Bighorn National Forest Plan Revision
Existing Condition Assessment

# Devil's Canyon

# Geographic Area Assessment

2001 Picture of Devil's Canyon
Pryor Mountains in Background

**Devil's Canyon Geographic Area Existing Condition Assessment for Forest Plan Revision**

# Appendix: Maps

**Click on map name for full page view of maps**

## I. Preface

This is one of nine geographic area existing condition assessments that will be used in the Bighorn Forest Plan Revision to describe resources at the geographic area scale and how they relate to the existing Forest Plan. A map of the Forest Plan revision geographic areas is in the appendix. A similar assessment will be done at the Forest-wide scale, and will include numerous resources/topics:

- that are not amenable to analysis at the geographic area scale. For example, most wildlife species are not bound by geographic area boundaries, and to avoid needless repetition in the assessments, such topics will only be discussed at the Forest scale.
- where data bases are not complete or where analysis is still on going at the time the geographic area scale assessments are completed. Examples in this category are fire condition classes and timber suitability, which are expected to be completed by early 2002.

This existing condition geographic area assessment includes the portions of several watersheds on northwest corner of the Bighorn National Forest. Some of the subwatersheds include Trout Creek, Deer Creek, Porcupine Creek, Cottonwood Creek, Elk Springs Creek and Crystal Creek.

There is very little information in this assessment concerning other than National Forest System land. This information will be gathered and analyzed, where appropriate, in the draft and final environmental impact statements' effects analyses.

These existing condition assessments focus on the physical and biological resources, and in some cases, human uses and resources, such as timber harvest, grazing and recreation. There will be a social and economic section in the Forest-wide existing condition assessment, and the draft and final environmental impact statements will also include the work of the social and economic analyses, which are currently being compiled by the University of Wyoming.

Despite the fact that these assessments primarily focus on the environmental effects of human uses, it must be remembered that National Forests are managed *to be used* by people. This is implicit in the laws governing National Forest management[1]. Human use of the National Forests has been directed administratively since the earliest days of the Forest Service, "This force has two chief duties: to protect the reserves against fire, and to assist the people in their use."[2] That tradition continues to this day in the "Caring for the land and serving people" mission. While these assessments focus on the environmental effects that people are having on the resource, the point is to make sure that the uses we enjoy today are sustainable so that our children and grandchildren can continue to use and enjoy the Bighorn National Forest.

**Disclaimer for GIS generated data:** The Forest Service uses the most current and complete data available. GIS data and product accuracy may vary. They may be: developed from sources of differing accuracy, accurate only at certain scales, based on modeling or interpretation, incomplete while being created or revised, etc. Using GIS products for purposes other than those for which they were created, may yield inaccurate or misleading results. The Forest Service reserves the right to correct, update, modify or replace GIS products without notification. The GIS data in these documents were generated using ArcInfo 7.2.1, operating on a Unix platform, with analysis occurring between August of 2001 and January of 2002. For more information, contact the Bighorn National Forest.

[1] The Multiple Use Sustained Yield Act of 1960, the Renewable Resources Planning Act, and the National Forest Management Act, just to name a few.
[2] Forest Service "Use Book" of 1905.

## II. Forest Plan

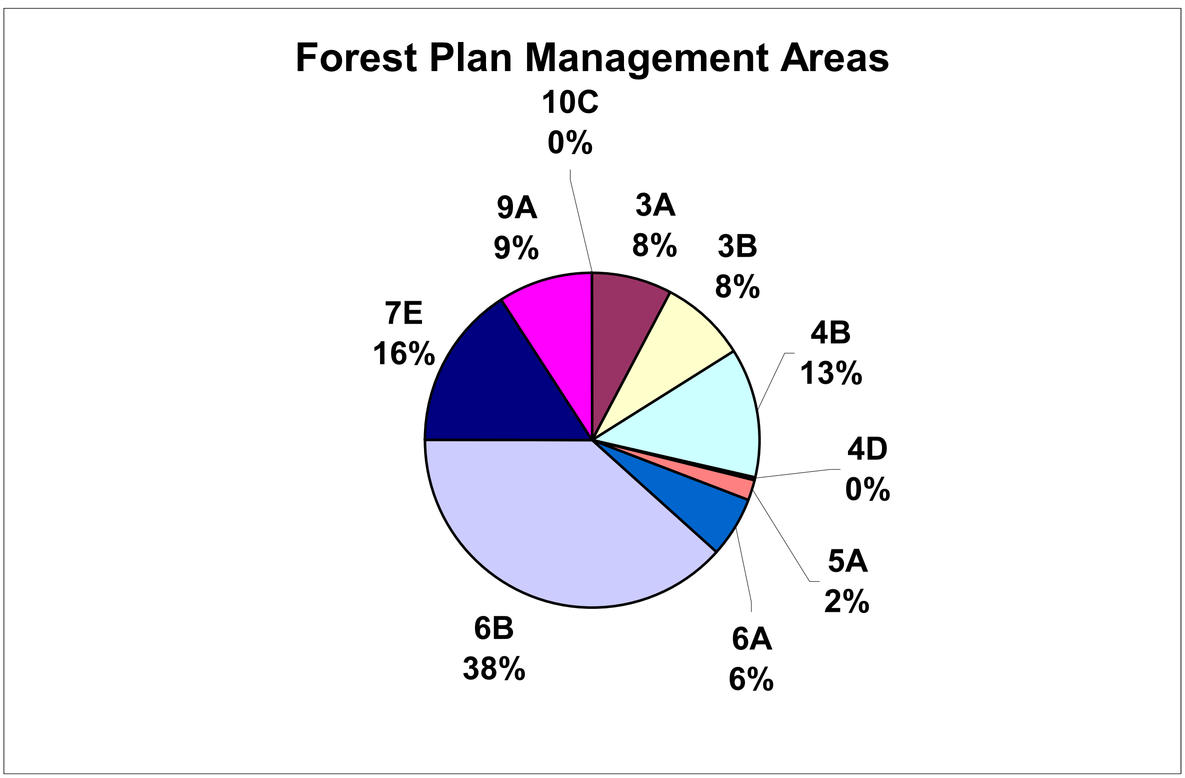
**Table 1. Existing Forest Plan Management Area Allocations**

| Forest Plan Prescriptions | Prescription Description | GIS Acres with 9A Riparian Applied | |
|---|---|---|---|
| | | Acres | % |
| 3A | Semi-Primitive Nonmotorized Recreation Opportunities | 4594 | 8% |
| 3B | Primitive Recreation in Unroaded Areas | 5078 | 8% |
| 4B | Wildlife Habitat Management for Management Indicator Species | 7748 | 13% |
| 4D | Aspen Stand Management | 166 | 0% |
| 5A | Wildlife Winter Range in Non-forested Areas | 1169 | 2% |
| 6A | Livestock Grazing, Improve Forage Condition | 3551 | 6% |
| 6B | Livestock Grazing, Maintain Forage Condition | 23,367 | 38% |
| 7E | Wood Fiber Production | 9565 | 16% |
| 9A | Riparian and Aquatic Ecosystem Management | 5593 | 9% |
| 10C | Special Interest Area – Medicine Wheel | 60 | 0% |
| Total | | 60,891 | |
| Non-FS | | 306 | |

Some interpretations from Table 1 include:

- The livestock grazing management areas account for 44% of this geographic area.
- Next high is 16% for 7E and 4B at 13%.
- These four prescriptions account for 73% of this geographic area.

**Figure 1. Existing Forest Plan Management Area Allocations**



**What is broken and needs to be fixed in the Forest Plan?**

- The Medicine Wheel Historic Preservation Plan goals and objectives create some management conflicts with the existing Forest Plan management areas, which were not revised after the HPP went into affect. Specifically, the Elk Springs area is accessed by the Medicine Wheel road and is 7E. Much of the area in the work center vicinity is 7E, as is areas within the viewshed and areas accessed by roads within the consultation area.
- MIS species selection, modeling (elk habitat), and monitoring provisions.
- Riparian and Aspen communities forage utilization standards and guidelines.
- Road Density standards/guidelines need incorporated for elk security habitat.
- Revise the standard/guideline regarding old growth.
- Vacant allotments need consideration for bighorn sheep reintroduction.
- Fences rebuilt/constructed need to have wildlife passage considered.

**What are the issues in this geographic area?**

- Medicine Wheel
- National Recreation Trail to Bucking Mule Falls
- High elevation sedimentary soils create unique, interesting plant habitats.
- Yellowstone cutthroat exist
- Mercury in porcupine creek from past mining operations
- Primary human access is from "above" in this geographic area.
- Area is used as a major elk migration route along Dugan Bench and up towards Sheep Mtn. Competing uses of forage resources may be of greater concern than in other geographic areas.
- Riparian and Aspen impacts (past and present) may be affecting wildlife habitat quality. Less beaver than previously thought to exist, consider this species as possible MIS/Focal.
- High road density has lowered the amount of elk security habitat. This type of habitat can be an indicator for other species benefiting from less disturbance (e.g. marten).
- Bighorn sheep utilize habitat to the north and west of the geographic area and have the potential to expand onto the Forest.
- Management practices must not cause detrimental changes in water temperature or chemistry, or sediment deposits that adversely affect water conditions or fish habitat (36 CFR 219.27).
- Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area (36 CFR 219.19).
- Management direction specific to the BNF is derived from NFMA through the Land and Resource Management Plan (Forest Plan) (USFS 1985). Other management direction is derived from the Region 2 Forest Service Geographic area Conservation Practices Handbook 2509.25 (USFS 1996). General direction from both the Forest Plan and Forest Service Handbook, for specific soil and aquatic resources within the analysis area, is given below.
  - **Soils**
    - Maintain and improve soil productivity (USFS, 1985 p. III-5).
    - Maintain soil productivity, minimize man-caused soil erosion, and maintain the integrity of associated ecosystems (USFS 1985 p. III-78).
    - Identify upland areas that are immediately adjacent to riparian areas that have a potential for directly affecting the conditions of the adjacent riparian area (USFS 1985 p. III-79).
    - Restore and maintain the long-term inherent productive capacity of the soil (USFS 1996 p.4).

- **Water Quality**
  - Maintain or improve BNF water quality (USFS 1985 p. III-5).
  - Improve water quality through visitor information and management of recreation and livestock grazing (USFS 1985 p. III-5).
  - Rehabilitate disturbed areas that are contributing sediment directly to perennial streams as a result of management activities to maintain water quality and reestablish vegetation cover (USFS 1985 p. III-57).
  - Improve or maintain water quality to meet State water quality standards (USFS 1985 p. III-57).
  - Reduce, to a natural rate any erosion due to management activity in the season of disturbance and sediment yields within one year of the activity through necessary mitigation measures such as water barring and revegetation (USFS 1985 p. III-57).
- **Streamflow**
  - Manage land treatments to conserve site moisture and to protect long-term stream health from damage by increased runoff (USFS 1996 p.1).
- **Stream Channels**
  - Conduct actions so that stream pattern, geometry, and habitats are maintained or improved toward robust stream health (USFS 1996 p.6).
- **Fisheries**
  - Maintain quality fisheries habitat and improve deteriorated fish habitat (USFS 1985 p. III-4).
- **Riparian Areas/Wetland Resources**
  - Manage riparian areas to reach mid to late seral ecological condition with rangeland riparian areas managed to achieve "satisfactory" or better condition by 2000 (USFS, 1985 p. III-5).
- **Disturbance Factors (MAN AND NATURAL)**
  - For riparian landscapes, the dominant disturbance factors are streamflow regulation, fire suppression, agriculture, irrigation, livestock grazing, and human development. These factors are creating a riparian habitat that is quite different from that of presettlement times. To varying degrees, alterations of the riparian zone are occurring in both the lowlands and mountains, especially where roads and summer homes have been constructed in valley bottoms, where large herds of livestock or big game congregate, and where the land is cultivated. Such uses may be sustainable if management is done correctly, but the riparian zone has been altered more extensively than any other landscape (Knight 1994).

