system.

There is a commercial traffic use restriction on NFS roads, whereby a permit is required for commercial use of the system. The USFS makes efforts to enforce this restriction on the TBNG. The relationships between the road system and other special uses such as minerals management (including associated pipelines), range use, and water production sites are discussed in detail under Mineral Management (MM-1), Range Management (RM-1), and Water Production (WP-1), respectively.

GENERAL PUBLIC TRANSPORTATION (GT)

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

The TBNG and surrounding areas include numerous small tracts under public management (State, BLM, and USFS), interspersed by private inholdings. State highways and major County roads provide the backbone of arterial roads that connect major communities.

Two major north-south transportation routes traverse the western and eastern portions of the National Grassland. State Highway 59 runs along the western edge of the grassland, and provides connections (south to north) between Douglas, Wright, and Gillette, and the Spring Creek geographic area of the TBNG. State Highway 585 and U.S. Highways 18/85 together traverse the eastern edge of the TBNG, running from (north to south) Sundance to Newcastle to Cheyenne (eventually). State Highway 450 traverses east-west across the TBNG, connecting these two major north-south routes, and also serving as the main connection for travel between Wright and Newcastle. An additional transportation route, U.S. Highway 16 services the Newcastle-Osage-Upton corridor, traversing in a northwest direction from Newcastle to U.S. Highway 90.

The TBNG road system provides numerous connections between the major highways listed above and other major County roads. These connections are listed in **Table 4-18**.

Table 4-18. Major Road Connections with the TBNG Road System	
Major U.S., State, or County Route	**Connected USFS Roads (Maintenance Level 3 Only)**
U.S. Hwy 16	1276, 1248, 1325, East Upton Road (914.03)
State Hwy 59	Steckley Road (942), Jacobs Road (944), Stienle Road (13.40), Dull Center Road (13.38)
State Hwy 585	East Upton Road (914.03)
State Hwy 450	1108.e, School Creek Road (968), 1107,1105.G, 1105, Field Ranch Road (1257.B), Cellars Loop (923.03; via WY-56), 1256, 1240.G, 1235
County Road 83	Corder Creek Road (1619), Payne Road (934), 1109, School Creek (968), 934.G, 934.F
County Road 7C	1257F, C
County Road 7A	Keyton Rd. (937), 1263.H , Frog Creek (938), 1235, Dull Center Road (13.38)
County Road 62	Bacon Creek Road (925)
County Road 58	1242
County Road 56	Cellars Loop Road (923.03), Field Ranch Road (1257.B)
County Road 54	1263H
County Road 39	Dull Center Road (13.38)
County Road 34	Steckley Road (942)
County Road 17	1269
County Road 14	Dull Center Road (13.38)

The majority of roads on the TBNG under USFS jurisdiction do not provide major or primary connections between large communities. However, approximately 57 miles of road under USFS jurisdiction is considered to serve an arterial function, serving as a primary route to access major TBNG areas utilized for ranching, mineral resource operations, recreation, and/or administrative purposes (see **Table 4-19**). An additional 67 miles of road serve as collector roads, primarily serving as access routes to the multiple local roads (roughly 1,400 miles) that serve individual oil and gas installations, ranches, windmills, etc. Many local roads are serviced directly by USFS arterial roads or by major County or State highways. Roads that were considered to have an arterial function on the TBNG were rated by the IDT as “high,” collector roads as “moderate,” and local roads as “low” to determine an overall transportation value for each road (see Chapter 5, *Road Risk and Valuation*).

Table 4-19. Arterial and Collector Roads on the TGNG		
Road Name	**Length (miles) (USFS)**	**Function**
Arledge Road	8	Arterial
Bacon Creek Road	8	Arterial
Cellars Loop	17	Arterial
Dull Center Road	29	Arterial
East Upton Road	14	Arterial
Payne Road	5	Arterial
School Creek Road	3	Arterial
Steckley Road	24	Arterial
Stienle Road	12	Arterial
West Cellers	7	Arterial
Beckwith Road	4	Collector
Bobcat/Cow Creek Road	4	Collector
Clay Spur	1	Collector
East Bill/Cow Creek Road	20	Collector
Keyton Road	10	Collector
Phillips Road	11	Collector
Rochelle Hills Road	13	Collector
York Road	9	Collector

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

Land ownership throughout the TBNG is highly fragmented. Public lands within and surrounding the National Forest include lands owned by the BLM and the State. Numerous roads on the TBNG access these lands (see **Table 4-20**).

Private land ownerships are also found surrounding and within the TBNG. The amount and dispersion of private ownership varies across the grassland. Roads that access private land inholdings (private lands that are completely or effectively enclosed in federally owned lands) are a particular concern for road system management decisions and maintenance. Many of the maintenance level 3 roads provide access to private inholdings (see **Table 4-21**). Some inholdings are accessed by lower standard local roads and some by no roads at all Access needs for inholdings are addressed on an individual basis as requests are received. It is USFS policy that access will be provided to a level that is reasonable and suitable for the uses occurring on the land. When landowners desire access, they are asked to apply for a special use or road use permit. The application is then analyzed through the NEPA process to determine possible environmental effects and the level of reasonable access required. Some private land inholdings use National Forest System roads for access. When these tracts are subdivided, the resulting multiple ownership can increase demands on the road system.

Table 4-20. TBNG Roads Accessing BLM and State Lands

Road Number	Name	BLM or State Lands
925	Bacon Creek Road	State of WY
1618	Beckwith Road	State of WY
923.02	Cellars Loop	State of WY
13.38	Dull Center Road	State of WY
958	East Bill/Cow Creek Road	State of WY
914.03	East Upton Road	BLM
938	Frog Cr. Road	State of WY
937	Keyton Road	State of WY
934	Payne Road	State of WY
973	Phillips Road	State of WY
918	Sixmile Basin	State of WY
942	Steckley Road	State of WY
13.40	Stienle Road	State of WY
1246	Weston	BLM
900	York4351	State of WY
1024	Unnamed	State of WY
1109	Unnamed	State of WY
1121	Unnamed	State of WY
1121.E	Unnamed	State of WY
1248	Unnamed	State of WY
1256	Unnamed	State of WY
1263.H	Unnamed	State of WY
1276	Unnamed	State of WY
1413	Unnamed	State of WY
1423	Unnamed	State of WY
1424	Unnamed	State of WY

In some areas, the USFS lacks adequate legal access to the public road system. Priorities for acquiring access are identified during planning for commercial or land management projects. Historic access across some private land is being closed to the public as ownership and land uses change. While this is not a change in legal status, it gives the appearance of shutting off large tracts of public land.

Where access to the TBNG is needed for grassland management, additional rights-of-way need to be pursued. An important aspect of National Forest System roads is that they are not public roads. Although they generally are open and available for public use, they are authorized only for the administration, protection, and utilization of National Forest System lands. The USFS is a public roads agency with the authority to designate certain National Forest System roads as public roads. By definition, a Public Forest Service Road is under USFS jurisdiction with a valid right-of-way and a maintenance level 3 to 5. These roads are designated "open to public travel" in accordance with the following (23USCs101(a)):

- The roads must serve a compelling public need.
- The roads would remain open and meet Federal Highway Safety Act requirements.

Exceptions would be for scheduled seasonal closures or emergency closure needs. To date, and per agreement with the Federal Highway Administration, most maintenance level 3 to 5 roads have been subject to the Highway Safety Act requirements, but without the public road designation. Roads with potential to be Public Forest Service Roads are noted in Appendix A.

Table 4-21. USFS Maintenance Level 3 Roads Accessing Private Land Inholdings

Road Number	Name
1618	Beckwith Road
1619	Corder Creek Road
914.03	East Upton Road
934	Payne Road
973	Phillips Road
933	Rochelle Hills Road
968	School Creek Road
942	Steckley Road
926	West Cellers
1109	Unnamed
1111.A	Unnamed
1121.E	Unnamed
1413	Unnamed
934.A	Unnamed
934.F	Unnamed
934.G	Unnamed

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

Due to the highly fragmented pattern of land ownership on the TBNG, many roads, especially USFS maintenance level 3 arterial and collector roads, are subject to jurisdictional issues. The definition of jurisdiction has been subject to different interpretations over the years. According to FSM 7705, "Jurisdiction is the legal right to control or regulate use of a transportation facility derived from fee title, an easement, an agreement, or other similar method. While jurisdiction requires authority, it does not necessarily reflect ownership."

A review of the USFS INFRA database shows that numerous roads on the TBNG pass through various ownerships and jurisdictions. However, in many cases, formal documentation designating jurisdiction for a road is not available. Therefore, there is a need to verify that the correct jurisdiction is reflected in the INFRA database. To focus these efforts, the IDT assessed information from the INFRA database for each maintenance level 3 road with respect to which and how many jurisdictional authorities are represented for each road, how many jurisdictional changes occur on each road, and how jurisdictional changes might impact the management of the road or other resources to which the road provides access. Based on this analysis, nearly 50 percent of the maintenance level 3 road mileage on the TBNG (27 individual roads) has high jurisdictional risk issues associated with road management. In most cases, the roads that rated highest pass through numerous jurisdictions many times, such as the Philips Road (11 jurisdiction changes), Steckley Road (9 jurisdiction changes), and Dull Center Road (9 jurisdictional changes). However, in some cases, roads with a relatively low number of jurisdictional changes were also rated high for the following reasons:

1. The potential for a specific jurisdictional change to pose serious effects on roads or other resource management,
2. The road is currently under USFS jurisdiction, and based on current use patterns and function, may not need to be, or
3. Information concerning the jurisdiction of the road was questioned, and more information was needed to make a determination.

An example of category #1 above is Six Mile Basin Road (USFS Route 918), along which the beginning and ending of the road must pass through private jurisdiction, suggesting that access restrictions at either the beginning or ending of the road imposed by the private landowner could completely close off the road to USFS use. An example of category #2 is USFS Route 1242, which currently provides access to private lands, and provides little benefit to management needs of the TBNG. An example of #3 is Cellars Loops Road (USFS Route 923.02), of which more information and/or accuracy review of the INFRA data is needed to determine jurisdictional concerns.

Rights of access by law, reciprocal rights, or easements are recorded in USFS files and County courthouse documents. The USFS recognizes these rights and works with the owners to preserve access while protecting the natural resources and facilities on adjacent National Forest System lands. There is also an understanding by the USFS that individuals or entities may have established valid rights, unknown to the USFS at this time, to occupy and use National Forest System lands and roads. The courts have established that such valid outstanding rights may be subject to some Federal regulation (Sierra Club v. Hodel, 848 F 2d. 1068, 10th Circuit, 1988). This analysis recognizes that such valid outstanding rights may exist, and the USFS will honor such rights when it is subsequently determined that the specific facts surrounding any claim to such rights meet the criteria for occupancy and use.

Non-Federal ownership of lands or interests in lands may include rights granted as part of a reserved or outstanding right or as provided in statute or treaty. Roaded access is the most common type of access pursued in conjunction with two of the more prominent statutes:

- The Alaska National Interest Lands Conservation Act (ANILCA); and
- Recognized highway rights-of-way granted over National Forest System lands under Revised Statute 2477 (RS 2477).

ANILCA ensures access to non-Federal land inholdings: “The authorized officer shall authorize such access deemed adequate to secure the landowner the reasonable use and enjoyment of their land.” This access may not be the most direct, economical, or convenient route for the landowner, and may not be road access in all cases. Alternative routes and modes of access may be considered. If a landowner has an adequate alternative route or mode of access, including access across other land ownerships, the USFS is not obligated to authorized roaded access.

Reasonable access is currently determined on a case-by-case basis. The USFS recognizes valid ANILCA access as a statutory right. Additional discussion on access to private inholdings, and a preliminary assessment and list of those roads providing access to private land inholdings, is included in question GT (2).

RS 2477 grants rights-of-way for public highways constructed across public domain lands in the late 1800s to early 1900s. A RS 2477 highway must have been constructed across public domain lands before the date of the national reservation; for example, before the land became a National Forest or Grassland. The TBNG has been affected by Federal management since 1934 (under the Agricultural Adjustment Act), but was not formally designated with permanent National Forest System status until 1960. The Federal Lands Policy Management Act repealed RS 2477 in 1976. However, rights-of-way that predate the establishment of the National Grassland are still in effect, unless they have been subsequently relinquished. To date, there is a moratorium on processing RS 2477 claims. Any reviews are undertaken on a case-by-case basis.

Numerous roads crossing the TBNG fall under the jurisdiction of other agencies. When desirable, cooperative agreements should be established to share road improvement and maintenance responsibilities when all partners can benefit.

Forest Highways are designated under the Federal Lands Highways program of the Transportation Equity Act for the 21st Century. These routes are State, County, or USFS owned roads qualifying for Highway Trust funding for improvement or enhancement. The USFS, Federal Highway Administration, and the Wyoming Department of Transportation signed a Memorandum of Understanding (MOU) in 1997. This document set forth general procedures for planning, programming, environmental studies, design, construction and maintenance of designated Forest Highways. The USFS needs to cooperate with these agencies by supporting them in their efforts to obtain funding through the Federal Lands Highway Program. When funding is secured and improvements are made to bring these sections to Federal Highway Administration standards, they will be turned over to either the State or County. Dull Center Road (USFS Route 13.38) is currently the only Forest Highway designated by the Federal Highway Administration.

The TBNG does not currently have any cooperative maintenance agreements, but are in the process of developing such agreements with the local county road and bridge departments. These agreements would define the joint road maintenance plans for identified roads. The degree of shared maintenance can vary depending on the most efficient operations for parties involved (see FSM 1509.11-23 and R2 Supplement 1509.11-96-1 for a more complete explanation of the agreements).