## III. Disturbance Factors

### Riparian

Disturbance influences upon riparian areas and riparian vegetation are discussed in the Forest-wide assessment.

### Fire

Over the long term, fire is the most dominant disturbance factor in this landscape, from the perspective of total number of acres affected. A very small percentage of fires affect a majority of the acre burned.

- Fires role is different among the major forest cover types of Douglas-fir, lodgepole pine and Engelmann spruce/subalpine fir. These are described in more detail in Knight (2001), and will be summarized in the forest-wide assessment.
- The only fire over 250 acres in the fire database is the Intermission fire, which burned in 1988, the same year as the Yellowstone fires.

### Insect and Disease

- Insect and disease are the second most dominant disturbance factor in this geographic area. Western balsam bark beetle has hit Douglas fir hard in Devil's Canyon.

### Timber Harvest

Table 2 shows the amount of timber harvest and fire since the 1940s.

**Table 2. Timber Harvest and Fires in the Devil's Canyon Analysis Area**

| Harvest Type | 1940's | 1950's | 1960's | 1970's | 1980's | 1990's | 2000 |
|---|---|---|---|---|---|---|---|
| **Clearcut** | | | | | 1029 | | |
| **Shelterwood: Prep Cut** | | | | | | | |
| **Shelterwood: Seed Cut** | | | | | 318 | | |
| **Shelterwood: Overstory Removal** | | | | | | | |
| **Seed Tree** | | | | | | | |
| **Selection** | | | | 172 | | | |
| **Commercial Thin** | | | | | 110 | | |
| **Sanitation/Salvage** | | | | | 927 | | |
| **Pre-commercial Thin** | | | | | 34 | | |
| **Aspen Clearcut** | | | | | | | |
| **Fire** | 122 | 248 | | | 1400[3] | | |
| **Blowdown** | | | | | | | |
| **Acres CC + SW + ST + S + S/S[4]** | | | | 172 | 2247 | | |

Some of the insights from table 2 are:

- While there has been a small amount of timber harvest, on a total acreage basis, a high percentage of the available suitable timber has been harvested, see pages 9-10 of this assessment.

[3] Intermission fire – approximate acreage, will get actual from fire database.

[4] CC = Clearcut, SW = Shelterwood, ST = Seed Tree, S = Selection, S/S = Sanitation/Salvage. These were summed to portray the amount of sawlog harvest that has occurred.

- The 927 acres of sanitation/salvage harvest was the Intermission fire salvage. The salvage sale contract was signed approximately one month after the fire was contained, and there was still smoke on the day of contract signature.

Tinker, et al, 1998 quantifies fragmentation caused by timber harvest and roads on the Bighorn National Forest. That analysis and conclusions are presented in the Forest wide portion of the Forest Plan Revision existing condition assessment, rather than in each geographic area discussion.

Figure 2 shows the relative amounts of suited timber by geographic area. Devil's Canyon has the second smallest percentage of forested area that is currently classified as suitable for timber harvest, at about 12%. This table could be considered an indicator of the relative amount of forested area that is *available* for timber production purposes.

**Figure 2. Amount of Forested Area Available That is Suited Timber, by Geographic Area**

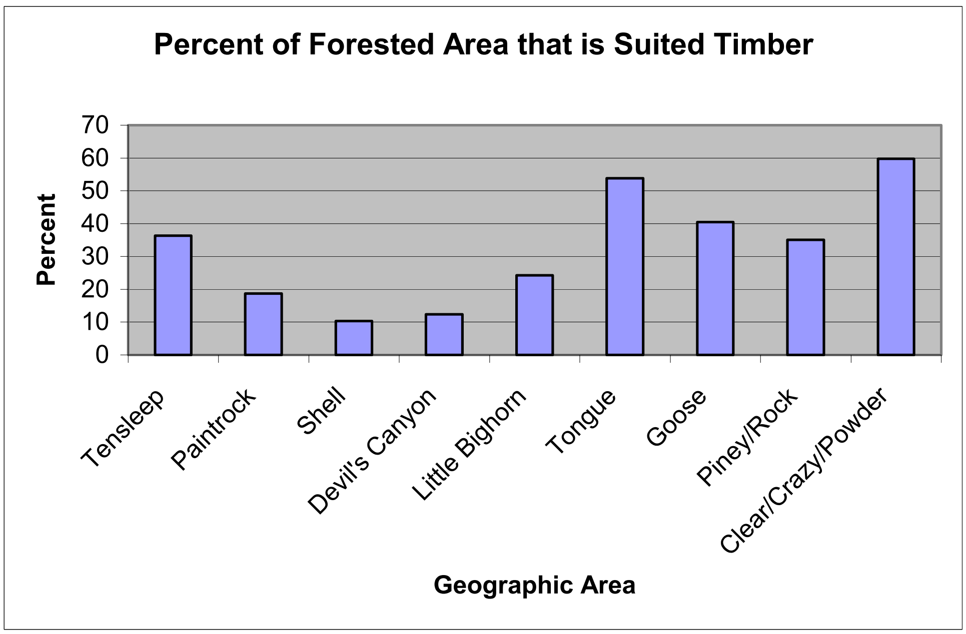



Figure 3 shows the percentage of the suited timber area that has received a final harvest (clearcut, shelterwood removal or seed cut, selection harvests) or stand-replacing fire or blowdown between 1960 and 2000. This is an indicator of the *intensity* of forest successional change, as it indicates how much of the suited land has actually had a stand-replacing event between 1960 and 2000. This is from the RIS activity database and includes the time between January 1, 1960 and February 1, 2000. Each bar is divided into "fire and blowdown" and "timber harvest" to show the relative amounts of each type of disturbance. Devil's Canyon has the highest percentage for both total stand replacement and for the stands replaced through timber harvest.

Figure 4 shows the percentage of all forested lands that has received a final harvest (clearcut, shelterwood removal or seed cut, selection harvests) or stand-replacing fire or blowdown between 1960 and 2000. This is an indicator of the *intensity* of forest successional change, as it indicates how much of the forested area has actually had a stand replacing event between 1960 and 2000. This is from the RIS activity database and includes the time between January 1, 1960 and February 1, 2000. Each bar is divided into "fire and blowdown" and "timber harvest" to show the relative amounts of each type of disturbance.

**Figure 3. Percent of Suited Timber that Received a Stand Replacing Event, 1960-2000**

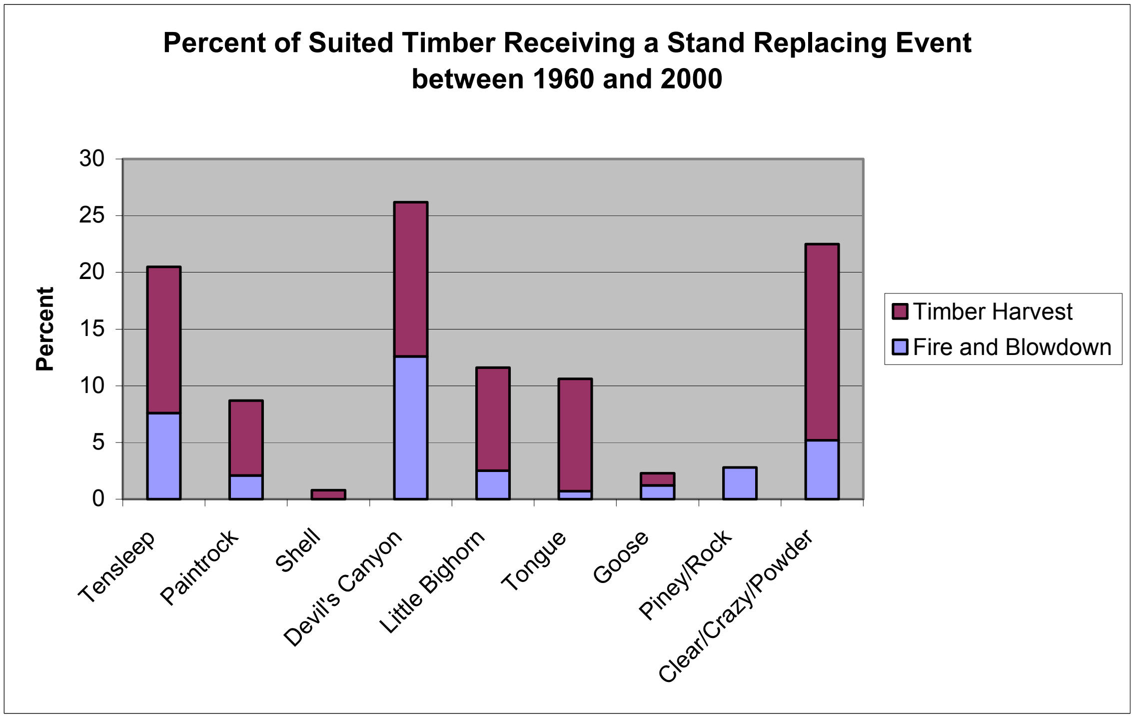
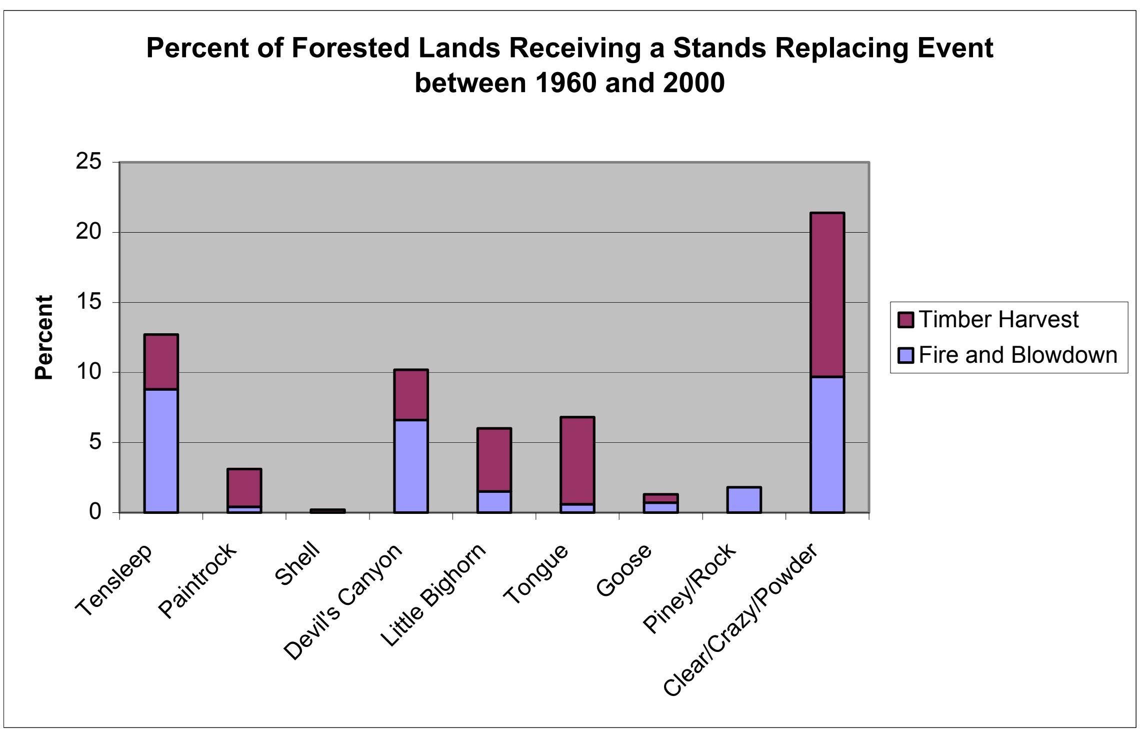



**Figure 4. Percent of All Forested Lands that Received a Stand Replacing Event, 1960-2000**



**Exotic Species**

- Forest-wide issue of non-native grass/forb seed mix for revegetation and erosion control.
- Fish: Eastern Brook trout, brown trout, golden trout, and rainbow trout are popular fishing species, but are not native to the Bighorn NF. Yellowstone cutthroat trout were native to this geographic area, and are being impacted by these species.
- The forest's weed database indicates that Canadian and musk thistle and houndstongue is present in this geographic area. This is not considered to be a complete inventory of weeds in the geographic area. Forest personnel are working closely with livestock permittees and the county weed districts to manage exotic plant species.

## IV. Geology and Geomorphology

Table 3 shows the Landtype Associations (LTAs) within the assessment area. Landtype associations are general descriptions of local geology and topography[5]. A map of the LTAs is in the appendix.

**Table 3. Acres of Landtypes within Devil's Canyon Geographic Area**

| Landtype Description | Acres | % of total |
|---|---|---|
| Glacial cirquelands | 0 | 0 |
| Alpine mountain slopes and ridges | 0 | 0 |
| Glacial/tertiary terrace deposits | 0 | 0 |
| Granitic mountain slopes, gentle | 10,693 | 17% |
| Granitic mountain slopes, steep | 0 | 0 |
| Granitic breaklands | 6813 | 11% |
| Sedimentary breaklands | 12,773 | 21% |
| Sedimentary mountain slopes, limestone/dolomite | 13,788 | 23% |
| Sedimentary mountain slopes, shale/sandstone | 11,572 | 19% |
| Landslide/Colluvial Deposits | 5542 | 9% |
| **Totals:** | **61,181** | **100** |

From Buffalo to the eastern mountain front, Highway 16 traverses Eocene rocks of the Wasatch, at the base of the Bighorn range, which is composed of cobbles of Paleozoic rocks that were deposited as gravels on alluvial fans along the front of the rising Bighorn Range around 55 million years ago. About 6 miles west of Buffalo, the road crosses the Piney Creek thrust fault, which shoved this portion of the central Bighorns over the western margin of the Powder River Basin. The road climbs through a narrow section of steeply inclined Paleozoic limestone and dolomite beds in the hanging wall of the Piney Creek thrust, and then cuts into much older Precambrian "basement" rocks. The Precambrian is composed of extremely ancient metamorphic gneisses that are over 3 billion years old. The earth is 4.7 billion years old, so these rocks are about 2/3 of the age of the planet. US 16 follows Precambrian rocks across the crest of the range to the west side where it again cuts through Paleozoic sedimentary layers along Tensleep Canyon.

### Geologic Hazards

**Table 4. Landslide Prone Acres**

| Geographic Area Name | Acres of Soils Prone to Landslides |
|---|---|
| Devil's Canyon Geographic Area | 9846 |

The landslide map used in this analysis was created from 1:24,000 scale maps obtained from the Wyoming State Geological Survey office in Laramie, WY. Within the Devil's Canyon geographic area there are 9,846 acres of soils prone to landslides. The areas subject to slides are widely distributed in small units throughout the geographic area.

[5] Landtype associations are groupings of landtypes or subdivisions of subsections based upon similarities in geomorphic process, geologic rock types, soil complexes, stream types, lakes, wetlands, and plant association vegetation communities. Names are often derived from geomorphic history and vegetation community. Avers, et al, 1993. See also Table 3, Chapter 1, for hierarchical location of landtype associations.

**Erodibility of the Geographic Area**

**Table 5. Acres of Erodible Geology**

| Geographic Area Name | Acres of Erodible Geology |
|---|---|
| Devil's Canyon Geographic Area | 8198 |

There are approximately 8198 acres of soils within the analysis area classified as having a severe risk for erosion

**Mineral resources**

The following information was copied from a document titled, "Mineral Report-Tie Hack Campground Withdraw" prepared by Ronald L. Baer, Regional Geologist. The report is dated 3/5/2001 and can be found in the Tie Hack special uses file.

The area does not have a history of mining or mineral development. Potential diamondiferous kimberlite deposits may exist within some of the old intrusive bodies of the Bighorn Mountains, however none have been found to date. Presently, only kimberlitic indicator minerals have been identified in Precambrian and Paleozoic conglomerates along the Bighorn Mountains approximately 80 miles to the southwest of the tie hack reservoir.

**Locatable Minerals**
No known locatable mineral deposits (gold, silver, etc) are known to exist within the area. No information was found in the records or literature indicating past or present discoveries of locatable mineral deposits. From a record search, it does not appear there were any past mineral locations recorded in the area. There were no indications of dikes or other younger intrusive bodies, suggesting the presence of kimberlite deposits, found during the field mapping. In addition, no signs or indications of other mineralization were observed during the fieldwork.

**Leasable Minerals**
No known leasable mineral deposits of coal, potassium, sodium, phosphate, oil, gas, oil shale, or tar sand are known to exist within the withdrawal tract. Commercial deposits of oil and gas are present in various formations east of the Bighorn Mountains in the Powder River Basin. No oil and gas drilling, exploration, or production has occurred within the area of tie hack reservoir.

**Salable Minerals**
There are no known salable mineral deposits within the withdrawal tract boundary. This includes aggregate and dimension stone deposits.

There are no known mineralized areas adjacent to the withdrawal tract. There has been a small amount of gold produced from the Cambrian Flathead Sandstone in the Kelly Creek area (T50N, R83W), a few miles southeast of the subject lands (Hausel 1989 p. 40). Some salable aggregate sources have been developed within a 10-mile radius of the withdrawal tract for road and reservoir construction use.

The potential for locatable, leasable, and saleable mineral resources within the tract area is considered low. No deposits of locatable minerals are found within the tract and the potential for economic resources, including diamonds, is considered low. There are no known leasable mineral resources within the area, thus giving the area a low potential for occurrence of leasable minerals. The salable mineral potential is rated low because of the small size of the deposit within the tract and the presence of other larger developed source deposits within a reasonable proximity of the withdrawal tract.

**Hydrologic Disturbance factors**

Disturbance is defined as a relatively discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability or the physical environment (White and Pickett 1985). When quantifying the range of variation within an ecosystem, it is better to do so with an absolute measure that stresses the physical characteristics of disturbance and the mechanisms of ecosystem response, compared to an approach that focuses solely on the bounds of variation.

In general, disturbance varies along topographic gradients, as do other physical factors like insolation, temperature, and precipitation. Some disturbances are associated with particular geological settings and substrates; these include landslides and earthquakes. Others are biological in origin and include burrowing animals, grazers, and ants, beavers, and insects or pathogens. Most ecosystems experience not only several kinds of disturbance, but a range of disturbance impacts within each kind.

Not all disturbances are equivalent. Disturbances differ in six categories of descriptors: kind, spatial characteristics, temporal characteristics, specificity, magnitude, and synergisms. Taken together, the attributes of all the disturbances occurring in a system, the interactions between them, and their linkages with biotic and abiotic factors, define the disturbance regime.

**Table 6. Dominant Natural Hydrologic Disturbance Factors**

| Disturbance Factors: Streams | Disturbance Factors: Riparian Areas | Disturbance Factors: Soils |
|---|---|---|
| Floods | Floods | Wind throw |
| Beavers | Ice Flows | Debris Flows |
| Drought | Fire | Fire |
| Erosion | | Erosion |

## V. Soils and Topography

### Erosional processes

Sediment either originates from surface erosion of exposed mineral soil or from mass movements such as landslides, debris torrents, slumps and earth flows. Sediment entering streams is delivered chiefly by mass movements and surface erosion processes. In this area, the dominant sources of erosion are derived from roads and concentrated livestock grazing in riparian areas.

Failure of stream crossings, diversions of streams by roads, washout of road fills, and accelerated scour at culvert outlets are important sources of sedimentation in streams within roaded geographic areas. The most common causes of road-related mass movements are improper placement and construction of road fills, inadequate road maintenance, insufficient culvert sizes, very steep hillslope gradients, placement or side cast of excess materials, poor road location, removal of slope support by undercutting, and alteration of slope drainage by interception and concentration of surface and subsurface water.

Generally, in grazed areas, stream channels contain more fine sediment, streambanks are unstable, and banks are less undercut than is the case for streams in ungrazed areas.

### Range of variability in soil conditions

The range of soil conditions on managed forested lands has changed dramatically over the last 50-80 years. These changes are apparent in increases in soil bulk densities, lower productivity, and accelerated soil erosion. In general, where management has occurred on sensitive soils, or where mitigation measures has not occurred, there is a wider range of conditions than is found on unmanaged soils. For example, the range of soil bulk densities in a timber harvest unit is shown to vary widely depending upon slope, soil moisture, and logging intensity. This can be compared to soils outside the unit where soil bulk densities are generally less and are less variable. The same pattern holds true for areas grazed by livestock.

Table 7 shows the soil types that occur in the Devil's Canyon geographic area and the amount of the analysis area comprised of each soil type. A description of each soil type can be found in the Project File. Forage production is displayed in Table 7 as a way to display the natural range of soil productivity within the analysis area (Nesser, 1976).