GT (4): How does the road system address the safety of road users?

In 1975, the USFS developed a Memorandum of Understanding (MOU) with the Federal Highway Administration that required the USFS to apply the requirements of the National Highway Safety Program to all roads open to public travel. This agreement was modified in 1982 to define “open to public travel” as “those roads passable by four-wheeled standard passenger cars and open to general public use without restrictive gates…" Most roads maintained at level 3 on the TBNG meet this definition.

One barrier to evaluating road safety is the lack of a comprehensive program on the TBNG for identifying accident locations and for maintaining surveillance of those locations that have high accident rates. The USFS is oftentimes not informed of accident incidences occurring on TBNG roads unless an employee is involved. Accidents involving only public motorists are typically reported to the local sheriff or County authorities, if reporting occurs at all. When the USFS becomes aware of an accident, an investigation is initiated to identify the cause. If the investigation determines that a feature of the road is at fault for the accident, addressing the road condition becomes a high priority. The Highway Safety Act requires the USFS to implement a program for identifying accident locations and monitoring those locations. The USFS needs to address this area of non-compliance.

Another road safety concern on the TBNG involves the response time for responding to road washouts resulting from intense storm events. Properly posting warning signs notifying the public of the washouts in a timely manner could be improved.

Road Maintenance and Jurisdiction Issues

Road safety work, including surface maintenance, roadside clearing, and installation and maintenance of warning and regulatory signs, is performed on an annual basis on the TBNG. Traffic control signing follows the standards set forth in the *Manual on Uniform Traffic Control Devices* (MUTCD) (USDOT, 2001). Exceptions are permitted where State or County practices on similar public roads deviate from these guidelines.

The largest portion of road maintenance and improvement funds allocated to the TBNG is spent on higher standard roads (maintenance level 3 roads) that are subject to the Highway Safety Act. The database currently reflects more than $2.2 million dollars of annual and deferred maintenance needs for the TBNG. Since the database has not been adequately maintained, this number is far below what is actually needed for to maintain the road system. Current road management funding for the TBNG accounts for only a fraction of the annual and deferred maintenance needs. While safety work is performed annually, road maintenance funding is currently not adequate to maintain all roads and signs to standard. Inadequately maintained road surfaces may lead to safety hazards, such as severe rutting, washboarding, or even washout of the road surface. In addition, inadequate funding is causing some roads classified as maintenance level 3 to be maintained at a lower level that may not be sufficient for safe public use.

Road maintenance and management on TBNG roads is also sometimes impaired as a result of split jurisdictions (where a single road crosses through private, USFS, and County jurisdictions along its length). Jurisdictional road changes result in more time and administrative effort being used up to determine who is responsible for maintenance of a particular road segment and scheduling such maintenance. Currently, the USFS does not have any maintenance agreements with the surrounding counties regarding NFS roads, although this project is under development. Some agreements do exist in relation to commercial activity, such as special use permits for roads. However, these permits are not actively managed, and the USFS does not conduct monitoring or enforcement of the permits. Establishing a program to inspect and monitor completion of road maintenance requirements of special use agreements would allow the USFS to focus its maintenance efforts and budget on other NFS roads in need of improvement for safety or natural resource concerns.

Public road safety issues may also arise from road jurisdiction changes or maintenance level changes along the length of a single road. Road maintenance standards may be different based on the jurisdiction of a given road segment. When a road changes jurisdiction multiple times along its length, portions of the road may not be maintained to the same degree as other portions under different jurisdictions. These varying maintenance levels may lead to sudden changes in road surface conditions along a road's length, differences in roadside clearing, or even different signage, which may confuse some motorists. Twenty-six maintenance level 3 roads on the TBNG were rated high for jurisdictional changes, indicating that these roads change jurisdictions multiple times along their lengths. Developing cooperative road maintenance agreements with surrounding counties that establish consistent surface maintenance standards and signage could alleviate these issues.

Likewise, public safety may be compromised where a road changes objective maintenance level classification along its length, resulting in a change in surface conditions. There are several locations on the TBNG where a road changes from maintenance level 3 to maintenance level 2, and the road surface subsequently changes from gravel to 2-track dirt. If motorists are not aware of this change in surface material, they could lose control over their vehicles at these locations. This issue can be alleviated with installation of proper signage on the road approximately before the location where the surface material changes.

Conflicting Uses

The road system serves a variety of users and vehicle types, and there is a potential for hazardous safety conditions on public roads serving mixed-use traffic. The USFS does not restrict the legal use of all-terrain vehicles (ATVs) by licensed drivers on any roads on the TBNG (regardless of maintenance level). However, the USDA Forest Service does require that all ATV's used on forest system roads are street legal. Small ATVs, motorbikes, and highway vehicles use the same roads on the TBNG, occasionally at the same time. This can be a safety problem, especially in high road density areas. High density areas are a safety concern due to the potential for heavy use, high levels of conflicting uses, and a large number of smaller roads intersecting larger, more heavily used roads. High road density areas on the TBNG are primarily located in areas more intensely used for oil and gas development (east-central and central portions of the Grassland) and in areas surrounding towns, particularly in the northern portion of the Grassland. Roads within these high density areas are primarily maintenance level 2 roads; maintenance level 3 roads serve to connect areas of high density. The exception to this is in the area surrounding Upton, where maintenance level 3 roads are located within this high density area. Similar concerns regarding the safety of road users occurs where livestock are frequently found on high use roads.

There is a potential for hazardous safety conditions when there is mixed-use traffic on public roads. Road Management Objectives (RMOs) are developed for each road in accordance with

FSM 7712.5. Road management objectives establish design criteria (FSM 7720) and operation and maintenance criteria (FSM 7730.3) for each road. RMOs require approval and signature by the District Ranger and Forest Engineer, and become part of the road atlas (FSM 7711.1). Safety concerns and travel management restrictions should be addressed in the RMOs, especially where mixed traffic is a concern. Appropriate signing and education can help alleviate the safety concerns. RMOs should be updated to reflect changes in management or resource needs. Documenting the primary use of the road and any safety issues can also help prioritize funding to address critical health and safety concerns.

High road density areas may also promote illegal use of existing unclassified roads, which may further increase road densities by the creation of new unclassified roads and additional illegal use. This occurs because some users view old roadbeds as access to backcountry areas, and use these old roadbeds even if they are closed.

Potential safety concerns also exist for situations in which slower-moving vehicles use high speed roads, especially during big game hunting season or when trailering livestock. Tractors are often used to haul ranch equipment and supplies on high-speed roads, as well as on USFS roads used to access rangelands. Several maintenance level 3 roads on the TBNG were rated as high or moderate value for multiple uses, including recreational use, rangeland management, and mineral development. The majority of these roads are located in the south-central and northeastern portions of the TBNG, as well as in the southern Spring Creek area. These roads, along with their use value ratings, are presented in **Table 4-22.**

Table 4-22. High Value Roads on the TBNG by User Type

Road Names (ID #)	Relative Value		
	Mineral Development	**Recreation**	**Range Management**
Dull Center Road (13.38) Beckwith Road (1618) York 4351 (900) School Creek Road (968) Steckley Road (942) Phillips Road (973)	High	High	High
Rochelle Hills Road (933) Keyton Road (937)	Moderate	High	High
Arledge Road (913) East Upton Road (914.03) Cellars Loop (923.02) 924 (Unnamed)	Low	High	High
Payne Road (934) Bobcat/Cow Creek Road (959)	High	High	Moderate
Clay Spur (917)	Moderate	High	Moderate

ADMINISTRATIVE USE (AU)

AU (1): How does the road system affect access needed for research, inventory, and monitoring?

The road system provides access for research, inventorying, and monitoring activities. The results of such monitoring efforts and studies often aid decision-makers on other access-related issues, as well as contribute to other general objectives.

There are two special area designations, Research Natural Areas (RNAs) and Special Interest Areas (SIAs), on the TBNG that emphasize research, inventory, and monitoring. The TBNG contains two RNAs and six SIAs (Table 4-23).

Table 4-23. Areas of Special Designation on the TBNG

Name	Area Classification
Rock Creek	Research Natural Area
Wildlife Draw	Research Natural Area
Cow Creek	Special Interest Area
Cheyenne River Zoological	Special Interest Area
Lance Creek	Special Interest Area
Alkali Divide	Special Interest Area
Cellars	Special Interest Area
Buffalo Divide	Special Interest Area

Construction of new roads or trails within RNAs is prohibited by the Standards and Guidelines for RNAs outlined in the LRMP, except where new road or trail construction is necessary to correct resource damage from existing infrastructure. Existing road closure or obliteration is a priority for RNAs, except where roads provide necessary access for administrative or scientific purposes (USFS, 2001a). The primary access to the two RNAs is via Cellars Loop (Road 923.02), Road 924, and Road 926, all of which are maintenance level 3 roads that receive high recreational and range management use. While the existing road system is currently adequate for administrative access to these areas, Cellars Loop and Road 926 undergo several jurisdictional changes along their lengths, which may pose access problems in the future if segments of these roads are closed or improperly maintained.

Several maintenance level 2 roads branching off the primary roads can also be used to access the two RNAs. Given the location of these RNAs adjacent to high use roads, along with the high density of maintenance level 2 roads in the vicinity of the RNAs, there is a potential for a higher level of off-road ATV use in these areas and an increase in user-created trails.

New road construction is generally permitted within SIAs, but only when consistent with SIA values. The exception to this is within the Cow Creek Historic Rangeland SIA, where new road construction is further restricted to those necessary to exercise outstanding rights (USFS, 2001a).

Currently, the road system is adequate to bring scientists, land managers, and the interested public into the TBNG SIAs. Four of the SIAs, including Alkali Divide, Lance Creek, Cheyenne River Zoological Area, and Buffalo Divide, are accessible only via other jurisdiction roads and/or lower-maintenance roads (level 2 or below, both NFSRs and other jursdiction roads). Jurisdictional issues exist for portions of the Cheyenne River Zoological Area, which could affect access to this area.

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

The road system on the TBNG generally provides good access for investigative and enforcement activities. Access for these activities does not need to be provided by higher maintenance level roads; all roads can be used for investigation and enforcement. While the road system provides access to perform enforcement activities, it also provides access for increasing public use of the National Forest System lands and an associated increased potential for illegal activities to occur.

The primary road-related illegal activities of concern to the USFS on the TBNG are off-road motorized travel and unauthorized use of the road system (i.e. commercial use without a permit). Off-road motorized travel, primarily ATV use, is the most common travel management violation, and all NFS roads provide access for these vehicles. Off-road use occurs throughout the TBNG, and is a major concern on all areas of the Grassland.

Illegal off-road use can be initiated by people driving around road closure devices on maintenance level 1 and decommissioned roads. Ineffective road closures can facilitate the illegal motorized use of the closed portion of the transportation system. This problem mostly occurs on maintenance level 1 roads, decommissioned roads, temporary roads, and roads that are closed seasonally. Approximately 39,880 acres of the TBNG have seasonal motorized travel restrictions (except administrative use) (USFS, 2001b). In addition, the open terrain of the TBNG makes road closure efforts particularly difficult. Planning for the appropriate type and location of the road closure will help alleviate this problem. Identification of the closed road system, both on the ground and with maps, and closure orders are essential for law enforcement personnel to ensure compliance with the closures.

The USFS currently does not have the staff or resources to sufficiently patrol or monitor off-road motorized use or other illegal activities on the TBNG, and existing enforcement activities are extremely limited. With over 1.8 million acres currently under USFS jurisdiction on the TBNG, it is unlikely that the USFS alone will ever have sufficient staff or resources to provide extensive monitoring or enforcement in all areas of the TBNG. However, the opportunity exists for the USFS to develop cooperative agreements with several area ranching organizations, including the Thunder Basin Grazing Association, Inyan Kara Grazing Association, and Spring Creek Grazing Association, to assist in policing TBNG lands and monitoring for environmental damage. There are some agreements in place with local counties to patrol these roads.

PROTECTION (PT)

PT (1), PT (2), & PT (3): How does the road system affect fuels management? How does the road system affect the capacity of the USFS and cooperators to suppress wildfires? How does the road system affect risk to firefighters and to public safety?

Wildfire has been, and will continue to be, an essential influence on grassland vegetation. Historically, fires were of high frequency and low intensity. This regime was altered after Anglo-American settlement of the region, when fire suppression was conducted to protect property.

Approximately 9 wildfires occur on the TBNG each year, with about 3,500 acres burned. The USFS has agreements with local volunteer fire departments for wildfire suppression on the TBNG. Under these agreements, the local fire departments take initial attack against wildfires; if a fire is beyond the scope of control of the local departments, the USFS is contacted for support. In addition to wildfires, the USFS conducts prescribed burning on the Grassland at a rate of about 100 acres per year (USFS, 2001b). This amount of prescribed burning conducted by the USFS will likely increase under the direction of the new LRMP, as fire is reintroduced into several habitats on the TBNG (USFS, 2001a).

The existing road system on the TBNG provides more than adequate access for wildfire suppression and prescribed burning activities. Roads provide access to lands for fire suppression and fuels management activities and create linear firebreaks that affect the spread of fires (maintenance level 3 or higher roads are the primary roads used for this latter purpose). Roads also provide for motorized access, which increases the level of human activities and the frequency and risk of human-caused ignitions. Access provided by the road system can improve fire crew response times and increase the effectiveness of wildfire control efforts. These benefits can increase in areas of higher road density. Access for wildfire suppression is provided by roads of all maintenance levels. The majority of fire crews and engines are not limited by lower maintenance level roads, and where roads do not exist on the TBNG, crews and engines are able to travel off-road for fire suppression or prescribed burning activities, as authorized in the Grasslands Plan.