**Table 7. Acres of Soils within Geographic Area**

| Soil Identification Number | Acres | Productivity as Measured by Forage Production (#/acre) |
|---|---|---|
| 10 | 5498 | 500-700 |
| 11 | 0 | 500-700 |
| 12 | 54 | |
| 13 | 0 | Na |
| 14 | 9766 | 500-700 |
| 15 | 0 | 500-1,800 |
| 16 | 351 | 3,000-3,500 |
| 17 | 0 | |
| 18 | 0 | 1,500-1,800 |
| 19 A and B | 0 | 500-700 |
| 20 | 0 | |
| 21 | 996 | |

| Soil Identification Number | Acres | Productivity as Measured by Forage Production (#/acre) |
|---|---|---|
| 22 | 0 | 1,200-1,700 |
| 23 | 999 | |
| 24 | 418 | 1,600-2,400 |
| 25 | 5207 | 1,500-1,800 |
| 26 | 0 | 600-1700 |
| 27 | 3422 | 1,600-2,400 |
| 28 | 0 | |
| 29 | 3452 | 1,600-2,400 |
| 30 | 6094 | |
| 31 | 6062 | 500-700 |
| 32 | 4597 | 500-700 |
| 33 | 0 | 600-800 |
| 36 | 0 | 500-800 |
| 37 | 0 | Na |
| 38 | 0 | 500-700 |
| 39 | 0 | 600-1,700 |
| 40 | 0 | 500-700 |
| 41 A and B | 0 | 1,500-1,800 |
| 43 | 0 | 500-700 |
| Water | 0 | Na |

**Risk to soil resources including soil loss or compaction**

The range of soil conditions on managed forested lands has changed dramatically over the last 50-80 years. These changes are apparent in increases in soil bulk densities, lower productivity, and accelerated soil erosion. In general, where management has occurred on sensitive soils, or where mitigation measures has not occurred, there is a wider range of conditions than is found on unmanaged soils. For example, the range of soil bulk densities in a timber harvest unit is shown to vary widely depending upon slope, soil moisture, and logging intensity. This can be compared to soils outside the unit where soil bulk densities are generally less and are less variable. The same pattern holds true for areas grazed by livestock.

## VI. Hydrology and Water Quality

The analysis area encompasses the Porcupine Creek fifth level watershed for a total of approximately 61,000 acres. The watersheds range in elevation from just over 7,000 feet at the Forest boundary to over 12,000 feet at the upper portion of the Porcupine Creek drainage.

**Table 8. 6th Field Watershed Data within Planning Area**

| 6th Field Watershed Name | 6th Field Watershed Number | Perennial Stream Miles | Intermittent Stream Miles | FS WS Acres | Other WS Acres | Total WS Acres |
|---|---|---|---|---|---|---|
| Bear Creek | 100800100204 | 0 | 13 | 2600 | 0 | 2600 |
| Dry Bear Creek | 100800100206 | 0 | 1 | 238 | 0 | |
| Crystal and Alkali Creek | 100800100207 | 8 | 28 | 7269 | 0 | 7269 |
| Five Springs Creek | 100800100302 | 5 | 10 | 4737 | 0 | 4737 |
| Willow Creek | 100800100303 | 0 | 1 | 359 | 0 | 359 |
| Cottonwood Creek | 100800100304 | 5 | 8 | 3472 | 306 | 3778 |
| Porcupine Creek | 100800100311 | 42 | 71 | 31334 | 0 | 31334 |
| Porcupine Creek | 100800100312 | 6 | 5 | 3685 | 0 | 3685 |
| Trout Creek | 100800100313 | 10 | 11 | 7503 | 0 | 7503 |
| **Totals:** | | **76** | **148** | **61197** | **306** | **58665** |

### Precipitation

The majority of the annual precipitation in this geographic area comes in the form of snowfall. In the summer, there is the risk of high intensity thunderstorms that result in flashy runoff. This high-intensity rainfall often exceeds the local infiltration rates and is directly related to the amount of runoff and the rapid response of the stream. Local surface erosion and channel erosion directly affect the water quality of the surface runoff.

### Human Impacts Upon Water Quality

Cattle and wildlife grazing in riparian areas is having a detectable effect on local water quality (bacteria/nutrients). Cattle are also trampling stream banks, increasing downstream sedimentation. This results localized erosion and sedimentation as well as a direct change in channel form. Flow is moderately affected by localized soil compaction. Timing of flows is not affected by domestic stock.

Due to the relatively high road densities, there are detectable influences on water yield and timing. The effects of roads on water quality are highest during periods of high precipitation and runoff. Roads are a major source of sediment because of the geology, road densities, location, and proximity to streams.

Influences of Wildfire on Freshwater Aquatic Ecosystems

Wildfire has been a common agent of change in the assessment area since the Mesozoic. Present aquatic systems have evolved in response to, and in accordance with, fire. The effects of fire on aquatic systems may be direct and immediate (i.e., increased water temperature) or indirect occurring over an extended period. Ultimately fire results in a natural mosaic of habitats and populations. The persistence of species in freshwater aquatic systems is linked to adaptation to periodic perturbations such as those resulting from wildfire. In fact, the metapopulation concept is focused on the periodic loss of habitat patches (local extirpations) and subsequent re-invasion by individuals from neighboring patches (dispersal). In an ecologically functioning stream network, which provides sufficient stream connectivity for species refuge, reestablishment of fishes is generally rapid. The long-term effects of fire usually result from erosion. Erosional processes potentially change channel morphology, sediment composition and concentration, food availability, and recruitment and distribution of large woody debris. The intensity and scale of these effects are related to the size and intensity of the fire, geology, topography, and size of the stream system, and amount, intensity, and timing of subsequent precipitation events. Physical properties of soil that influence water retention are altered by heating, and in some cases, soils become water repellent after sever burns. The amount of vegetation remaining in a watershed after a fire directly influences runoff and erosion by physically mediating the force of precipitation on soil surfaces, altering the evapotranspiration cycle, and providing soil stability through root systems. Runoff rate and pattern and subsequent erosion potential are directly affected by the amount of organic debris left in the watershed. Revegetation of burned areas is influenced by the intensity and duration of a fire, and the amount and type of new vegetation are related to changes in water yield and nutrient retention in the watershed. Erosional effects of fire generally peak within 10 years following the event.

Influence of Human Activities on Aquatic Systems

By the late 1880's, human activities had begun to alter the assessment area landscape, including the hydrologic function of rivers and streams and features that served as important habitat for aquatic life. By 1860, livestock grazing had reduced extensive willow coverage along many streams to scattered patches. Water withdrawals for irrigation were also developed early and rapidly. Constructing drains, ditches, and dikes in valley bottoms and lowlands reduced terrestrial-aquatic interaction. Dams also altered the natural basin hydrology and sediment transport capacity. In short, the ecological integrity of streams, lakes, and wetlands was significantly compromised by the mid 1900's. Increasing human populations, downstream water demands, and agriculture accelerated greatly following WWII. Individually, and in combination, these activities continue to fragment and compromise the remaining hydrologically connected and vegetated reaches of streams.

Influence of Human Activities on Water Quality

The extent and intensity of land development and land-use activities within the area have increased during the past century. Environmental disturbances from non-mechanized, agriculturally based settlements have evolved into perturbations associated with urban and suburban development. Non-point source pollution may be the most problematic cause of water quality deterioration because the origin of perturbation is often difficult to identify and control. Residential development around or near lakes, reservoirs, and wetlands is directly associated with much of this non-point source pollution. Analysis of lakes in the area shows that they have very low buffering capacities due the granitic geology. The low buffering capacity of the lakes makes them susceptible to acidification due to atmospheric acid deposition.

Influence of Farming and Grazing on Water Quality

Grazing is a major non-point source of channel sedimentation. Grazed watersheds typically have higher stream sediment levels than ungrazed watersheds. Increased sedimentation is the result of grazing effects on soils (compaction), vegetation (elimination), hydrology (channel incision, overland flow), and bank erosion (sloughing). Sediment loads that exceed natural background levels can fill pools, silt spawning gravels, decrease channel stability, modify channel morphology, and reduce survival of emerging salmon fry. In addition, runoff contaminated by livestock wastes can cause an increase in potentially harmful bacterial. Compared to ungrazed sites, aquatic insect communities in stream reaches associated with grazing activities often are composed of organisms more tolerant of increased silt levels, increased levels, of total alkalinity and mean conductivity, and elevated water temperatures.

Influence of Timber Harvesting on Water Quality

Timber harvest activities are one of the major land management activities within the area. The mechanical processes involved in timber harvest and associated road construction, in conjunction with natural conditions, influence the level of disruption or disturbance within watersheds. Negative effects tend to increase when activities occur on environmentally sensitive terrain with steep slopes composed of highly erodible soils that are subject to high climatic stresses.

Soil and site disturbance that inevitably occur during timber harvest activities are often responsible for increased rates of erosion and sedimentation, modification and destruction of terrestrial and aquatic habitats, changes in water quality and quantity, and perturbation of nutrient cycles within aquatic ecosystems. Physical changes affect runoff events, bank stability, sediment supply, large woody debris retention, and energy relationships involving temperature. All of these changes can eventually culminate in the loss of biodiversity within a watershed. All of these changes can eventually culminate in the loss of biodiversity within a watershed.

Increased delivery of sediments, especially fine sediments, is usually associated with timber harvesting and road construction. As the deposition of fine sediments in salmonid spawning habitat increase, mortality of embryos, alevens, and fry rises. Erosion potential is greatly increased by reduction in vegetation, compaction of soils, and disruption of natural surface and subsurface drainage patterns. Generally, logged slopes contribute sediment to streams based on the amount of bare compacted soils that are exposed to rainfall and runoff. Slope steepness and proximity to channels determine the rate of sediment delivery.

Influence of Roads on Water Quality

**Table 9. Number of Stream Crossings in Planning Area**

| Geographic Area | No. of Stream Crossings | No. of Stream Crossings/sq mile |
|---|---|---|
| Devil's Canyon Planning Area | 86 | 0.90 |

Roads contribute more sediment to streams than any other land management activity, but most land management activities such as mining, timber harvest, grazing, recreation, and water diversions are dependant on roads. The majority of sediment from timber harvest activities is related to roads and road construction and associated increased erosion rates. Serious degradation of fish habitat can result from poorly planned, designed, located, constructed, or maintained roads. Roads can also affect water quality through applied road chemicals and toxic spills.

Roads directly affect natural sediment and hydrologic regimes by altering stream flow, sediment loading, sediment transport and deposition, channel morphology, channel stability, substrate composition, stream temperatures, water quality, and riparian conditions within a watershed. Road related mass movements can continue for decades after the roads have been constructed. Such habitat alterations can adversely affect all life-stages of fishes, including migration, spawning, incubation, emergence, and rearing.

Poor road location, concentration of surface and sub-surface water by cross slope roads, inadequate road maintenance, undersized culverts, and sidecast materials can all lead to road related mass movements. Sediment production form logging roads in granitics of Idaho was 770 times higher than in undisturbed areas, approximately 71 percent of the increased sediment production was due to mass erosion and 29 percent was due to surface erosion.

In granitic landtypes, sedimentation is directly proportional to the amount of road mileage. For instance, 91 percent of the annual sediment production by land use activities in the South Fork of Salmon River has been attributed to roads and skid trails. Research has determined that roads in the Idaho batholith increased surface erosion by 220 times the natural rates per unit area. Roaded and logged watersheds in the South Fork of Salmon River drainage also have significantly higher channel bed substrate embeddedness rations than undeveloped watersheds.

Road/stream crossings can also be a major source of sediment to streams resulting from channel fill around culverts and subsequent road crossing failures. Plugged culverts and fill slope failures are frequent and often lead to catastrophic increases in stream channel sediment, especially on old abandoned or unmaintained roads. Unnatural channel widths, slope, and streambed form occur upstream and downstream of stream crossings, and these alterations in channel morphology may persist for long periods of time. Channelized stream sections resulting from riprapping of roads adjacent to stream channels are directly affected by sediment from side casting, snow removal, and road grading; such activities can trigger fill slope erosions and failure. Because improper culverts can reduce or eliminate fish passage, road crossings are a common migration barrier to fishes.

Influence Of Non-Native Fish Species Introductions

The introduction of non-native fishes and aquatic invertebrates has had an important influence on species assemblages and aquatic communities throughout the geographic area. Currently at least seven species, subspecies, or stocks of fish have been introduced or have moved into habitats where they did not occur naturally. Most introductions have been made with the intent of creating or expanding fishing opportunities and were initiated in earnest as early as the late 1800's. Stocking of mountain lakes with cultured stocks of cutthroat, brook, and rainbow trout has been extensive. Many lakes that were historically barren of fish were capable of sustaining them, but lack of spawning habitat or isolation from colonizing populations prevented natural invasion. A variety of species such as lake trout, rainbow trout, golden trout, brown trout, and splake were introduced to diversify angling opportunities, create trophy fisheries, and to provide forage for potential trophy species. Cultured strains of rainbow trout have been widely used to sustain put-and-take fisheries in lakes and rivers where angler harvest or habitat degradation is too excessive to rely on natural reproduction.

Such introductions have led to the elimination of some native populations, while further fragmentation and isolation of other populations have left them more vulnerable to future extirpation. Although instructions have provided increased fishing opportunities and socioeconomic benefits, they have also led to catastrophic failures in some fisheries and expanded costs to management of declining native stocks.

Consequences of introducing non-native species are not limited to a few interacting species. Effects frequently cascade through entire ecosystems and compromise structure and ecological function in ways that rarely can be anticipated. There is a growing recognition that biological integrity and not just species diversity is an important characteristic of aquatic ecosystem health. The loss or restriction of native species and the dramatic expansion of non-native species leave few systems that are not compromised.

Influence of General Recreational Activities

Mountain lakes, especially those in wilderness areas may be the most susceptible aquatic systems to the negative effects of recreation. The inherent sensitivity of a lake to pollutants influences its susceptible to water quality degradation. Sensitivity varies among lake types. Large, deep lakes with a large inflow may be least susceptible to water quality degradation because pollutants are diluted by large volumes of water and settle along with particulate matter. Lakes that are small and shallow, or that have a low inflow, are more sensitive to pollutants. Likelihood of pollutant-loading increases if soil, geologic, or hydrologic characteristics of a watershed favor the transport of pollutants to the lake.

Where visitor use is high, trampling associated with foot traffic can affect vegetation along lakes and streams through direct mechanical action and indirectly through changes in soil. Resistance to trampling depends on plant life form; large and broad-leaved plants are most susceptible, and grasses generally are most resistant. Loss of vegetation from shorelines, wetlands, or steep slopes can cause erosion and pollution problems.

Influence of Habitat Fragmentation and Simplification

The physical environment and the natural and human-caused disturbances to that environment profoundly influence the structure composition, and processes defining aquatic ecosystems. Aquatic habitat fragmentation (impassable obstructions, temperature increases, and water diversion) and simplification (channelization, removal of woody debris, channel bed sedimentation, removal of riparian vegetation, and water flow regulation) have resulted in a loss of diversity within and among native fish populations. The fragmentation of aquatic systems occurs though natural, dynamic processes as well. Over geologic time river basins become connected or isolated. Within the assessment area, geologic processes that influence the distribution of species and subspecies have isolated river basins. Natural populations of Yellowstone cutthroat trout, for example, are found in very small isolated pockets of remote streams on the Forest.

## VII. Aquatic Species and Their Habitat

### TES (species at risk) and their habitats

The Yellowstone cutthroat trout (Oncorhynchus clarki bouvieri) is the native trout of the Bighorn Mountains, although it is generally considered unlikely they were native to the Powder River watershed. Individual populations of the Yellowstone subspecies have evolved numerous life-history characteristics in response to the diverse environments in which they have been isolated since the last glacial retreat. Anthropogenic activities have resulted in a substantial reduction in the historical distribution of this subspecies, and many unique local populations have been extirpated. As a result, the Yellowstone cutthroat trout has been designated as a species of special concern – class A by the American Fisheries Society.

Historical Distribution

The Yellowstone cutthroat trout is more abundant and inhabits a larger geographical range in the western US than any other non-anadromous subspecies of cutthroat trout. Yellowstone cutthroat trout were historically found in the Yellowstone River drainage in Montana and Wyoming and in the Snake River drainage in Wyoming, Idaho, Utah, Nevada, and Washington.

Current Status and Distribution

The current distribution of Yellowstone cutthroat trout in the Bighorn Mountains can be found in the project file. There are known populations of genetically pure Yellowstone cutthroat trout on both the east and west sides of the Forest. Most populations are small and isolated in short reaches of remote streams. All populations are at risk of introgression from non-native species.

Life History Characteristics

Low genetic diversity among populations of Yellowstone cutthroat trout may reflect a substantial compression of the geographic range of the subspecies during the Pleistocene. In contrast, life-history strategies across the range, and even within individual assemblages of Yellowstone cutthroat trout, are highly diversified. The variability in life-history strategies may represent a complex response to environmental variability operating at different temporal and spatial scales.

Habitat Relationships

Yellowstone cutthroat trout occupy diverse habitats. Lacustrine populations inhabit waters ranging in size from small beaver ponds to large lakes. Fluvial populations were historically present in streams ranging in size from large rivers to small first-order tributaries with mean widths of one meter and less.

The subspecies is well adapted to relatively cold, harsh environments. Although Yellowstone cutthroat trout are associated with cold-water habitats, researchers report that water temperatures within portions of the historical range exceeded 26 degrees C. Most large river warm water populations have been extirpated; however, several populations have been documented in geothermically heated streams in Yellowstone National Park.

Key Factors Influencing Yellowstone Cutthroat Trout

Introgression with introduced salmonids is clearly a key factor in the decline of Yellowstone cutthroat trout. Hybridization resulting from introductions of rainbow trout and nonnative cutthroat trout is believed to be a primary cause in the decline of this subspecies. Hybrids are developmentally successful, and progeny may appear as morphological and meristic intermediates between parental types or virtually identical to a singe parental type. Consequently, verifying genetic integrity with morphological data alone is virtually impossible.

Habitat degradation is a second factor important in the decline of this trout. Activities such as dam construction, water diversions, grazing, mineral extraction, road construction, and timber harvest have substantially degraded environments throughout the range of Yellowstone cutthroat trout.

Recreational use can also be a significant source of disturbance. Anthropogenic activities such as road construction have resulted in barriers to migration, reduced flows, sediment deposition, groundwater depletion, stream bank instability, erosion, and pollution. Efforts to curtail human activities and restore degraded stream segments are increasing, but habitat degradation continues.

Effects of livestock grazing on riparian habitats are well documented. In the range of the Yellowstone cutthroat trout, researchers have reported that intensive livestock grazing has caused degradation of riparian areas and subsequent stream bank sloughing, channel instability, erosion, and siltation. Alterations are broadly distributed. Degraded water quality and unscreened irrigation ditches contribute to the problems associated with water diversions.

Angling is another factor that may play an important role in the status of remaining Yellowstone cutthroat trout. Yellowstone cutthroat trout are extremely vulnerable to angling, and angler harvest has contributed to substantial declines in population abundance throughout the historical range of the subspecies.

Habitat Conditions and Trends for TES

The effects of land use on aquatic systems are often manifest through substantive changes in hydrology and morphology of streams and rivers. Such changes can have serious ramifications for aquatic organisms. Streams and adjacent environments are generally the most biologically productive areas within watersheds, and are often the sites of greatest conflict in resource management.

Research has have documented the detrimental effects of land management on aquatic habitats, and subsequent effects on aquatic species. This has spurred a closer look at the connections between land use, stream-channel characteristics, and habitat conditions.

The variables used to describe stream channel characteristics at the geographic area scale must be sensitive to land-use practices and be important indicators of habitat quality. The following 12 variables are suited for analysis and of those, four have biological implications. The indicators used are listed in Table 10.

**Table 10. Aquatic Habitat Measurement Indicators**

| Aquatic Habitat Indicators | Measurement Criteria |
|---|---|
| Large Pool Frequency | Number of pools with maximum depth > 0.8 m and surface area > 20 $m^2$ per mean reach riffle width. |
| Pool Frequency | Number of pools per mean reach riffle width. |
| Fraction Slow Water | Fraction of total reach length consisting of pools and glides |
| Mean Pool Depth/Width | The mean of the ratio of maximum depth to width for all pool channel units in a reach. |
| Variance Pool Depth/Width | Variance of the ratio of max depth to width for all pools in a reach. |
| Mean Riffle Depth/Width | Mean of the depth to width for all riffles in a reach. |
| Variance Riffle Depth/Width | Variance of the ratio of depth to width for all habitat units in a reach. |
| Wood Frequency | The number of pieces of wood per average riffle width. |
| Wood Aggregate Frequency | The number of wood aggregates per average riffle width. |
| Embeddedness | Substrate is classified as being embedded if 35 percent of the interstices are filled with fine sediment. |
| Bank Stability | Fraction of the reach that is estimated being stable. |
| Surface Fines | Reach mean of the areal fraction of each pool tail and low-gradient riffle covered in sediment < 6mm in diameter. |

## VIII. Air Quality and Visibility

Sulfur Dioxide ($SO^2$), nitrogen dioxide ($NO^2$), and ozone ($O_3$) are gaseous pollutants that can harm vascular vegetation. Effects include injury of plant leaves or needles, reduced growth, and increased susceptibility to insects and disease. Generally, because $SO^2$ and $NO^2$ quickly convert to other compounds, they are only a threat to vascular vegetation in the immediate vicinity of the pollution source. Ozone, on the other hand, can affect vegetation far downwind of the source. Lichens may also be affected by $SO^2$ and ozone. Reported effects include changes in community composition and sulfur accumulation.

$SO^2$ and $NO^2$ convert to sulfate and nitrate, respectively. Sulfate and nitrate are acidic pollutants that can be deposited in dry or wet (snow or rain) form and can acidify soils and surface waters. Nitrate deposition can also affect soil nutrient cycling and plant community composition. Particulate matter, volatile organic compounds, $SO^2$ and $NO_X$ all contribute to visibility impairment. The impairment can be in the form of a cohesive visible plume, or the pollutants can be dispersed, forming a diffuse regional haze.

**Summary of air quality and visibility or other air resource concerns**

The only wilderness in the Bighorn National Forest is Cloud Peak, a Class II air quality area. Visibility and lake chemistry data have been collected on the forest, and ozone and deposition data have been collected at nearby sites. Table 11 lists the air quality data that have been collected on the Bighorn.

**Table 11. Air Quality Data on the Bighorn National Forest**

| Data Source | Parameter | Dates |
|---|---|---|
| USFS | Lake Chemistry (long-term) | 1994-Present |
| USFS | Lake Chemistry(synoptic monitoring) | 1992-1993 |
| USFS | Visibility (Camera only) | 1995-Present |

The Wyoming Department of Environmental Quality (WDEQ) District 4 engineer compiled a 1997 summary of permitted emissions for all major and minor sources in Big Horn, Hot Springs, and Washakie counties. Permitted emissions are the pollution limits contained in the source permit. Often sources emit less than their permitted limits because pollution controls work better than anticipated or lack of demand for their product curtails the number of operating hours. Permitted emissions are shown in Table 12.