USFS R2 Roads Analysis guidance suggests that the road system's effects on the capacity of the USFS and cooperators to suppress wildfires are better addressed at the subforest scale. Likewise, the effects of the road system on firefighters and public safety is more appropriately addressed at the subforest scale.

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

There are no non-attainment areas within the TBNG, although there is a non-attainment area within the Thunder Basin airshed. The State of Wyoming maintains particulate matter monitoring sites in the cities of Sheridan and Gillette, to the northwest of the TBNG. Air quality monitoring data from the Sheridan site exceeds the National Ambient Air Quality Standards for particulate matter 10 microns or smaller in size (PM_{10}).

Though currently in attainment, use of the road system does contribute to air quality problems through dust emitted into the atmosphere by vehicles moving on unpaved roads. Large amounts of this dust can reduce visibility and contribute to human health problems. Although impacts from dust emissions are usually localized and temporary, the amount of dust emitted and the extent of air quality impacts depend on the amount of traffic, weather conditions, and vehicle characteristics. The amount of dust emitted from an unpaved road increases with dryness and with vehicle weight.

All USFS jurisdiction roads on the TBNG are unpaved roads; maintenance level 3 roads are typically graveled. The primary uses of these roads are for oil and gas development, range management, recreational purposes (passenger cars and ATV use), USFS administrative purposes, and to a lesser extent mining operations. Of these uses, oil and gas development and range management are responsible for the most frequent traffic and use the heaviest vehicles, which tend to result in more dust emissions than lighter-weight vehicles, such as passenger cars or ATVs. Areas receiving the highest use for oil and gas development and rangeland management generate more dust emissions than lesser-used areas. Approximately 84 miles (or 44 percent) of USFS maintenance level 3 roads are rated as high value for mineral resources development on the TBNG, and 100 miles (or 52 percent) are rated as high value for rangeland management.

Resource management activities, such as mining, oil and gas development, and range management, typically require dust abatement measures to reduce dust emissions from sustained and heavy traffic use. During specific, planned commercial use or construction operations using unpaved NFS roads, watering or other treatments are often required to reduce dust emissions. Dust abatement mitigation measures and treatment frequencies are considered at the project level for commercial and resource management activities and special use permits, particularly where a higher level of traffic is projected on arterial and major collector roads or near recreational areas.

It should be noted that other sources also contribute to particulate matter impacts on air quality from other sources than the TBNG road system. The Thunder Basin airshed is affected by oil and gas development and mining occurring in the Bighorn and Powder River basins; pollutants from these areas are carried into the airshed by northwesterly winds (USFS, 2001b). In addition, mining operations at TBNG also contribute to particulate matter emissions, but these emissions are not produced as a result of traffic or use of USFS roads.

RECREATION (UR and RR)

[Corresponds to UR (1) and RR (1)]: What are the supply and demand relationships for non-motorized (unroaded) and/or motorized (roaded) recreation opportunities?

The recreational opportunities available in any given area of the TBNG are heavily dependent on the presence of roads and trails. The TBNG is primarily grassland, with only a small proportion forested (roughly 3 percent) with ponderosa pine of mostly non-commercial value. The road density of the TBNG is relatively high, resulting in a limited number of areas that are considered roadless. The need for recreational opportunities and planning to supply the anticipated demand is part of the forest planning process.

Recreational activities in the TBNG are primarily considered dispersed recreation uses, such as hunting, hiking, etc. The TBNG has 7 miles of recreational riverine fisheries and 19 miles of inventoried motorized trails. There are no inventoried non-motorized trail systems or developed campgrounds on the TBNG, but opportunities for hiking and camping exist.

Two developed recreation sites are located at the Soda Wells Picnic Ground and Turner Reservoir, which has an unimproved boat ramp. Eight undeveloped reservoirs on the TBNG are also available to the public and open for recreational activities. These reservoirs include Weston Reservoir, Little Powder Reservoir, Upton Centennial Pond, Kellog Dam, Mays Pond (some times incorrectly called Upton Bass Pond), East Iron Creek Reservoir, Brown's Reservoir, and Little Thunder Reservoir. Though not developed, these areas are considered high concentration dispersed recreational use areas. These reservoirs are open to the general public with no restrictions (Reddick, 2004b). However, access to these reservoirs may be restricted by a lack of legal public right-of-way across private lands.

In general, the TBNG is becoming more popular as a recreation destination. The area is also experiencing an increasing popularity in the use of exclusive private reserves, primarily for hunting or camping. Recreation demand in grassland areas differs markedly from that in forested areas. Consumptive game users constitute the primary recreational users of the area. Other dispersed recreational opportunities include viewing scenery and wildlife, dispersed camping, picnicking, fishing, and biking. ATV use (both legal and illegal) on the grassland is also a major recreational activity. Most day use of the grassland is organized in some fashion around the use of motorized vehicles.

Recreation Opportunity Spectrum

The Recreation Opportunity Spectrum (ROS) is used to describe the available or potential recreation opportunities on a given landscape. Each ROS class is defined based on the extent to which the natural environment has been altered, the type of facilities provided, the degree of outdoor skills needed to enjoy the area, and the relative density of recreation use. The presence of roads and the distance from roads are two criteria for determining an area's ROS class. The mix of existing and planned ROS classes on the TBNG is shown in **Table 4-24** by acreage.

Table 4-24. Existing and Planned ROS Class Mix on the TBNG		
ROS Class	**Existing Acres (% of Total)**	**Acres (% of Total)***
Urban	14,050 (2.5%)	48,130 (8.7%)
Rural	70,690 (12.7%)	41,200 (7.5%)
Roaded Natural	444,620 (80%)	418,940 (76%)
Roaded Natural Nonmotorized	0 (0%)	15,380 (2.8%)
Semi-Primitive Motorized**	27,070 (4.8 %)	22,290 (4.0%)
Semi-Primitive Nonmotorized	0 (0%)	6,550 (1.2%)
TOTAL	556,430 (100%)	552,490 (100%)
*Based on the Revised TBNG Land and Resource Management Plan and EIS (2001); numbers are approximate. ** There are no maintenance level 3 roads in Semi-Primitive Motorized		

Source: USFS, 2001b

Table 4-25 below presents a breakdown of miles of USFS jurisdiction maintenance level 3 roads by their recreational value/amount of use and by the ROS classification of the lands the roads pass through.

Table 4-25. USFS Roads by ROS Classification and Recreational Value		
Recreational Value	**ROS Class**	**Miles of Road***
HIGH	Rural	8.4
	Roaded Natural	102.6
	Urban	4.3
MOD	Rural	7.0
	Roaded Natural	40.2
	Urban	0.6
LOW	Rural	10.3
	Roaded Natural	19.6
	Urban	1.4
*Maintenance level 3 roads only		

The Rural ROS class includes farmland, small communities, commercial facilities, or large campgrounds and trailheads along paved roads in the TBNG. The Roaded Natural ROS class describes an area with maintenance level 3 roads (arterials) that provide easy access to other, less developed areas. Sightseeing is dependent on maintenance of these roads. Roaded natural areas have subtle modifications to the natural environment. Improvements are limited to roads, trails, campgrounds, and a few scattered structures. There is limited opportunity to get away from others. The Roaded Natural Nonmotorized ROS class is given to areas that are closed to motorized use, yet have been heavily modified or are not large enough to be set aside as Semi-Primitive Nonmotorized. The Semi-Primitive Motorized ROS class offers access on maintenance level 1 and 2 roads and no facilities in a backcountry setting. The Semi-Primitive Nonmotorized ROS class offers solitude and quiet in a large (greater than 2,500 acres) area more than a mile from open roads. While motorized recreation is not permitted in these areas, local roads used for other resource management activities may be present on a limited basis. Use of such roads are typically restricted to minimize impact on recreational opportunities. As shown in **Tables 4-24** and **4-25**, the majority of the TBNG emphasizes the roaded natural setting.

<u>Non-Motorized (Unroaded) Recreation Opportunities</u>

Although there are very few segments of land that are not in close proximity to a road (most are within one mile or less of a road) there are six inventoried roadless areas. Inventoried roadless areas include HA Divide, Red Hills, Cow Creek, Downs, Miller Hills, and Duck Creek. These areas are a high priority for management as non-motorized recreation use areas. Other smaller areas that are less densely roaded are also important to semi-primitive non-motorized recreation. Areas designated for semi-primitive recreation are managed to provide opportunities in a natural-appearing landscape. Most of the remaining land area of the TBNG is available for motorized access, although access is restricted or limited to winter months in some areas.

The TBNG is lacking in motorized trail opportunities that many off-road users are seeking. This may be linked to the increasing numbers of illegal, user-created routes.

Since most areas of the TBNG are accessible to motorized vehicles, the current supply of available roaded recreation opportunities is sufficient to meet, and in many areas exceed, current and foreseeable demand. The demand for non-motorized opportunities is perceived to be strong and increasing. Recreation experience may improve with fewer roads, especially for hunting, which is listed as the most prevalent form of recreation. Maintenance and preservation of the six inventoried roadless areas, as well as the several other smaller less densely roaded areas, continues as management priority for the TBNG.

UR (2) and RR (2): Is developing new roads into non-motorized (unroaded) areas, decommissioning of existing roads, or changing the maintenance of existing roads causing substantial changes in the quantity, quality, or type of non-motorized and motorized recreation opportunities? How do user-created routes affect the management of the road system?

In general, the user satisfaction with recreational opportunities available in the TBNG is heavily dependent on the level of access provided by the road system. However, the potential effect of the TBNG road system on recreation is dependent on the characteristics and qualities of a particular area. Because there are very few land segments that are not in close proximity to a road, management decisions affecting the construction of new roads, maintenance of existing roads, or road closure and decommissioning can be expected to have a major influence on the type and accessibility of recreational opportunities available on the TBNG.

Construction of new roads, especially into roadless areas, can have the effect of changing passive use values for visitors. Road maintenance levels can affect the quantity, quality, or type of recreation opportunities available on the TBNG. Changes in maintenance can alter the frequency of use of certain roads. An increase in the road maintenance level facilitates easier access to recreational areas and increased user visitation, but it could also eliminate ORV experiences. A decrease in the maintenance level may make access more difficult, resulting in a more uncomfortable trip for users and causing users to abandon certain areas or seek alternate transportation routes. Ineffective road closures or roads that have not been decommissioned following cessation of oil field operations can result in increased unauthorized use on the road, and motorized access into non-motorized areas, or where public access conflicts with other jurisdictions or uses.

Currently, there are 20 road segments, or a total of 115 miles (nearly 60 percent) of USFS maintenance level 3 roads that are rated as high value for recreation on the TBNG, indicating that these roads access either of the 2 developed recreation sites on the TBNG or areas of concentrated dispersed recreation use. Additionally, there are 19 roads, totaling 45 miles, considered to be of moderate value for recreation. Moderate value roads are those that access dispersed recreation areas that have a steady year-round or high seasonal demand. A total of 30 roads, or 31 miles are considered to be at low value for recreation. These roads normally afford direct access to a specific location that experiences only occasional or infrequent use and possess no real recreational value.

Areas of high road density could be degrading the quality of big game hunting on the TBNG, creating conflict between non-motorized and motorized users, particularly during peak game season. Conflicts may also exist on mixed use roads: small ATVs and faster-moving passenger and commercial vehicles use the same roads on the grassland, occasionally at the same time, which can pose safety hazards for road users. In addition, with a growing interest in the area for train spotting, users have been parking on bridges to photograph passing trains, raising a potential user conflict and safety problem, especially on mixed traffic roads.

New road construction by the USFS has been limited over the past decade. However, resource extraction and mineral resource development have increased the development of new roads. These roads may provide increased access to backcountry areas that were previously inaccessible to the public or may allow increased access to paleontological or archeological resources that may threaten site integrity.

Illegal use of unclassified roads and the development of new user-created roads continue to be a problem for the management of the TBNG road system. Although most public users conform to posted restrictions, user-created routes can become a problem in areas where signs have been damaged or removed. Once new routes are created, there is a tendency to attract additional users, especially in areas where the user-created route opens access to an otherwise closed or limited use area. The potential adverse effects of user-created roads can place an additional burden on USFS management of the road system and require that resources be diverted from other planned uses.

UR (3) and RR (3): What are the adverse effects of noise and other disturbances caused by building, using, and maintaining roads on the quantity, quality, or type of non-motorized and motorized recreation opportunities?

Because this is not a programmatic issue, the *Rocky Mountain Region 2 Roads Analysis Supplement to FS-643* does not include this assessment at the forest plan level and suggests that it is a rare concern at the subforest scale. However, where noise or other disturbances are an issue, they can adversely influence the experience of recreational opportunities available in a given area.

The high density of roaded areas would indicate that that most areas of the TBNG are susceptible to increased ambient noise during periods of high vehicular use. General disturbance factors, including noise, can influence the feeling of solitude and remoteness associated with some sites, creating conflict between non-motorized and motorized users. Factors such as vegetative cover, terrain, topography, or weather may impede sound transmission and serve to mitigate noise impacts under certain conditions.

UR (4) and RR (4): Who participates in non-motorized recreation and motorized recreation in the areas affected by constructing, maintaining, and decommissioning roads?

Roads provide access to the Grassland for a diverse user population engaged in a variety of recreational activities, such as hunting, hiking, camping, mountain biking, ATV use, and viewing scenery and wildlife. The primary recreation user populations are located in the outlying areas or nearby adjacent communities surrounding the TBNG. The 3 largest communities surrounding the TBNG are located in Gillette (population 19,646 people, USCB, 2003), Wright (population 1,300 people), and Douglas (population 5,655 people). A number of small mining towns are located in and around the TBNG. The area has also become a recreation destination for residents of Casper Major metropolitan centers near the TBNG from which a portion of the user population is drawn include Denver, Cheyenne, and Rapid City.