**Table 12. Permitted emissions (tons/year) in selected counties**

| County | Sulfur Dioxide ($SO^2$) | Nitrogen Oxides ($NO_X$) | Volatile organic compounds (VOC) | Particulate Matter (PM) |
|---|---|---|---|---|
| Big Horn | 2568 | 546 | 69 | 510 |
| Hot Springs | 1709 | 33 | 588 | 0 |
| Washakie | 1591 | 1330 | 288 | 170 |

The city of Sheridan is in non-attainment for the PM10[6] standard under the North American Air Quality Standards. Under the 'conformity' section of the Clean Air Act, federal agencies such as the USDA Forest Service are prohibited from conducting or approving activities that could impede the clean up of these areas. Consequently, Forest Service activities, such as prescribed fire, that

[6] Particles with a diameter less than or equal to 10 micrometers.

produce pollutants in or near Sheridan may be subject to special restrictions, documentation requirements, and or mitigation.

Ozone data have not been collected at the Bighorn NF; however, Yellowstone National Park data are likely representative of conditions on the Forest. The annual 1-hour maximum ozone concentrations measured at the park are well below the primary ozone NAAQS of 120 parts per billion (ppb). The growing season 7-hour mean and SUM60 (sum of all hourly concentrations greater than 60 ppb) are more relevant to assessing impacts on vegetation than the 1-hour maximum. The Yellowstone NP values for these statistics are far below those believed to result in foliar injury or growth effects in vegetation. In conclusion, ozone concentrations at Yellowstone NP, and probably at the Bighorn NF are not currently high enough to affect human hearth or vegetation. It is not likely that ozone concentrations will increase significantly in the future.

**Table 12. 1988-1994 ozone data for Yellowstone NP (ppb)**

| | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 |
|---|---|---|---|---|---|---|---|
| 1-hr max | 98 | 71 | 61 | 64 | 75 | 62 | 72 |
| Ave daily mean | 37 | 33 | 31 | 35 | 36 | 35 | 39 |
| Growing Season 7-hr mean | 44 | 45 | 34 | 42 | 42 | 41 | 47 |
| SUM60 (ppb/hr) | 11376 | 6658 | 483 | 1169 | 6315 | 363 | 6015 |

On-site deposition data are not available. The closest NADP site is at Little Bighorn Battlefield National Monument in Montana (approx 70 km from Sheridan). Nitrate and sulfate concentration data from the site are probably representative of precipitation chemistry on the forest. Deposition totals are dependent on both precipitation chemistry and precipitation amount. The precipitation chemistry data from the Monument can be used with precipitation amount data from Cloud Peak Wilderness to estimate sulfate and nitrate deposition on the Forest.

Camera data have been collected on the forest since 1995. Summer season slides were evaluated to provide a rough estimate of the standard visual range (SVR). SVR is inversely related to light extinction and can be interpreted at the farthest distance a large, black feature can be seen under prevalent atmospheric conditions. The theoretical maximum SRV is 391 km. The slides suggest that visibility in the Bighorn NF on the best days is 327 km.

The Wyoming Department of Game and Fish conducted sporadic lake chemistry sampling in and near the Bighorn NF between 1984 and 1991. The USDA Forest Service conducted synoptic sampling of 35 lakes in the Cloud Peak Wilderness in 1992 and 1993. The surveys identified a number of lakes in the wilderness with acid neutralizing capacity (ANC) below 100 micro equivalents per liter (µeq/l), indicating the lakes are sensitive to acid deposition. In fact, many of the lakes are extremely sensitive, with ANC below 25 µeq/l. The Cloud Peak Wilderness had a higher percentage of sampled lakes with acid sensitivity than the Collegiate Peaks, Eagles Nest, Mount Evans, Weminuche, or San Juan wildernesses in Colorado.

Two lakes in the Cloud Peak Wilderness, Emerald and Florence, were selected for long-term monitoring. While monitoring has not been conducted long enough to detect trends, data collected from 1994 through 1997 have consistently shown that the lakes are acid-sensitive (low buffering capacity). Data have not been collected for other AQRV's; however, a list of plant species with known sensitivity to air pollution has been developed for the Cloud Peak wilderness.

**Air Quality Trends**

A review of the 1996 actual emissions from counties within 100 km of the Bighorn NF shows the major stationary source categories that are the largest contributors of air pollutants near the forest. The largest contribution of $SO^2$ emissions is from oil and gas production/distribution, followed by electric services, then petroleum refining, then chemical production. The largest contribution of Nox emissions is from oil and gas production/distribution, followed by electric services. The largest contribution of VOC emissions is from oil and gas production/distribution, followed by petroleum refining, then electrical services. The greatest contribution of particulate matter is from coal and lignite mining.

Other than statewide information, there are no data on emission or source category trends near the Bighorn NF.

A number of activities and industries emit air pollutants that can affect the air quality and resources on National Forests. Examples include power plants, pulp and paper mills, motor vehicles, wildfire, prescribed burning, oil and gas, and mining. Actual emissions information for major stationary sources (those that emit more than a threshold amount of at least one pollutant) is entered into the US Environmental Protection Agency AIRS database by the Wyoming DEQ on an annual basis. Actual 1996 emissions, by country, from the stationary source categories in Wyoming responsible for the greatest amount of pollution were compiled from an AIRS database retrieval of February 1998, and are shown in table 13. Note that emissions from most minor stationary sources and all non-stationary sources are not included and may comprise a significant portion of total statewide emissions.

**Table 13. Actual 1996 emissions (tons/yr) by source type for Counties near the Bighorn National Forest**

| County | Source Type | Sulfur Dioxide ($SO^2$) | Nitrogen Oxides ($NO_X$) | Volatile organic compounds (VOC) | Particulate Matter (PM) |
|---|---|---|---|---|---|
| **Bighorn** | Oil and Gas | 1327 | 103 | 37 | 0 |
| | Bentonite | 0 | 13 | 0 | 7 |
| | Clay and related minerals | 0 | 46 | 0 | 0 |
| | Beet sugar | 0 | 38 | 0 | 0 |
| | Gypsum products | 0 | 40 | 0 | 0 |
| | Nonmetallic mineral products | 0 | 54 | 0 | 0 |
| **Sheridan** | Oil and gas | 0 | 0 | 22 | 0 |
| | Hospitals | 47 | 46 | 0 | 0 |
| **Washakie** | Bentonite | 0 | 10 | 0 | 0 |
| | Beet sugar | 11 | 79 | 0 | 0 |
| | Metal cans | 0 | 0 | 105 | 0 |
| | Oil and gas | 460 | 1150 | 146 | 0 |

## IX. Climate

The climate in the survey area is that of a highland area surrounded by a midaltitude steppe. This surrounding area is an interior, midaltitude desert and steppe region that mountains protect from invasions of maritime air masses. It is dominated by continental tropical airmasses in summer and by continental polar air masses in winter. The annual temperature range is wide; summers are hot (90 to 105 degrees F) and winters are cold (-20 to –30 degrees F). The Bighorn Mountains make up the highland areas. The range in temperature is less in this area; summers are generally cool (75-85 degrees F). Also, precipitation is higher and is more uniform throughout the year.

In winter, cold airmasses from Canada bring strong northerly and northwesterly winds, low temperatures, and snow. Warm winds from the west and southwest often follow the pasge of these fronts and moderate the weather. Airmasses from the Pacific Ocean and the Gulf of Mexico rarely reach the survey area. Upslope conditions that cause precipitation occur frequently in winter and spring on the eastern side of the Bighorn Mountains. In summer, local thunderstorms that move in a northeasterly direction occur in the mountains. Tornadoes have occurred in scattered locations. The average annual temperature varies from 47 degrees F at Hyattville to 34 degrees at Burgess Junction and Dome Lake. Generally, the mean annual air temperature decreases about 3 degrees per 1,000 feet increase in elevation. Recorded extreme temperatures are –42 degrees and 99 degrees at Hunter Ranger Station and –42 and 90 degrees at Dome Lake. The growing season at these elevations is about 50 to 55 days. July is the warmest month and is marked by an average daily high temperature of about 70 degrees; January is the coldest month and is marked by an average daily minimum temperature of about 0 degrees. Freezing temperatures can occur in any month of the year.

Annual precipitation ranges from about 10 inches to more than 40 inches. Commonly, one-half to two-thirds of the annual precipitation is snow. The wettest months, in order, are June, May, April, and September. The driest are December, January, and February. Generally, the distribution of precipitation from month to month is more nearly uniform at the higher elevations. The western side of the Bighorn Mountains receives less precipitation than the eastern side because it lies in the rain shadow of the Absorka Mountains, 75 miles to the west, and because precipitation caused by upslope conditions is less frequent. Average snow depth on May 1, based on snow course measurements, ranges from 14 to 81 inches, with an overall average of 47 inches. There are perennial snowfields on the flanks of Cloud Peak, Blacktooth Peak, and other peaks in the central part of the mountains.

## X. <u>Vegetation</u>

**Composition, distribution, and abundance of the major vegetation types and successional stages of forest and grassland systems**

Figure 5 shows the major vegetation cover types that occur in the Devil's Canyon geographic area. Non-vegetation includes rock and bare areas.

**Figure 5. Vegetation Cover Types in the Devil's Canyon area.**

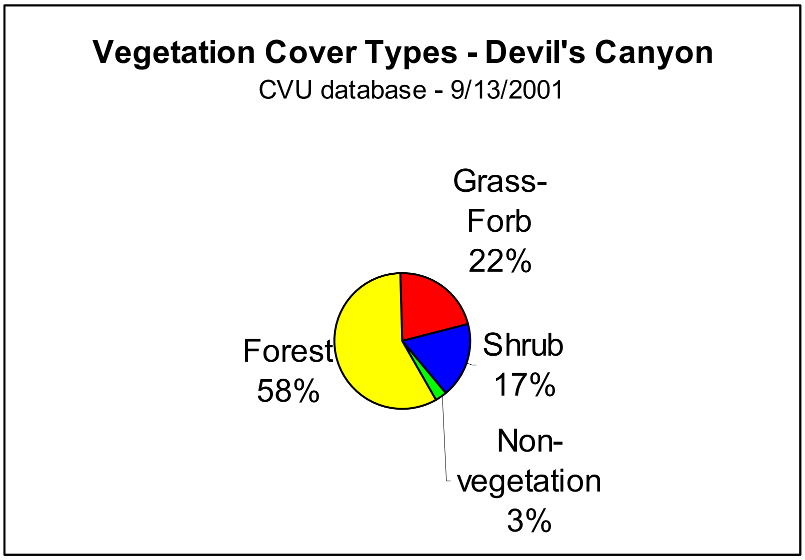
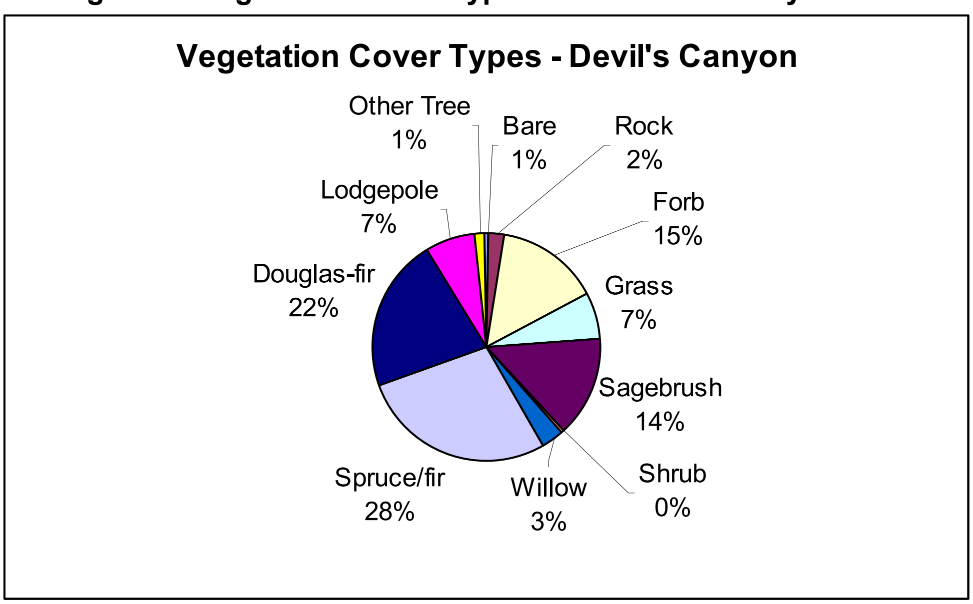