Although specific data for the TBNG are not available, some indication of the potential user population can be derived from statistics provided by the National Visitor Use Monitoring Results for the nearby Medicine Bow National Forest (USFS, 2003b). From this study, a basic characterization was developed to identify forest visitors. The average user is male (approximately 72 percent), and younger (48 percent below the age of 40 and 70 percent below the age of 50). Characterized by race and ethnicity, the great majority of recreation users are white (96.7 percent). The second largest user group is Hispanic (1.8 percent), reflecting a growing Hispanic population in the surrounding region (USFS, 2003b).

The majority of TBNG users are day users. Grassland recreation uses are primarily hunting related; other activities are generally centered around dispersed recreation, such as ATV use (both legal and illegal), hiking, and wildlife viewing. The numbers of hunters are high at the beginning of rifle season.

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

The TBNG serves a local resident population of approximately 52,364 people (USCB, 2003) in the 3-county area of Campbell, Converse, and Weston. There are several special interest sites in the area, including some archeological and paleontological sites that are of importance. The presence of several Native American sites also increases the sense of attachment to the area experienced by these groups.

UR (6) and RR (6): How does the road system affect Scenic Integrity? How is developing new roads, decommissioning of existing roads, or changing the maintenance of existing roads into unroaded/non-motorized areas affecting visual quality?

Roads that satisfy Scenic Integrity Objectives (SIOs) established during the grassland planning process are accorded high value. Passive-use values are assigned to natural resources and scenic vistas, especially in roadless areas or other natural areas with unique characteristics. New roads introduced into an area can contrast with the surrounding landscape, affecting the observer's perception. Conversely, decommissioning roads in a given area can enhance the visual quality of the landscape and enhance the visitor's experience. However, where roads provide access to otherwise inaccessible resources, especially for elderly or handicapped visitors, or function as a scenic byway for visitors, the scenic intrusion may be balanced by the enhanced access to aesthetic resources.

Reduced or deferred maintenance can contribute to the scenic intrusion of a road system by increasing damage from erosion and other natural effects. The visual effects of roads and new road construction can be diminished through careful alignment, and reduction in the level of clearing and grading required. Careful vegetation management, proper drainage, and increased maintenance can increase and preserve the scenic integrity of the road system.

There are very few segments of the TBNG that are not in close proximity (one mile or less) to a road. Road density varies by location. With high road density, there is a greater potential to compromise the character and setting of some areas. Preserving and developing naturally appearing areas has been a recent raising concern among users of the TBNG.

SOCIAL ISSUES (SI), CULTURAL/HERITAGE ISSUES (CH), CIVIL RIGHTS (CR) AND ENVIRONMENTAL JUSTICE

SI (1): Who are the direct users of the road system and of the surrounding areas? What activities are they directly participating in on the forest? Where are these activities taking place on forest?

The TBNG road system provides access and basic transportation needs to a diverse group of local residents, visitors from the greater Wyoming/Colorado area, and to a lesser extent, visitors from across the nation. International visitors also make use of TBNG resources, although they constitute only a small portion of the overall user community. According to the National Visitor Use Monitoring Results for the nearby Medicine Bow National Forest, less than one percent of forest users in 2001 were drawn from foreign countries (USFS, 2003b).

Users of the road system can be generally categorized into six separate groups:

1. Local residents who use TBNG roads as a part of their daily transportation system;
2. Local school districts who rely on the road system to bus students;
3. Ranchers who rely on the road system to support grazing and ranching operations that are interspersed throughout TBNG acreage;

4. Workers in the oil and gass fields and coal mines who use the road system for transportation to work or to access drilling sites;
5. Visitors and tourists who use TBNG resources for recreation, thru-traffic and other activities; and
6. Ethnic or other subcultures who have a spiritual, cultural, historical, or sacred attachment to the area.

The road system directly serves as part of the transportation needs for the approximately 52,394 residents of the 3 surrounding counties. Over the decade from 1990 to 2000, the population of this area increased by approximately 10.3 percent, slightly higher than the State of Wyoming as a whole, which grew at a rate of 8.9 percent over the same period. Estimates of the population for 2003 indicate that this rate of growth is expected to continue. The growth in population from 2000 to 2003 shows an increase of 5.3 percent. The surrounding population has also become increasingly more diverse, with minorities representing 4.9 percent of the total population in 2000, as contrasted with 2.7 percent in 1990. The population of the 3 counties is also growing younger, with 29.5 percent of residents under the age of 18 and only 7.9 percent over the age of 65 (USCB, 2003; 2000; 1990).

In addition to oil and gas development, coal mining and ranching, the TBNG road system supports a broad range of other uses and activities, such as hunting, ATV use, pleasure driving, scenic and wildlife viewing, camping, picnicking, biking, and snowmobiling. With the steadily increasing population growth in the surrounding area, there is an increased demand on the road system from both local residential users and recreation users. One area of important concern is that existing road access may not be sufficient to address future land management needs in the TBNG.

Currently, there are 7 USFS maintenance level 3 roads totaling 34 miles (18 percent of all maintenance level 3 road miles) that are considered to be of high social value to the local community. High value roads serve either as high volume transportation links between communities or as primary transportation access for the delivery of services to local citizens. Another 12 USFS maintenance level 3 roads totaling 62 miles (32 percent) are considered to be of moderate social value. In this context, moderate value roads are suitable for passenger or highway vehicles and provide access to the TBNG for rural residents and access to private lands. A total of 50 USFS maintenance level 3 roads totaling 96 miles (48 percent) are considered to be of low or limited social value. These roads normally afford direct access to a specific location that experiences only occasional or infrequent use.

SI (2): Why do people value their specific access to national forests and grasslands--what opportunities does access provide?

The roads of the TBNG provide access to recreational and cultural resources; valued commodity resources; and historic, traditional, paleontological, or prehistoric sites of significance to specific groups within the user community. Access to these sites affords opportunity for economic gain, recreation, and educational experiences, as well as spiritual or emotional satisfaction. In addition to providing access, the roads themselves can often take on special meanings that include them as a part of the user experience.

The values that users attribute to access are developed as a part of their social experience. For a number of users, access represents the opportunity to engage in a specific activity or view and experience the natural environment of the TBNG. For others, access is a question of facilitating a commute to work or the transportation of economic goods from source to market. Visitors may associate the TBNG with ceremonial, commemorative, or celebratory activities, or value the area for its spiritual, sacred, or traditional qualities. The need for access to these areas is of importance to maintaining these use values. Alterations or changes to the roads of the TBNG may affect not only people's access to areas important to these values, but may also interfere with the aesthetic or emotional experience of visitors when they reach the sites.

However, users may also value the absence of roads in certain areas as an enhancement of the wilderness experience. Although certain economic uses and recreational activities in the TBNG are road-dependent, other uses depend on the "remoteness" of areas that have little or no access. Roads are also a potential threat to sensitive wildlife and habitats. They may increase both motorized and non-motorized traffic in areas where such access may threaten the integrity or setting and quality of historic or cultural sites. Because the TBNG displays an extremely high road density, preservation of the six inventoried roadless areas is a high priority.

The creation of new roads or other means of access, closure of existing roads, or alterations in the management approach to maintenance of roads involves a cost – benefit analysis at the project level not only for monetary (or priced) consequences and benefits, but also for the social values and patterns of behavior that may depend on the specific access in question. Also important are the preservation of the natural qualities of the area and any important scenic vistas, cultural sites, or unique features.

SI (3): What are the broader social and economic benefits and costs of the current forest road system and its management?

Human communities are dependent on road systems to support important economic, social, and public safety requirements. Effective road management results in improved conditions for safe and accessible travel. Alterations in the road system and associated management practices may have a substantial effect on community social patterns and practices. Such changes may have beneficial or adverse effects on residential transportation requirements, individual lifestyles, employment, the quality of life in local communities, or the income derived from local businesses engaged in TBNG products or tourism.

Benefits associated with the TBNG road system and its management have broader social and economic impacts that go beyond direct users and the communities surrounding the TBNG. For example, local counties receive additional revenue based on the production of goods and services on public lands. Coal, oil, and gas bonus bids, rentals and royalties paid by operators in the TBNG currently return an estimated $60 Million per annum to the Federal Government of which $30 million are returned to the State of Wyoming.

Beyond the direct economic benefits from jobs and income associated with commodity production on the TBNG (oil and gas, coal, and rangeland operations), local communities may also benefit from indirect trade in ancillary businesses associated with tourism and TBNG visitation. These include lodging and food services, guide/outfitter providers, and other social services. Other support industries may be developed to provide necessary services and products to TBNG workers and businesses, such as feed and equipment sales to ranchers, or housing, entertainment, and social services for oilfield personnel and coal miners.

The cumulative effect of changes in the TBNG road system may have important considerations for the overall economic and social benefit derived by both recreational and other users. Over time, incremental changes both beneficial and adverse may alter both the relationship of the individual user to the TBNG and of the TBNG to the surrounding communities.

SI (4): How does the road system and road management contribute to or affect people's sense of place?

The extent to which local residents or visitors to the TBNG attach meaning to a designated area and identify a "sense of belonging" or a "sense of place" associated with it can be both directly and indirectly affected by road management practices. "Sense of place" involves the value that people place on a given site, vista, or activity, and the emotional response elicited by feelings attached to the individual's experience. Important spaces may include natural or scenic vistas, residential, historic or other structures, traditional use areas, or places of scenic or other value for the local community.

Other important factors in determining a sense of place concern the extent to which humans identify a place with specific activities that occur there or with spiritual, traditional, or sacred values associated with the place or its wildlife or vegetation. The individual attachment to place may be sufficiently strong so that, in the event that a site is damaged, destroyed, or inaccessible, the activity itself may no longer have meaning and may be abandoned.

Specific road management practices can affect access to or alter the physical setting and character of a place, affecting what people value and diminishing their collective experience of the place. Poor road conditions may affect the frequency with which residents use certain places or may contribute to an overall deterioration of visual quality. Similarly, noise, traffic, or other disturbances associated with maintenance or new construction activity may also contribute to a sense of lost value.

SI (5): What are the current conflicts between users, uses, and values (if any) associated with the road system and road management? Are these conflicts likely to change in the future with changes in local population, community growth, recreational use, resource developments, etc?

Given the multiple and varied uses supported by the TBNG, the potential for conflict between users with differing interests in and perceptions of the TBNG is inevitable. Generally, conflicts occur between different types of users and are based on the perceived value of the particular resource to the activity in question. Road management policies and practices are important to resolving these potential conflicts, especially as related to changes in access or alteration of the setting of specific sites.

Conflicts may emerge between various types of users, such as those between recreationists and commercial users, motorized and non-motorized users, consumptive and non-consumptive game users, and environmental preservationists and resource extraction users. Conflicts may also emerge between conflicting land uses, such as an oil well drilled in an otherwise natural area or intruding into a scenic landscape. As the energy requirements of the national economy increase, demand for TBNG-related mineral resources will likely continue to grow. Mineral extraction activities are more likely to conflict with recreation-related activities and environmental values, especially as the local user population continues to grow.

Several specific sources of conflict on the TBNG have been identified. One key issue is related to the emerging emphasis on environmental concerns. These views tend to conflict with other users view of the of the area's value, which is primarily associated with commodity production. Another source of potential conflict exists between older residents and users and the growing trend in ATV use. Illegal ATV use is an ongoing concern for the TBNG, as is the introduction of motor vehicles into areas that are non-motorized. Other potential conflicts are related specifically to road safety as slower moving ranch vehicles and ATVs compete for the same roadways as faster moving passenger cars. .

As user activity on the TBNG continues, other sources of conflict can be expected to emerge and existing conflicts may be exacerbated. These conflicts are a part of the context in which road management decisions are made. Consideration of these potential conflicts as a part of the site-specific roads analyses will allow for the prediction of potential outcomes and, in some cases, may allow for decisions that serve to mitigate conflict among users.

CH (1): How does the road system affect access to paleontological, archaeological, and historical sites and the values people hold for these sites?

Access to cultural heritage (archeological and historical) or paleontological sites can be greatly enhanced by the presence of nearby roads. In some instances, this may be a desirable outcome, as access increases opportunities for academic study or public education and enjoyment of natural history and cultural heritage. Roads also provide access to areas that have not yet been surveyed for important cultural heritage resources. Approximately 40 percent of the TBNG has undergone some degree of archaeological surface examination since the mid-1970s. Just over 1,200 sites, ranging from aboriginal encampments to historic trails and wagon roads to more recent homesteads and pastoral camps, have been located and recorded. About 160 of the historic and prehistoric sites recorded have been determined eligible for the National Register of Historic Places (NRHP), but none are currently listed on the NRHP. Site densities are high, averaging about 4 sites per square mile.

However, increased access may also lead to an increased level of human activity at the site(s), indirectly contributing to site disturbance, the possibility of vandalism, destruction of the site, or the illegal removal of artifacts from the site. Increased access may also introduce new and incompatible uses that may compete with the site's setting and character.

Roads may also alter the general physical setting and appearance of a site. This is especially important to sites that have historic, spiritual, religious, or other traditional characteristics that depend on a more natural setting as part of the overall understanding of the site. Conversely, the increased public access afforded by increased access may enhance public awareness and appreciation of the site, contributing to its protection and facilitating its proper management.

TBNG road management decisions are guided by policy seeking to discourage unauthorized access to special interest sites that may be associated with paloentlogical, archeological, historic, or cultural sites, including those of importance to Native American groups. Some reports of looting and theft at these sites have been received by the USFS. Of concern here is the identification of special interest sites and the issue of balancing legitimate user access with the need to preserve site integrity.

Four of the six SIAs on the TBNG emphasize cultural resources, including the Cellars, Alkali Divide, Buffalo Divide, and Lance Geologic SIAs. Access to and within these sites is discussed under question AU (1). The LRMP for TBNG (USFS, 2001a) addresses each of these SIAs and provides direction and guidelines regarding the construction of roads and motorized use within these areas to protect the cultural resources they contain (pages 3-8 through 3-12). While guidelines are provided specific to each SIA, those road-related guidelines common to all SIAs include:

- Require monitoring by a professional archaeologist or paleontologist during all activities that disturb the soil.
- Limit off-road motorized vehicle use to authorized administrative purposes, including fire control, emergency services, research, permitted activities, control of invasive plants, and motorized use necessary to exercise outstanding rights.

CH (2): How does the road system and road management affect the exercise of American Indian treaty rights?

By increasing public access to areas that have acquired specific cultural or traditional value, roads may indirectly result in the introduction of "modern" elements or artifacts, thereby disturbing the aesthetics of a site or its surrounding environment or influencing the site's sacred or spiritual qualities. Constructing new roads or road segments can also affect these areas. Determination of the specific effects to any given site must be made at the project level.

CH (3): How does road use and road management affect roads that constitute historic sites?

Historic roads are roads that, through design, experience, or association, have contributed to culture in a meaningful way. This quality may be based on the road's aesthetics, engineering, or historic significance. In some cases, features forming parts of a road or that are associated with a road, such as roadside structures, bridges, or trails, may also be historically or culturally valuable for their own merits and be designated as historic sites. Where roads are designated under the National Historic Preservation Act of 1966 (NHPA), they must be managed in accordance with this Act, including project-level assessments for compliance with Section 106 of the Act.

Significant roads, bridges, trail sites, or other structures are included in the Grassland Plan Analysis. At present, there are no roads or road segments on the TBNG that been determined to be eligible for the National Register of Historic Places (NRHP).

CR (1): Is the road system used or valued differently by minority, low-income, or disabled populations than by the general population? Would potential changes to the road system or its management have disproportionate negative impacts on minority, low-income, or disabled populations?

Access to the TBNG road system is open and available to all user groups for a broad range of activities. However, members of certain cultural groups or income strata are more likely to use the TBNG for specific practices or forms of recreation than others. For members of economically disadvantaged, minority, or handicapped groups, access to TBNG resources may represent a valued alternative recreational experience, or represent a place for traditional gatherings for celebration, commemoration, or ceremony. For others, the hunting opportunities or the gathering of products, such as plants or firewood, may be important to supplementing lifestyle values. Alternatively, some activities, such as nature walks, hiking, picnicking, or sightseeing, are commonly enjoyed among almost all groups.

Changes to specific TBNG roads may have a greater effect on minority and low-income populations, depending on the extent to which these groups value access to resources and products to supplement income or lifestyle. Conversely, the introduction of new roads into roadless areas may significantly impact certain groups who attach sacred or traditional value to the undisturbed quality of the area. Closure of some roads could limit access to grassland resources and activities for people with disabilities.

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (February 11, 1994), requires that Federal Agencies consider any disproportionately high and adverse human health or environmental effects to minority and low income populations. Agencies are required to ensure that these potential effects are identified and addressed. The U.S. Environmental Protection Agency defines environmental justice as “the fair treatment and meaningful involvement of all people regardless or race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.”

Consideration of the potential consequences of management decisions for environmental justice requires three main components:

1. A demographic assessment of the affected community to identify the presence of minority or low income populations that may be potentially affected;
2. An integrated assessment of all potential impacts identified to determine if any result in a disproportionately high and adverse impact to these groups; and
3. Involvement of the affected communities in the decision-making process and the formation of any mitigation strategies.

The USFS does not discriminate against any group or persons based on color, creed, abilities, nationality, income, age, or background. In accordance with Executive Order 12898, the USFS evaluates all of its programs and projects at the TBNG for adverse effects on minority or low-income populations prior to implementation.

CHAPTER 5
DESCRIBING OPPORTUNITIES AND SETTING PRIORITIES

PROBLEMS AND RISKS POSED BY THE CURRENT ROAD SYSTEM

INTRODUCTION

In order to focus more clearly on where opportunities exist to improve the transportation system, roads in this analysis were categorized by the IDT, District Ranger and Deputy District Ranger based on the key values and identified risks associated with each road. Each open USFS maintenance level 3 road on the TBNG was evaluated for its value to the transportation system as a whole, and in providing access to mineral resources developments, recreation opportunities, social amenities, and rangeland. Likewise, each road was evaluated for the degree of risk it posed to wildlife, aquatic species, hydrology, potential for noxious weed proliferation, jurisdiction issues, and its maintenance costs.

The protocols and available data utilized to assign values and risks are described below. The complete road-by-road rating is provided in Appendix A with additional category specific analysis information provided in Appendix B. This process placed each road into one of four categories based on similar ratings: high value-high risk, high value-low risk, low value-high risk, and low value-low risk. This was done as a way to prioritize road management options, and was not intended to capture the absolute value or risk of a road.

In this chapter, as throughout this document, numbers and mileages are approximate.

ROAD VALUES

General Transportation Value

Individual roads in a transportation system support different overall functions. In general, major arterial routes provide connections between populated places or provide high level access to major areas, and are generally built to support high volumes of traffic. Collector roads provide mid-level access to areas, are often accessed via larger arterial routes, and are built to support moderate traffic levels. Local roads are generally the most numerous, support the lowest traffic volume in the hierarchy, and function to provide direct access to specific locations, sites, and resources. The primary concern for this category is the identification of those roads that have maintenance levels that do not reflect their function.

Available data used during the evaluation of this category included:

- Miles of USFS maintenance level 3 roads by transportation function (i.e., arterial, collector, local)
- Miles of road by maintenance level designation (maintenance levels 3, 4, and 5). There are no maintenance level 4 or 5 roads on the Thunder Basin National Grassland that are under Forest Service Jurisdiction. Roads with functions that do not reflect their operational maintenance were also identified.

Evaluation Criteria

High Value (5): Road is an arterial road.

Moderate Value (2): Road is a collector road.

Low Value (0): Road is a local road.

Table 5-1 summarizes the rating results for USFS maintenance level 3 roads. Road-by-road ratings are provided in Appendix A, and Appendix B, 4-6.

Table 5-1. Summary of the General Transportation Value of Roads

General Transportation Value	Number of Roads	Approximate Total Road Miles
High	10	68
Moderate	10	51
Low	49	75
TOTAL	69	194

Mineral Resources Management Value

Roads are crucial in providing access to mineral resources on the TBNG. Roads that serve as direct access points to coal mines, active oil and gas wells, or areas either currently or soon to be serving coal bed methane production would be considered to have value under this category.

Available data used during the evaluation of this category included:

- Miles of USFS maintenance level 3 roads in high, moderate, or low density areas of oil and gas activity (based on oil and gas well density per square mile)
- Miles of road in an area under permit for coal mining
- Miles of road within an area of coal bed methane development potential (within 1,000 feet of a coal bed methane site or within an active coal bed methane development area)

Evaluation Criteria

High Value (5): Road serves high density areas of active oil and gas wells, passes through or falls within an area under permit for coal development, or is within 1,000 feet of a coal bed methane development site.

Moderate Value (2): Road provides access to areas with a moderate density of oil and gas producing wells or provides some level of access to areas under permit for coal mining or with future development plans for coal bed methane.

Low Value (0): Road primarily exists within or provides access to areas with a low density of producing oil and gas wells, and does not provide access to coal or coal bed methane sites.

Table 5-2 summarizes the rating results for USFS maintenance level 3 roads. Road-by-road ratings are provided in Appendix A, and Appendix B, 16-18.

Table 5-2. Summary of the Mineral Resources Management Value of Roads

Mineral Resources Management Value	Number of Roads	Approximate Total Road Miles
High	27	84
Moderate	14	38
Low	28	73
Total	69	194

Social Value

Roads may have specific "social" value to the local community. Certain roads may be used as traditional links between communities, school bus routes, public safety routes, or provide access to traditional hunting or sites of local symbolic meaning.

Available data used during the evaluation of this category included:

- Miles of USFS and non-USFS roads by transportation function (i.e., arterial, collector, local) and by maintenance level designation, in conjunction with proximity to populated places.
- IDT knowledge of the area and local populations

Evaluation Criteria

High Value (5): The road is an arterial serving as a high volume transportation link between local communities, or population clusters. The road serves as a primary transportation access for the provision of services to local residents, such as a school bus route or public safety vehicle access.

Moderate Value (2): The road provides access to TBNG areas for moderate levels of traffic. There are private residential clusters for which the road serves as a collector link to major arterial routes. The road provides access to private inholdings requiring transit over NFS land, or conversely, access to NFS land across private inholdings.

Low Value (0): The road supports only low traffic volumes, and provides direct, local access to a specific site, location, or resource that has a limited, seasonal or specialized use. The road has been maintained to accommodate passenger vehicles, but is primarily used for single resource access.

Table 5-3 summarizes the rating results for USFS maintenance level 3 roads. Road-by-road ratings are provided in Appendix A, and Appendix B, 4-6.

Table 5-3. Summary of the Social Value of Roads

Social Value	Number of Roads	Approximate Total Road Miles
High	7	33
Moderate	12	62
Low	50	99
TOTAL	69	194

Recreation Value

Roads that serve developed recreation sites or that support high level access to dispersed recreation opportunity are important to recreation value.

Available data used during the evaluation of this category included:

- Miles of USFS maintenance level 3 road per Recreation Opportunity Spectrum (ROS) designation (roaded natural, rural, or urban)

Evaluation Criteria

High Value (5): The road accesses either of the two developed recreation sites on the TBNG or areas of concentrated dispersed recreation use. The road represents a key recreation access to a wide variety of high use, dispersed recreation opportunities, such as hunting, ATV use, and hiking. The road serves as a scenic byway or tour route for visitors engaged in landscape and wildlife viewing.

Moderate Value (2): The road affords access to dispersed recreation areas that experience a steady year-round or high seasonal demand, such as hunting or other seasonal sports.

Low Value (0): Access provided by the road is limited to minor dispersed recreation sites that experience occasional or infrequent use. The road is a local direct access to a specific location, site, or resource that may be accessed by other routes in a high-density roaded area.

Table 5-4 summarizes the rating results for USFS maintenance level 3 roads. Road-by-road ratings are provided in Appendix A, and Appendix B, 7-9.

Table 5-4. Summary of the Recreation Value of Roads		
Recreation Value	**Number of Roads**	**Approximate Total Road Miles**
High	20	115
Moderate	19	48
Low	30	31
TOTAL	69	194

Rangeland Access/Water Production Value

Roads that provide access to active allotments and water structures are valuable for range management and use.

Available data used during the evaluation of this category included:

- Miles of USFS and non-USFS roads by maintenance level designation that provide access to, or fall within, an active range allotment

Evaluation Criteria

<u>High Value (5)</u>: Road provides primary access to areas with a high density of water structures and active range allotments.

<u>Moderate Value (2)</u>: Road provides access to an active range allotment, but does not need to be maintained to maintenance level 3 standards.

<u>Low Value (0)</u>: Road is a secondary access route to range areas, or does not provide access to active range allotments.

Table 5-5 summarizes the rating results for USFS maintenance level 3 roads. Road-by-road ratings are provided in Appendix A, and Appendix B, 19-21.

Table 5-5. Summary of the Rangeland/Water Production Value of Roads		
Rangeland/Water Production Value	**Number of Roads**	**Approximate Total Road Miles**
High	14	100
Moderate	41	87
Low	14	7
Total	69	194

ROAD-RELATED RISKS

Risk to Wildlife

Many scientific studies have documented impacts of roads on wildlife, including direct mortality, habitat loss and/or reduced available habitat due to road avoidance, habitat fragmentation, edge effects, increased competition and predation from edge-associated species, population isolation, nesting and rearing disturbances, and reduced habitat effectiveness. All of these impacts can adversely affect the viability and sustainability of wildlife populations.

Available data used during the evaluation of this category included:

- Average road density in the vicinity of the road, (See Appendix C)
- Number of miles passing through elk winter range, crucial winter range, winter/year long habitat, and year long habitat
- Miles of road passing within 1 mile of a known bald eagle nest or roost site
- Miles of road passing within 2 miles of a known grouse lek site
- Miles of road passing within 300 feet of a major riparian area
- Miles of road passing through known prairie dog habitat
- Miles of road passing through known mountain plover habitat
- Miles of road passing within ¼ mile of any known raptor nest

Evaluation Criteria-

To address the myriad of wildlife species and habitats and their potential to be impacted by the road system, a comprehensive approach, utilizing the experience and knowledge of the field biologists and the above calculations, was used to assess wildlife risk for each road. Major criteria or focus habitat used for this evaluation process are provided below.

1. Roads with the potential to impact woody draws were assessed based on the presence or absence of woody draws in the vicinity of the road (GIS data not available) and the condition/quality of habitat. The risk rating increased where potential adverse impacts associated with the road increased. The risk level was classified as high, medium or low. The presence of a woody draw with known potential risks, would result in a *high* overall wildlife rating.
2. Roads that terminate in a riparian area or at a reservoir have increased risk due to the inherent sensitivity of these habitats combined with the likelihood that the road receives high use from recreational users and increased potential for road derived pollution effects. Roads in this category were generally scored high.
3. A high ranking was given to roads with mileage in ungulate crucial winter range
4. Roads with a high relative road density, and USFS maintenance level 3 road miles in any two other wildlife data categories were considered a high risk to wildlife.
5. Roads with a high relative road density, and USFS maintenance level 3 road miles in one other wildlife data category were considered a moderate risk to wildlife.