Figure 6 shows the relative amounts of the dominant cover types. Other species exist in the geographic area, but were not of sufficient size and scale to be the dominant cover type in a common vegetation unit polygon. Other trees include aspen, narrowleaf cottonwood, limber pine and juniper.

**Figure 6. Vegetation Cover Types in the Devil's Canyon area.**



The origin dates chart, figure 7, shows the stand origin dates for the forested stands in the assessment area. This data is either from the Stage II point information, or origin years were assigned to stands that regenerated after harvests or fires. Some of the major disturbance events can be seen in this chart:

- The most recent spike represents the Intermission Fire (1988).
- There are two high spikes centered on 1785 and 1825 are "old" spikes for the watersheds on the Bighorn.

**Figure 7. Forested Stand Origin Dates in the Devil's Canyon area**

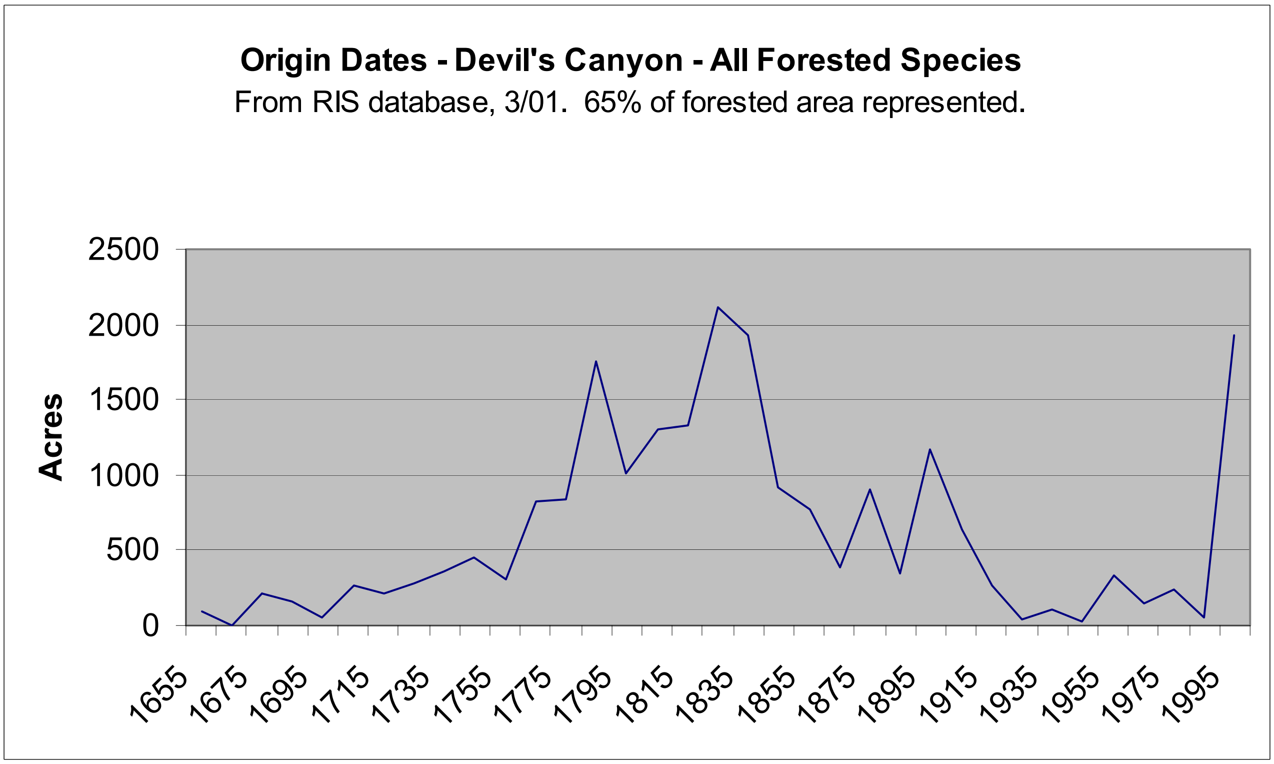



Figure 8 shows the habitat structural stages for the forests in the geographic area. Habitat structural stage provides a "coarse filter" look at habitats provided by forests in the geographic area. It gives an indication of forest size and density, which can be interpreted for wildlife habitat suitability. Forested stands provide an infinite variety of tree sizes and canopy densities, and to consider the amount, type, and spatial distribution of wildlife habitats, people need a simplified system to comprehend this variety. Many habitat considerations, such as amount and type of understory vegetation; size and amount of snags and coarse woody debris; and, the amount of hiding cover provided, can be approximately inferred from the broad habitat groupings described in the habitat structural stage model.

Habitat structural stages are defined in Hoover and Wills (1987). Structural stages describe the developmental stages of tree stands in terms of tree size and the extent of canopy closure. Structural stages can be considered a descriptor of the succession of a forested stand from regeneration, or bare ground, to maturity. For the purposes of a describing wildlife habitat, forest structural stages are divided into four categories, consisting of Stage 1, grass/forb; Stage 2, shrub/seedling; Stage 3, sapling/pole; and Stage 4, mature, Table 20. It is important to recognize that structural stages represent succession in *forested stands* only; the grass/forb, structural stage 1, refers only to forested stands that have undergone a stand-replacing event, and are temporarily in a "non-forested" condition. Structural Stage 1 does not include naturally occurring meadows. The Structural Stage 1 areas are shown on the transitory forest cover type map in the appendix.

These areas do not have a forested cover type in the CVU database, but they are areas that were either recently burned or harvested and have a current cover type of grass, forb, bare, wood, etc. The letter in the structural stage naming convention (a, b, or c) refers to the crown density, Table 14.

**Figure 8. Habitat Structural Stages in the Devil's Canyon Geographic Area**

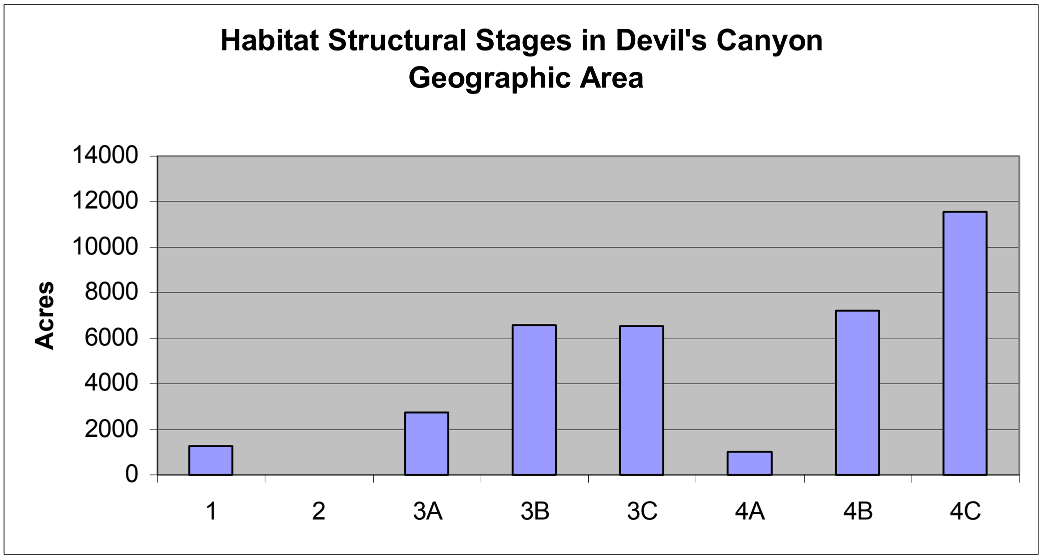



**Table 14. Habitat Structural Stage Definitions, Hoover and Wills 1987**

| Habitat Structural Stage | Diameter | Crown Cover % | Habitat Structural Stage | Diameter | Crown Cover % |
|---|---|---|---|---|---|
| 1 | Not applicable | 0-10% | 3C | 1 – 9 inches | 70-100% |
| 2 | < 1 inch | 10-100% | 4A | 9+ inches | 10-40% |
| 3A | 1 – 9 inches | 10-40% | 4B | 9+ inches | 40-70% |
| 3B | 1 – 9 inches | 40-70% | 4C | 9+ inches | 70-100% |

Interpretations from this table are:

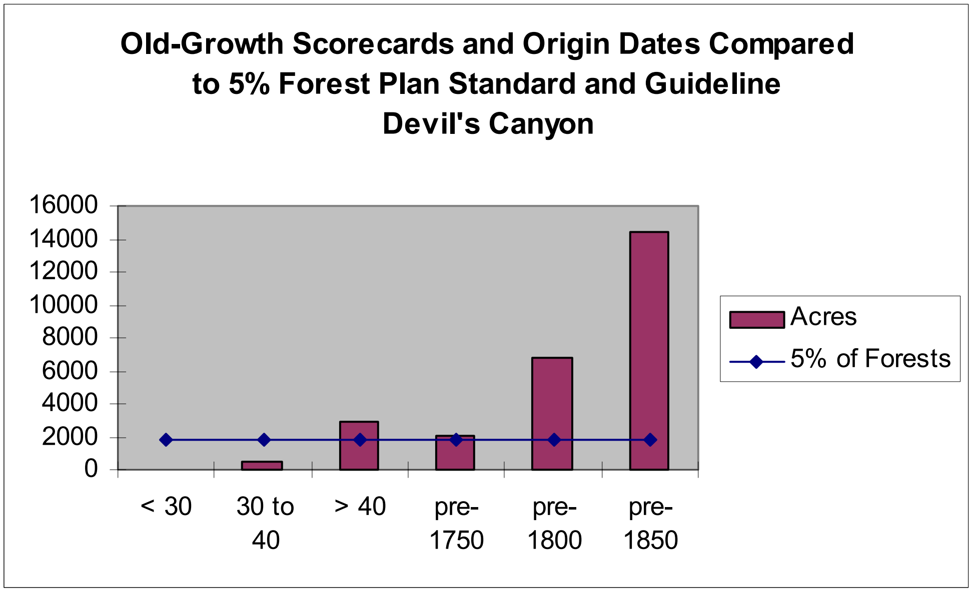
- Compared to the lodgepole dominated, granitic Bighorn geographic areas, there is a relatively high amount of 4* classes. This is consistent with the older age classes shown in figure 7.