6. Roads with a moderate relative road density, and USFS maintenance level 3 road miles in one other wildlife data category were considered a moderate risk to wildlife.
7. Roads that access a high use road with high wildlife risk are require only one other data category under #4, and no other category under # 6
8. Issues off NFS lands were considered to have reduced weight when determining impact on wildlife risk ranking efforts

Evaluations of this criteria took into account the above rules resulting in a high, moderate, or low wildlife risk rank. These ranks were given a 5, 2, or 0 value (respectively) for plotting and overall classification into one of the four value/risk categories.

Table 5-6 summarizes the rating results for USFS maintenance level 3 roads. Road-by-road ratings are provided in Appendix A and Appendix B, 22-24.

Table 5-6. Summary of the Wildlife Risk of Roads

Wildlife Risk	Number of Roads	Approximate Total Road Miles
High	33	132
Moderate	19	42
Low	17	21
TOTAL	69	194

Risk to Aquatic Communities

Roads can affect aquatic communities by modifying natural hydrologic processes, restricting movements of aquatic species (road crossings), and altering chemical and physical water quality conditions.

Available data used during the evaluation of this category included:

- Miles of road in a high, moderate, or low road density watershed
- Number of perennial stream crossings per road and per road mile
- Miles of road in an HUC with the potential for coal bed methane development
- Miles of road within 300 feet of a riparian/wetland area
- Miles of road within 300 feet of a water body
- Miles of road within 100 feet of slopes 40% or greater

Data was weighted with the following point system:

- Miles of road in a high, moderate, or low density watershed:
  Significant road length (greater than 2 miles): 2 pts
  Moderate road length (1.5 to 2 miles): 1 pt
  Low road length (less than 1.5 miles): 0 pts

- Number of perennial stream crossings per road and per road mile:

High amount (greater than 5 crossings): 2 pts
Moderate amount (2 to 5 crossings): 1 pt
Low amount (less than 2 crossings): 0 pts

- Miles of road in an HUC with the potential for coal bed methane development:
  Any length of road: 1 pt
  No length of road: 0 pts

- Miles of road within 300 feet of a riparian/wetland area:
  High amount (greater than 0.75 miles): 2 pts
  Moderate amount (0.25 to 0.75 miles): 1 pt
  Low amount (less than 0.25 crossings): 0 pts

- Miles of road within 300 feet of a water body*:
  High amount (greater than 0.75 miles): 2 pts
  Moderate amount (0.25 to 0.75 miles): 1 pt
  Low amount (less than 0.25 crossings): 0 pts
  * If road terminates at recreational waterbody: upgrade risk to aquatics by one risk category

- Miles of road within 100 feet of slopes 40 percent or greater:
  Any length of road: 1 pt
  No length of road: 0 pts

Evaluation Criteria

High Risk (5): Road has significant potential to affect aquatic communities. (7-10 total points)

Moderate Risk (2): Road has moderate potential to affect aquatic communities. (4-6 total points)

Low Risk (0): Road has little potential to affect aquatic communities. (0-3 points)

Table 5-7 summarizes the rating results for USFS maintenance level 3 roads. Road-by-road ratings are provided in Appendix A and Appendix B, 1-3.

Table 5-7. Summary of the Risk to Aquatic Communities from Roads

Aquatic Communities Risk	Number of Roads	Approximate Total Road Miles
High	6	44
Moderate	13	55
Low	50	96
Total	69	194

Jurisdiction Risk

Roads that pass through numerous jurisdictions, or those that alternate jurisdictions frequently, are a concern for management operations and maintenance, and can pose safety risks.

Available data used during the evaluation of this category included:

- Miles of road in each of USFS, State, County/Local, or Private jurisdiction
- Frequency of jurisdiction changes along road length

Evaluation Criteria

High Risk (5): Road has numerous jurisdictions or numerous changes in jurisdiction along its length.

Moderate Risk (2): Road has a few jurisdictions and a low frequency of jurisdictional change along its length.

Low Risk (0): Road is primarily in one jurisdiction.

Table 5-8 summarizes the rating results for USFS maintenance level 3 roads. Road-by-road ratings are provided in Appendix A and Appendix B, 10-12.

Table 5-8. Summary of the Jurisdiction Risk of Roads

Jurisdiction Risk	Number of Roads	Approximate Total Road Miles
High	27	94
Moderate	7	12
Low	35	88
Total	69	194

Hydrologic Risk

Roads can modify hydrologic conditions by constricting flow at stream crossings, altering floodplain dynamics, increasing runoff from road surfaces, and decreasing time to peak flow following storm events. At the same time, roads themselves may be at risk from changes in hydrologic processes due to coal bed methane development.

Available data used during the evaluation of this category included:

- Miles of road in a high, moderate, or low density watershed
- Number of perennial stream crossings per road and per road mile
- Miles of road in an HUC with the potential for coal bed methane development
- Miles of road within 300 feet of a riparian/wetland area
- Miles of road within 300 feet of a water body

- Miles of road within 100 feet of slopes 40% or greater

Data was weighted with the following point system:

- Miles of road in a high, moderate, or low density watershed:
  Significant road length (greater than 2 miles): 2 pts
  Moderate road length (1.5 to 2 miles): 1 pt
  Low road length (less than 1.5 miles): 0 pts

- Number of perennial stream crossings per road and per road mile:
  High amount (greater than 5 crossings): 2 pts
  Moderate amount (2 to 5 crossings): 1 pt
  Low amount (less than 2 crossings): 0 pts

- Miles of road in an HUC with the potential for coal bed methane development:
  Any length of road: 1 pt
  No length of road: 0 pts

- Miles of road within 300 feet of a riparian/wetland area:
  High amount (greater than 0.75 miles): 2 pts
  Moderate amount (0.25 to 0.75 miles): 1 pt
  Low amount (less than 0.25 crossings): 0 pts

- Miles of road within 300 feet of a water body:
  High amount (greater than 0.75 miles): 2 pts
  Moderate amount (0.25 to 0.75 miles): 1 pt
  Low amount (less than 0.25 crossings): 0 pts

- Miles of road within 100 feet of slopes 40% or greater:
  Any length of road: 1 pt
  No length of road: 0 pts

Evaluation Criteria

<u>High Risk (5)</u>: Road has significant potential to modify hydrologic conditions in a watershed. (7-10 total points)

<u>Moderate Risk (2)</u>: Road has moderate potential to modify hydrologic conditions in a watershed. (4-6 total points)

<u>Low Risk (0)</u>: Road has little potential to modify hydrologic conditions in a watershed. (0-3 total points)

Table 5-9 summarizes the rating results for USFS maintenance level 3 roads. Road-by-road ratings are provided in Appendix A and Appendix B, 1-3.

Table 5-9. Summary of the Hydrologic Risk of Roads		
Hydrologic Risk	**Number of Roads**	**Approximate Total Road Miles**
High	7	49
Moderate	15	61
Low	47	84
Total	69	194

Maintenance Costs

Roads that have low transportation value, yet require high maintenance costs, can be considered a "risk" to road system management. These roads can unnecessarily draw available funding from other road improvement projects and should be identified, if present.

Available data used during the evaluation of this category included:

- Annual road maintenance costs of each road
- Annual road maintenance costs per mile for each road
- Deferred maintenance costs for each road

The cost data is taken from Infra condition surveys completed over the last few years, which is known to be incomplete. While these costs may be used for comparison, they should not be assumed valid as actual costs. Further review of maintenance costs is recommended at the project scale before basing a road management decision primarily on costs.

Evaluation Criteria

A risk factor was assigned to each road based on its total deferred maintenance costs and its annual maintenance costs per mile. It should be noted that these two maintenance cost categories may have different impacts on management decision making, and as a result, were originally ranked separately, and then given a combined ranking. In this manner, large deferred maintenance tasks, such as a bridge reconstruction, are generally given the same ranking weight as those roads which have high annual road maintenance costs, etc.

For annual maintenance costs, roads were divided up into high, moderate, and low maintenance risk categories based on the costs divisions listed in the adjacent table. Note these costs are expressed as cost/mile of road.

Annual Maintenance Categories	
Rating	**Per Mile Cost**
High	$2000+ (43,000 max)
Moderate	$800-$1999
Low	$0-$799
No Data	N/A

For deferred maintenance costs, roads were divided up into high, moderate, and low maintenance risk categories based on the costs divisions listed in the adjacent table. Note these costs are expressed as total deferred maintenance needs per road.

Deferred Maintenance Categories	
Rating	**Per Road**
High	$10,000 + ($441,000 max)
Moderate	$200-$10,000
Low	$0-$200
No Data	N/A

The table below outlines the methodology for deriving the overall maintenance cost risk factor (based on a combination of the annual and deferred maintenance cost risk factors described above).

Deferred Maintenance Cost Rank	Annual Maintenance Cost Rank		
	High	***Moderate***	***Low***
High	High	High	Moderate
Moderate	High	Moderate	Low
Low	Moderate	Low	Low

Table 5-10 summarizes the rating results for USFS maintenance level 3 roads. Road-by-road ratings are provided in Appendix A and Appendix B,13-15.

Table 5-10. Summary of the Maintenance Costs of Roads		
Maintenance Cost	**Number of Roads**	**Approximate Total Road Miles**
High	24	89
Moderate	14	49
Low	31	57
TOTAL	69	194

Noxious Weeds Risk

Exotic (non-native) species can invade roadside habitat and be dispersed by wind, water, vehicles, and other human-related agents. Roads may serve as the first entry point for non-native species into a new landscape, and may serve as a corridor along which such species move farther into the landscape.

Available data used during the evaluation of this category included:

- Miles of road falling within 300 feet of a riparian area
- Number of stream crossings per road

Evaluation Criteria

High Risk (5): Road provides access to areas with a dense concentration of traffic and disturbance, with the high possibility for the spread of noxious weed seed. Road goes through existing weed infestation.

Moderate Risk (2): Road provides access to areas with an average amount of traffic and disturbances with the possibility for the spread of noxious weed seed.

Low Risk (0): Road provides limited access to traffic and disturbances. Small possibility of noxious weed spread.

Table 5-11 summarizes the rating results for USFS maintenance level 3 roads. Road-by-road ratings are provided in Appendix A.

Table 5-11. Summary of the Noxious Weed Risk of Roads

Noxious Weed Risk	Number of Roads	Approximate Total Road Miles
High	27	143
Moderate	30	42
Low	12	10
Total	69	194

ROAD SYSTEM MODIFICATION OPTIONS

The value factors and risk factors discussed above were given numerical equivalents. “High” values/risks were given a numerical equivalent of 5, “moderate” values/risks a numerical equivalent of 2, and “low” values/risks a numerical equivalent of zero. Values and risk numerical equivalents were then summed to determine “Total Value” and “Total Risk” numbers for each road.

Total values ranged from 0 to 25 and total risks ranged from 0 to 27. **The highest priority roads within each category are those at the more extreme ends of the value/risk range.** For example, a road with a total value of 10 and a total risk of 21 would usually be a higher priority for investment than a road with a value of 4 and a risk of 7.

Each road was then plotted by its Total Value (x axis) and Total Risk (y axis) on a Road Value/Risk matrix (**Figure 5-1**). This matrix placed each road into one of the management categories based on overall high/low threshold levels for developed by the RAP ID team:

1. High Value/Low Risk;
2. High Value/High Risk;
3. Low Value/High Risk; or
4. Low Value/ Low Risk.

Threshold levels for overall high or low ***value*** rankings were determined based on the following rationale. In general, most of the "backbone" road system of the TBNG has been developed over time and serves multiple resource needs. The RAP ID team suggested that it is the support of multiple resources that makes these “backbone” roads highly valuable. For this reason, any road that was considered to be of high value (5) for at least one value category (recreation, mineral resources, etc.), and had at least one moderate value ranking (2) for another value category could be said to serve multiple uses. Extending this rationale for determining an overall total value threshold for each individual road suggests that any road with a total value rank of 7 or greater should be considered to have an overall “high value” to the TBNG road system, and all others (below 7) would be considered to have an overall “low value”.

Threshold levels for overall high or low ***risk*** rankings were determined in a slightly different manner. Initially, it was suggested that if a high rating was given in any one resource category, than the whole road could be considered an overall high risk road. However, this would put most of the roads in the high risk category, give little opportunity for comparison between the roads, and limit the potential for prioritization of road maintenance and management efforts. For this reason, the ID Team suggested that to be given an overall high risk rating, a road should have at least two categories with a high risk rating. Extending this rationale for characterizing overall total risk for each individual road suggests that any road with a total risk rank of 10 or greater should be considered to have an overall “high risk” to the TBNG road system, and all others (below 10) would be considered “low risk”.

Appendix A, *The Road Matrix*, displays “Total Value” and “Total Risk” numbers, as well as the category assignment. **Figure 5-1** displays the total number of roads and road miles in each of the four categories. **Figure 5-2** displays the number of roads at each value/risk point within the 4 categories.

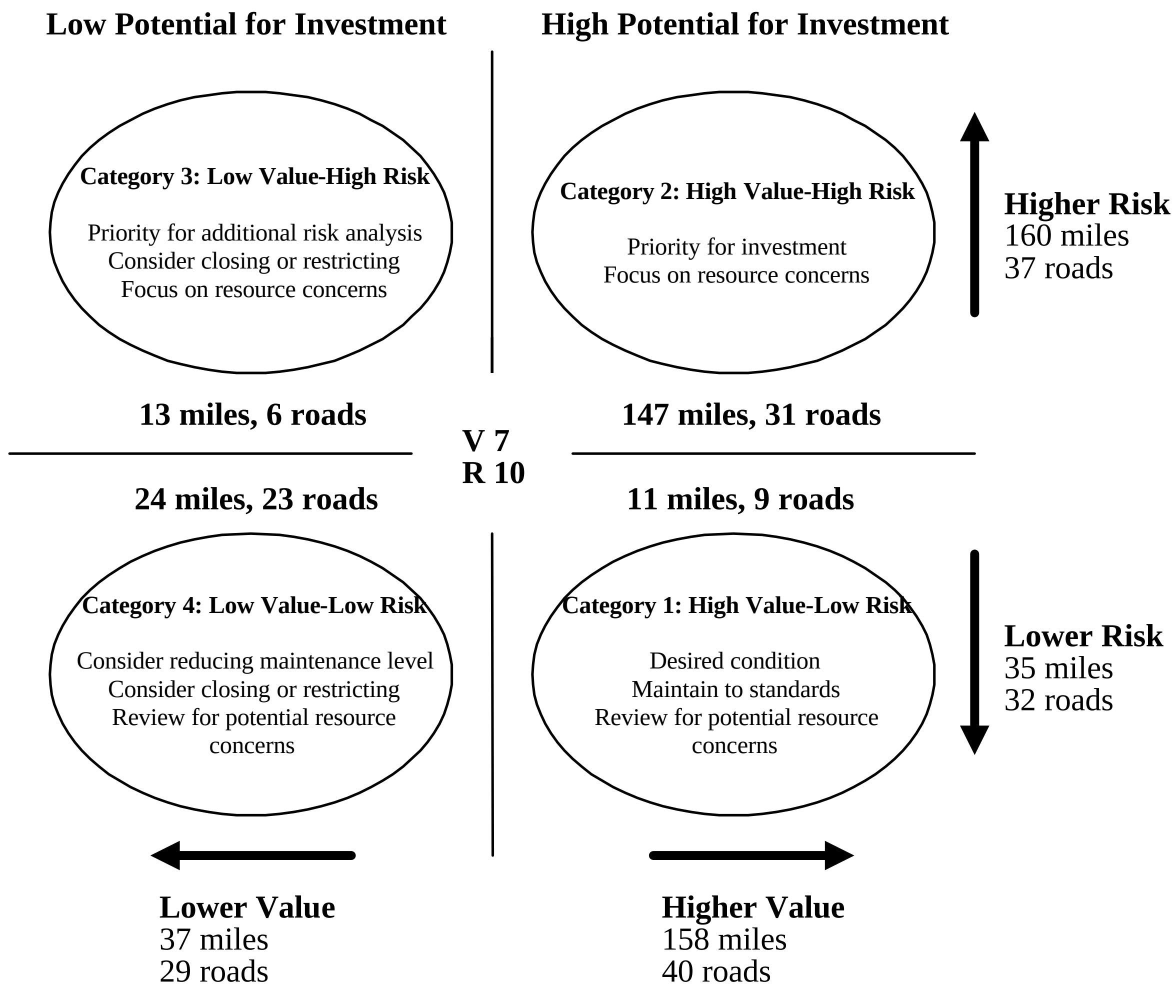

Figure 5-1. Number of Roads and Miles in Each Value/Risk Category

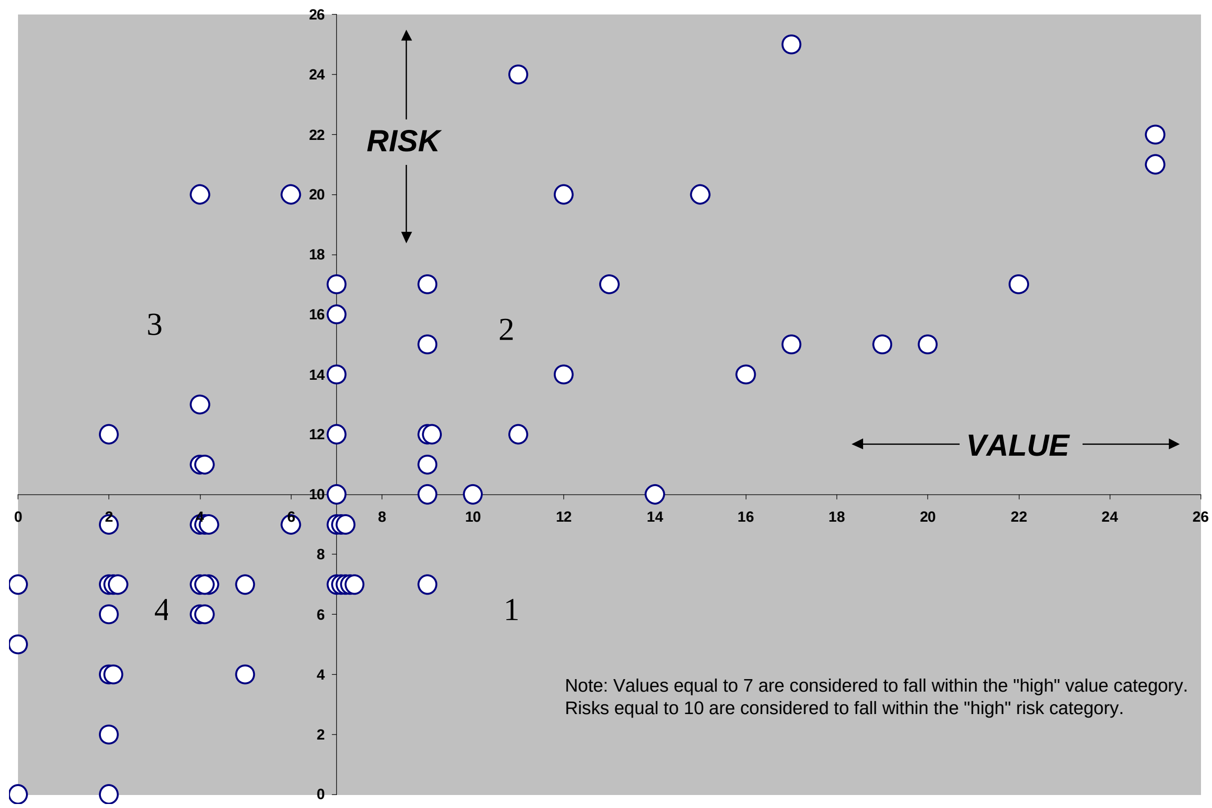

Figure 5-2. Number of Roads at Each Value/Risk Point

Road Management Categories

Category 1: High Value and Low Risk: Ideal Situation
9 Roads, 11 Road Miles

Options:

- Focus road maintenance funds on these roads to keep them in this category.
- High priority for the Public Forest Service Road designation.
- These roads form part of the potential minimum road system for the TBNG.

Category 2: High Value and High Risk: Priorities for Capital Improvements
31 Roads, 147 Road Miles

Options:

- High priority for sub-forest scale roads analysis to identify high risk reduction needs.
- High priority for capital improvement funding, such as Public Forest Service Road designation, road improvement, road relocation, funding, capital improvement program,

etc.

- Shift road maintenance funds to these roads to keep their resource risks from increasing.
- These roads are also part of the potential minimum road system for the TBNG.

Category 3: Low Value and High Risk: Priorities for Risk Analysis
6 Roads, 13 Road Miles

Options:

- High priority for sub-forest scale roads analysis to identify high-risk reduction needs and confirm use value.
- Potential for reducing maintenance level.
- High potential for decommissioning.

Category 4: Low Value and Low Risk: Priorities for reducing Maintenance Level
29 Roads, 37 Road Miles

Options:

- Lowest priority for expending annual road maintenance funding.
- Moderate potential for decommissioning or reducing maintenance level.
- Where there is a recreational demand, convert these roads to trails.

ROAD MAINTENANCE COSTS—IDENTIFICATION OF THE POTENTIAL MINIMUM ROAD SYSTEM

One purpose of a roads analysis is to identify ways to more efficiently spend the limited road maintenance dollars allocated to the forests. One approach is to reduce or eliminate expenditures on roads that are not needed or not needed at their current maintenance level. The process described above identifies the Potential Minimum (Maintenance Level 3) Road System.

Some conclusions can be made by comparing annual road maintenance funding needed for each road to the road maintenance graph on the following page. If all of the roads to the ***left*** of the vertical axis (low value) were to be decommissioned or the maintenance level reduced, the overall costs of the road system could be significantly reduced. See **Table 5-12**. Nevertheless, current maintenance funding remains below that needed, even when considering the potential for a significant reduction in maintenance costs as a result of adopting the minimum road system.

The cost data used in this summary table is taken from Infra condition surveys completed over the last few years, which is known to be incomplete. While these costs may be used for comparison, they should not be assumed valid as actual costs. Further review of maintenance costs is recommended at the project scale before basing a road management decision primarily on costs.

Table 5-12. Estimated Maintenance Costs by Value Risk Category, and Assessment of the Maintenance Costs of the Potential Minimum Road System

Risk/Value Category	Maintenance Cost Category	Total
1 (High Value/Low Risk)	Annual	$28,695.00
	Deferred	$102,861.00
2 (High Value/High Risk)	Annual	$616,340.00
	Deferred	$1,000,797.00
3 (Low Value/High Risk)	Annual	$13,800.00
	Deferred	$1,435.00
4 (Low Value/Low Risk)	Annual	$56,342.00
	Deferred	$425,016.00
Total Annual Maintenance Costs		$715,177.00
Total Deferred Maintenance Costs		$1,530,109.00
Total Annual Maintenance Costs of the Potential Minimum Road System		$645,035.00
Total Deferred Maintenance Costs of the Potential Minimum Road System		$1,103,658.00

ASSESSMENT OF BUILDING ROADS IN A CURRENTLY UNROADED AREA

An inventory of areas essentially roadless and undeveloped in character has been completed for the TBNG and is provided in Appendix C of the LRMP EIS (USFS, 2001b). Six areas of the TBNG have been assessed for their potential to be considered inventoried roadless areas: Cow Creek, H A Divide, Red Hills, Duck Creek, Downs, and Miller Hills. These areas are natural in appearance and their ecological processes remain intact. A description of these areas is provided in **Table 4-12**, along with the number of miles of USFS maintenance level 3 roads present in each.

Roading of these currently unroaded areas could cause adverse impacts to ecological processes, rare plants, wildlife, and wilderness qualities. A brief assessment of potential road impacts on currently unroaded areas is provided in EF(1) and potential effects to the human environment is discussed in SI(4). A detailed analysis of these areas in the LRMP EIS (USFS, 2001b) is incorporated here by reference.

OPPORTUNITIES FOR ADDRESSING PROBLEMS AND RISKS

The following sections outline management opportunities and recommendations that have been identified by the IDT based on the analyses presented in Chapters 4 and 5 of this document. To provide overall context and organization, recommendations are generally arranged by the categories that were used to organize major issues listed in Chapter 3, and subcategorized by major question themes in Chapter 4. Because of this, some recommendations are listed more than once in different general categories.

General Opportunities:

Opportunities for addressing other road-related problems and risks include:

1. Require the use of this TBNG Roads Analysis for all sub-forest scale roads analyses.
2. At appropriate intervals, update the data contained in the Road Matrix. Analyze the changes to determine new opportunities that may have developed as new information is collected.
3. Develop a strategy to review and update RMOs. Review and update RMOs (with current line officer signatures) for any project affecting roads.

Access Needs:

General Transportation Opportunities

1. Conduct a thorough review of jurisdiction and legal right-of-way for all roads.
2. Pursue opportunities to develop cooperative agreements in assisting in enforcement and monitoring activities with area ranching organizations, including the Thunder Basin Grazing Association, Inyan Kara Grazing Association, and Spring Creek Grazing Association..
3. Inform road users of the type of travel permitted on TBNG roads through appropriate signing and education, especially when the road crosses through multiple jurisdictions.
4. Identify and implement road closure methods that are most appropriate for effective road closure in an open, grassland setting.
5. As set forth in MUTCD, establish and maintain proper signing on roads subject to the Highway Safety Act (most maintenance level 3 roads).
6. Post signs on roads warning of road surface changes for roads that change objective maintenance levels along their path.
7. Develop an accident reporting system or program in conjunction with local law enforcement that provides for tracking the locations, types, and frequencies of motor vehicle accidents on National Grassland roads.
8. Use motor vehicle accident safety investigations and reports to help identify road safety hazards, including recurring road washout locations.

9. Conduct road location reviews prior to all new construction and road relocations. Ensure the location meets public and agency needs, while mitigating environmental impacts identified in the analysis. Responsible line officers and resource and engineering specialists should participate in the review.
10. Develop a cost effective plan for conducting an inventory of unclassified roads.
11. Maintain or decrease road densities in RNAs and SIAs through formal road removal projects and restrict any new road construction in these areas.
12. Monitor high road density areas for illegal off-road use or the signs thereof.
13. Improve timeliness of responding to road washouts that present a public safety concern.

Resource Extraction:

Mineral Resources Management Opportunities

1. Assess those roads that are considered valuable to private mineral resource operations and of high maintenance cost to the USFS. Determine if additional maintenance cost sharing agreements are required.
2. Monitor road closure, rehabilitation, or removal efforts by oil and gas, coal bed methane, and other mineral resource extraction operators for compliance with lease agreements.
3. Develop a plan to inventory the lower maintenance level road system. Identify those areas where roads were not rehabilitated following oil and gas operations.

Rangeland Access/Water Production Opportunities

1. Assess roads listed as moderate value for rangeland management to determine which, if any, can be reduced in objective maintenance level.
2. Identify areas of natural resource damage along roads heavily used for rangeland management purposes.

Environmental Concerns:

Opportunities for Addressing Risks to Wildlife/Sensitive Species

1. Develop an education program regarding the adverse effects of both off-road travel and motorized use of closed roads on wildlife and aquatic resources. Education may be the best tool to discourage additional development and use of unclassified roads.
2. Develop a strategy to inventory unclassified roads.
3. Consider certain roads for seasonal closures to reduce the effects of motorized vehicles in some areas of wildlife concern.
4. Strategically close certain low-value roads to reduce the encroachment of recreationists into wildlife habitat.
5. When roads with high risk to wildlife cannot be removed, plan maintenance outside of key habitat use periods (ie: nesting periods, ungulate winter range – refer to TBNG LRMP and project level decisions for specific direction).

6. When roads with high risk to wildlife cannot be removed, reroute high risk roads around or away from traditional key use habitats such as leks, nest sites, and prairie dog colonies.
7. When roads with high risk to wildlife cannot be removed or closed, limit road use in key areas. Allow access by special use permit only.
8. In occupied plover habitat, post warning signs (not regulatory speed limit signs) or utilize road design and maintenance techniques to discourage high speeds while maintaining safety requirements for the road. Examples of road design and maintenance techniques can include: limiting road width, reducing driving comfort level, remove gravel surfacing, add rolling dips.
9. Within 2 miles of sage grouse leks, regulate traffic to meet seasonal noise limitations from road use as described in the TBNG LRMP.

Opportunities for Addressing Risks to Aquatic Communities

1. Develop an education program regarding the adverse effects of both off-road travel and motorized use of closed roads on aquatic resources.
2. Consider relocating roads identified for potential for mass failures
3. Conduct culvert and drainage structure condition surveys. As part of this effort, identify those locations where gulley formation is induced by road drainage.
4. Focus maintenance efforts on drainage improvements for those roads considered to have high potential for hydrologic impact and high risk to aquatic communities.
5. Develop and implement a strategy for monitoring the effects of Coal Bed Methane development on roads and road drainage structures
6. Conduct a survey of roads with potential to impact wetland habitats, particularly playas. (See question AQ(8) for a list of potential survey targets.)
7. Assess recreational reservoirs and waterbodies during field surveys for the presence of: chytrid fungus, frogs carrying ranavirus, and bullfrogs. Provide information at recreation ‘hot spots’ that inform the public of these concerns and methods for limiting recreation induced dispersal to other water bodies in the grassland.
8. Conduct surveys or obtain current information regarding the amount and distribution of wetlands on the TBNG to determine potential impacts of the road system

Opportunities for Addressing Hydrologic Risks

1. Design roads to minimize interception, concentration, and diversion potential.
2. Evaluate and eliminate diversion potential at stream crossings.
3. Conduct culvert and drainage structure condition surveys. As part of this effort, identify those locations where gulley formation is induced by road drainage.
4. Design measures to reintroduce intercepted water back into slow subsurface pathways.
5. Use outsloping and drainage structures to disconnect road ditches from stream channels rather than delivering water in road ditches directly to stream channels.
6. Consider surfacing measures such as rocking, armoring, or paving high use roads to protect the integrity of the road surface.
7. Increasing the number and effectiveness of drainage structures.
8. Allow use of the road only during dry or frozen conditions to minimize rutting.

9. Relocate roads currently located on unstable soils
10. Relocate drainage structures so that the outlets are on less sensitive areas which may include flatter slopes and locations with better-drained soils.
11. Design crossings to pass all potential products including sediment and woody debris, not just water.
12. Realign crossings that are not consistent with the channel pattern.
13. Change the type of crossing to better fit the situation; for example, consider bridges or hardened crossings on streams with floodplains, and consider bottomless arch culverts in place of round pipe culverts.
14. Add cross-drains near road-stream crossings to reduce the connected disturbed area.
15. Reduce the number of road-stream crossings to minimize the potential for adverse effects.
16. Relocate roads out of wetland areas. Where relocation is not an option, use measures to restore the hydrology of the wetland.
17. Set road-stream crossing bottoms at natural levels of wet meadow surfaces.
18. Relocate roads out of riparian areas.
19. Restore the hydrology in riparian areas that have been dewatered by the road system.
20. Drainage structures should adequately account for increased flow volumes resulting from the CBM discharges, and road maintenance should be prioritized in watersheds with significant CBM development.

Opportunities for Addressing Noxious Weed Risks

1. Restrict travel through areas with active noxious weed infestations until they can be treated.
2. Current invasive species data is incomplete. Compile current invasive species information, and monitor change in distribution across the TBNG.
3. Monitor those areas with high road density and high road use for invasive species establishment and spread.

Illegal Use and Road Safety Concerns:

Recreation Opportunities

1. Develop an education program regarding the adverse effects of both off-road travel and motorized use of closed roads on vegetation, wildlife, and aquatic resources.
2. Develop educational material and signage to help users understand appropriate motorized and non-motorized uses, as well as restrictions to motorized use.
3. Monitor inventoried roadless areas for illegal off-road use, and potential for user created roads.
4. Monitor visitor use for the TBNG to determine the overall current and likely future demands on the road system from recreation.
5. Inventory and evaluate low value, low risk roads for their potential as motorized trails. Work with user groups from Gillette, Newcastle, Upton and Moorcroft.

Road Management and Jurisdiction:

Social Opportunities

1. Review maintenance and cost share agreements for roads that are primarily used to provide access to private land inholdings, and are not used for TBNG management purposes. Develop formal agreements with private land holders where none exist.
2. Identify roads supporting school bus traffic and consider transferring jurisdiction to the County.
3. Consult with local affected private landholders, prior to decommissioning or altering road management regimes

Opportunities for Addressing Risks from Jurisdictional Issues

1. Conduct a thorough review of jurisdiction and legal right-of-way for all roads, particularly roads with proposed projects, and those rated high for jurisdiction concerns in this analysis.
2. Involve land and engineering specialists in the project planning process early to help determine if access is going to be an issue.
3. Update the USFS right-of-way database, and keep the database current.
4. Keep existing road maintenance agreements updated.
5. Pursue new cooperative agreements for maintenance needs with other jurisdictions.
6. Inform road users of type of travel permitted on TBNG roads through appropriate signing and education, especially when the road crosses through multiple jurisdictions.
7. When road use patterns change, review road for appropriate jurisdiction and maintenance responsibility.
8. Identify roads supporting school bus traffic for potential transfer of jurisdiction to the County.

Funding:

Opportunities for Addressing Maintenance Cost Issues

1. Keep existing road maintenance agreements updated.
2. Pursue new cooperative agreements for maintenance needs with other jurisdictions.
3. Reduce the maintenance level on identified low-value maintenance level 3 roads and those roads where the access needs would be adequately met by maintenance level 1 or 2 roads. Consider this option during sub-forest scale roads analyses. Reduced maintenance of these roads should not result in any increased watershed risks as the most basic road maintenance will focus on maintaining road drainage. The reduced maintenance should only result in reduced user comfort.
4. To reduce annual maintenance costs, implement seasonal travel restrictions on roads susceptible to damage during wet or thawing conditions.
5. Collect road maintenance and surface rock replacement deposits, as appropriate, on all road use permits and special use permits.

6. Require authorized, permitted operations using USFS roads to pay a portion of road maintenance costs.
7. Develop an annual maintenance plan to prevent deferred maintenance costs from accruing on high value rated roads.
8. When road use patterns change, review road for appropriate jurisdiction and maintenance responsibility.
9. Prioritize funding to address critical health and safety and resource protection needs.

Decommissioning Guidelines:

Discussion

Road decommissioning results in the removal of a road from the road system. The goal is to return the roadway to a more natural state where the roadway is hydrologically self-maintaining and to permanently remove it from the transportation system. To accomplish this, a number of techniques can be used, such as posting the road closed and installing waterbars or earth berms, posting and installing barriers and barricades, ripping and seeding, scattering slash or boulders, planting vegetation in the roadway, converting the road to a trail, and full reclamation by restoring the original topography. There is a different cost associated with each of these techniques, and their effectiveness for deterring unauthorized motorized vehicle use varies as well. Planning for the location of the closures is important in ensuring their effectiveness.

Decommissioning level 1 and 2 roads can consist of removing the few culverts, ripping and seeding, posting closed with signs, and installing waterbars to discourage unauthorized motorized vehicle use and ensure proper drainage over time.

Decommissioning level 3, 4, and 5 roads is more expensive than decommissioning most level 1 and 2 roads. When choosing a technique for road decommissioning, the objective is to eliminate the need for future road maintenance.

Level 3, 4, and 5 roads are usually wider than level 1 and 2 roads, have culverts installed at designed intervals to cross drain the road, are ditched, have better sight distances designed on horizontal and vertical curve, have larger cuts and fills, and are designed through the topography rather than with the topography. It is much more expensive to decommission these roads than level 1 and 2 roads. Given the cost, it may be cheaper to maintain level 3, 4, and 5 roads than to decommission them. However, future maintenance costs may not be the only factor to consider; other resource considerations may outweigh the cost. For a particular road (level 3, 4, or 5), high deferred maintenance costs may exceed the costs of decommissioning.

Guidelines

- Balance cost with resource risk and effectiveness of the treatment when selecting methods for decommissioning roads.
- Convert roads to trails as a decommissioning method when analysis of recreation demand indicates a need to expand, connect or improve the existing trail system in

the area. Provide adequate trailhead parking as part of this treatment method (See UR1 and RR1 discussion in Chapter 4).
- Decommission by restoring the road to original contours when mitigating visual impacts is required by the forest plan or when necessary to assure the elimination of vehicular traffic.

Capital Improvement Guidelines:

Discussion

This analysis shows a need to reconstruct existing roads to correct deferred maintenance work items or improve some roads to meet the increasing use and traffic requirements. Funding limitations require prioritization for reconstruction work. The Road Risk-Value Graph provides a starting point for developing priorities. The following guidelines are to be used in conjunction with the graph when selecting, prioritizing, and implementing road reconstruction and construction projects.

Guidelines

Conduct road location reviews prior to all new construction and road relocations. Ensure the location meets public and agency needs while mitigating environmental impacts identified in the analysis. Responsible line officers and resource and engineering specialists should participate in the review.

- Establish a traffic counting program to identify high-use roads and traffic patterns.
- Consider reconstruction to two lanes for roads with seasonal average daily traffic volumes exceeding 400 vehicles per day.
- Use motor vehicle accident safety investigations and reports to help identify road safety hazards.
- Use the following categories to prioritize road investments planned to reduce deferred maintenance backlog on roads: 1 – Critical Health and Safety; 2 – Critical Resource Protection; 3 – Critical Forest Mission. Data for these work items can be found in the Infrastructure database.
- Coordinate reconstruction and construction work with other agencies whenever possible. Utilize interagency agreements to develop investment and maintenance partnerships.

Road Management Guidelines

- If a road's maintenance condition has decreased, consider the need for the road and the historic use, as well as alternative roads in the area, before permanently changing the maintenance level. Use the Road Management Objectives (RMOs) to document any changes.
- Reduce the maintenance level on identified low-value level 3, 4, and 5 roads and those roads where the access needs would be adequately met by a maintenance level

1-2 road. Consider this option during subforest scale roads analyses, as this can be a cost effective alternative. Reduced maintenance of these roads should not result in any increased watershed risks as the most basic road maintenance will focus on maintaining road drainage. The reduced maintenance should only result in reduced user comfort. Less use due to reduced user comfort will further decrease the potential for road-related watershed risks.

- Provide travelers with sufficient information necessary to decide which road(s) they will travel. When appropriate, utilize entrance treatments, warning signs, route markers, and information bulletin boards to advise travelers of conditions ahead.
- Do not post speed limit and other regulatory signs on roads under Forest Service jurisdiction without a Forest Supervisor's order and a law enforcement plan.
- Consider prohibiting OHV use on NFS roads when one or more of the following conditions exist:
    - ➢ The road is maintained at level 3, 4, or 5 and connects to a state, county, or other public agency road that is similarly regulated.
    - ➢ Traffic volumes exceed 100 vehicles per day (SADT) on single-lane roads.
    - ➢ Average traffic speed on the road exceeds 25 mph.
- To reduce annual maintenance costs, implement seasonal travel restrictions on roads susceptible to damage during wet or thawing conditions.
- Collect road maintenance and surface rock replacement deposits, as appropriate, on all road use permits and special use permits.

General Guidelines

The following are general road-related guidelines:

- Require authorized, permitted operations utilizing NFS roads to pay their fair share of road maintenance costs.
- Consider road decommissioning when planning projects that involve the construction and use of short-term, single-resource roads: for example, roads planned for mineral projects that undergo exploration, development, and abandonment phases. Incorporating decisions to decommission single-resource roads during the initial stages of project planning helps move the Forest toward the potential minimum road system. Document planned decommissioning when developing road management objectives.
- Develop an annual maintenance plan to prevent deferred maintenance costs from accruing on high value rated roads
- Update the road system databases and keep them current.
- Use an interdisciplinary process to develop, update, and implement road management objectives for all system roads. Ensure that information in the transportation atlas and inventory conforms with approved road management objectives.
- At appropriate intervals, update the data contained in the Road Matrix. Analyze the changes to determine new opportunities that may have developed as new information is collected.

- Require the use of this Thunder Basin National Grassland Roads Analysis for all subforest scale roads analysis through a Forest supplement to the 7700 Manual.
- At least once every 2 years, perform road condition surveys on all level 3, 4, and 5 roads.

NEPA ANALYSIS NEEDS

This roads analysis does not need any NEPA documentation, as it provides information and opportunities for subforest-scale roads analyses. Any decisions that change management of the road system resulting from subforest-scale roads analyses will require the appropriate level of NEPA analysis.

CHAPTER 6
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