Concerning old-growth, approximately 1780 acres of old-growth are needed to represent 5% of the forested area in the Devil's Canyon geographic area, which is the current Forest Plan minimum standard and guideline. The Bighorn has informally adopted the old-growth definition in Mehl, 1992. There is no cited definition in the 1985 Forest Plan. Different measures of old-growth are listed in table 15 and figure 9.

**Table 15. Old-Growth Acres**

| Old Growth Scorecard | | | Acres by Cover Type over 250 years old | | | | Acres by Cover Type over 200 years old | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Acres <30 | Acres 30-40 | Acres >40 | Doug-fir | Lodgepole Pine | Spruce/ fir | Aspen | Doug-fir | Lodgepole Pine | Spruce/ fir | Aspen |
| 0 | 433 | 2928 | 859 | 0 | 1231 | 0 | 2600 | 561 | 3623 | 33 |
| | | | Total Acres over 250 years old: 2090 | | | | Total Acres over 200 years old: 6817 | | | |

**Figure 9. Old-Growth Scorecards and Origin Dates**




### Estimate the Range of Variability in Vegetative Conditions

- The overall change in the relative amounts of forests to meadows in the subalpine habitat types[7] changes very little, due to soil conditions (Despain, 1973). Thus, the current mix, of 68% forest to about 14% meadow, fluctuates by no more than 1-2%. There is some meadow invasion occurring in Porcupine Creek on the road to the work center and below the Medicine Wheel.
- Riparian areas may fluctuate as large, catastrophically burned areas return to a forested condition, and more water is lost to transpiration and sublimation off of the forested canopy in the winter. This would only occur in watersheds and subwatersheds that have a large percentage of the watershed burned in the same event.
- Aspen is declining for three factors:
  - Long term climatic warming since the little ice age about 10,000 years ago. There was also a relative drying of the climate since that time until the last 100 years, at which point the climate became relatively wetter. (Knight, 1994)
  - Effects on seedling survival due to wildlife and domestic livestock grazing.
  - While the subalpine fire cycle has only marginally been affected (since this type has a fire frequency interval of 100-300 years and European man has only been suppressing fires for about 100 years), continued fire suppression will decrease the amount of aspen in the geographic area, since stand replacing fire events are regeneration events for aspen.

### Effects from air quality

There have been no studies to date on the Bighorn concerning air quality effects on plants. An applicable study from Yellowstone National Park concluded that ozone levels are suspected to be well below the level that would affect human health or vegetation.

[7] Subalpine habitats include lodgepole pine and Engelmann spruce forested areas. Douglas-fir and ponderosa pine forests are not included in this generalization.

**Risks to ecological sustainability**

- The cumulative effects of human intervention in the ecosystem. This includes:
    - People as vectors of exotic species. This includes plant and animal species.
    - Roads
    - Livestock and wildlife grazing and browsing
    - Timber harvest
    - Fire suppression
    - Recreation use

**Describe reference conditions (landscapes)**

Two areas in this geographic area were considered as potential Research Natural Areas (pRNAs):

- Devil's Canyon: This has moderate potential of the eleven pRNAs on the Bighorn. The main portion of Devil's Canyon just above the forest boundary is relatively unimpacted by humans and is defensible for RNA values. The southern portion of the pRNA would have to be remapped, because there is an active grazing allotment. The trail at the bottom of the canyon allows for some human intrusion into the pRNA.
- Pete's Hole: Like Devil's Canyon, this pRNA has moderate potential relative to the eleven areas considered at this time. Both sedimentary and granitic soil types are present, and there is a wide range of forest types, from Douglas-fir and limber pine to lodgepole pine and spruce/fir. Sheep and some exotic species, primarily timothy exists, once heavily grazed the lower portion of the pRNA.

In the Fine Filter Analysis (Welp, et al., 2000), three areas within the geographic area were considered areas "…that contain a high concentration of important taxa or representative vegetation communities." (For a complete discussion of ranking criteria, codes and descriptions, see pages 1192 to 1230 of Welp, et al., 2000):

- Medicine Mountain, B3 rank (high significance): Contains "…an unusual concentration of six rare plants, three of which are USFS Region 2 Sensitive Species". This area captures the unique, high altitude sedimentary habitat that WYNDD botanists recognized.
- Deer Creek, B4 rank (moderate significance): Contains a rare, genetically pure population of Yellowstone Cutthroat trout.

## XI. Terrestrial Species and their Habitat

Most of the wildlife existing condition information will be presented at the Forest wide scale, since geographic areas rarely bound terrestrial species. Topics included in the forest wide scale assessment include population viability, species categories (species of local concern, species at risk, etc.), and species habitats.

### General Theme/Vegetation

Wildlife species composition, distribution, and abundance are determined primarily by the distribution, structure, and composition of vegetative and non-vegetative habitat components. It is assumed that managing the vegetative components within the Historic Range of Variability (HRV) would be the most beneficial for the most wildlife species. Refer to the vegetation section description of current vegetation distribution and relevance to HRV. There is a large percentage of spruce/fir and Douglas-fir community types in this geographic area. Of concern in this area were the riparian areas and aspen stands. Aspen are at risk from a lack of disturbance and from ungulate browsing levels. Riparian areas may be at risk from livestock and wildlife grazing, dispersed recreation use, noxious weeds, and past road construction within these areas. It is assumed that priority watersheds will be identified through this process at the Forest level to prioritize any treatment or restoration activities needed relative to HRV. There is less potential for caves and karst topography in this geographic area as compared to others on the Forest. Old growth conifer likely exists within the geographic area, though inventories are lacking. Stand origin dates available for 65% of the geographic area indicate that there are several areas with potential old growth due to pre 1850 origins. There is a majority of 4C structural stage in the forested communities, further indicating a potential for old growth conditions.

### Viability/Species At Risk

All information relative to these species and viability concerns will be handled from a Forest wide compilation of species, recommended conservation measures, and viability assessments. Primary information for this analysis will be derived from the WYNDD database and existing literature reviews.

### WYNDD Biological Areas

The areas within the geographic area identified by Wyoming Natural Diversity Database as having a high concentration of important taxa or representative vegetation communities are described within the Vegetation section. These include Medicine Mountain and Deer Creek sites. Deer Creek is noted for occurrence of Yellowstone cutthroat trout. Medicine Mountain is noted for occurrence of rare plant species.

### Wildlife Species Information/Recommendations

Historically, *beaver* were likely more present in the geographic area than presently occur. The species is important for shaping and maintaining riparian communities. The link to deteriorated quality and reduced presence of aspen was also noted as an important consideration for this area. Beaver frequently uses aspen habitats for dam construction when they occur in riparian areas.

- Consider beaver as a potential focal species for this geographic area due to the habitat potential and previous use.

*Elk* habitat use in the geographic area would be similar to that described in the Clear/Crazy assessment. This geographic area is a major route of elk migration. In addition, there are conflicts with livestock occurring in this geographic area due to combined use of vegetative resources. In addition, elk calving may be limited in some instances due to the conflict with livestock if livestock are present in all pastures in the spring. Issues of wildlife winter range and motorized vehicle access persist in this area, as described in the Clear/Crazy assessment. However, road access is generally less available in this area and reduces potential conflicts. Adjoining BLM lands also provide a good availability of winter range.

*Bighorn sheep* are currently present adjacent to the Forest. They were more abundant in the pre-European settlement era. Elements of extirpation included loss of open corridors for migration habitat use, disease from domestic livestock, and over hunting. There is likely more suitable habitat in this geographic area than in others on the Forest. WG&F has also been considering this are for introduction of California Bighorn sheep. Opportunities for expansion of habitat for the adjacent Rocky Mountain sheep should be considered in conjunction with livestock management to reduce potential conflicts of disease. Potential issues include livestock management and protection for lambing areas where recreation may be a conflict.

*Peregrine falcons* were hacked adjacent to the Forest in Devils Canyon and may utilize habitat on the Forest, as there is additional potential habitat. No active nests have been noted the past couple of years on the Forest. Potential issues would involve nest protection from recreation pursuits as management activities would not likely be an issue due to nesting habitat location.

*Sage grouse* may utilize the Forest boundary areas for summer habitat as two leks are located within two miles of the boundary in the Dugan Bench area. Issues would involve integrity of sage steppe habitat with respect to understory conditions (weeds, cheatgrass) as well as the extent and age class diversity of sage habitat.

## XII. Cultural, Human Uses, Land Use Patterns

### Recreation and Travel Management

Summary
- The Medicine Wheel National Historic site is an important area to Native Americans for ceremonies throughout the season.

Participation in outdoor recreation has grown in most activities on the Bighorn National Forest including camping, hiking, horseback riding, atvs, motorcycles, fishing, snowmobiling and cross country skiing. Access is associated with almost every activity that takes place on the forest.

*Summer travel:* This geographic area is remote in the northern part, however accessed in the southern part from Highway 14A. Bucking Mule Falls is a popular destination and identified as a National Recreation Trail. This area is experiencing increasing use from horseback users with signs of resource damage from using tree areas for corrals.

The southeast part of this geographic area has a problem with being used as a trailer storage area. There is one area on Forest Road 14 authorized for storage.

*Winter travel*: The area is popular for snowmobiling with Crystal Creek rest stop developed for snowmobile parking. Many visitors to this area come from Billings, Montana.

*Relationship between supply and demand of opportunities:* Dispersed camping has exceeded supply because of the number of trailers dispersed camping. The fourteen day stay policy on the forest limits the time used in one area, however many campers use the forest from spring to fall.

*Recreation Opportunities:* There are many recreation opportunities within the Devil's Canyon geographic area. The Forest Service describes different recreation experiences using the setting, activities and the experience. These experiences are separated in recreation opportunity spectrum (ROS) classes. Table 16 displays the ROS classes and acres found within the analysis area.

**Table 16. Recreation Opportunity Spectrum (ROS) Classes within the Devil's Canyon Analysis Area**

| ROS class | Acres in analysis area | Percent |
|---|---|---|
| Primitive | 5,377 | 9 |
| Semi-primitive nonmotorized | 13,763 | 23 |
| Semi-primitive motorized | 26,843 | 44 |
| Roaded natural | 10,418 | 17 |
| Roaded modified | 2,450 | 4 |
| Rural | 2,206 | 3 |

As displayed in table 16, the area has forty-four percent of the geographic area in a semi-primitive motorized class. However, because of the remoteness of the area, it remains relatively undeveloped.

Primitive – 5,377 acres
These areas are characterized by an unmodified environment and have a very high probability of experiencing solitude, freedom, closeness to nature, tranquility, self-reliance, challenge and risk. There is very low interaction between recreation users. Access and travel is nonmotorized on trails or cross-country.

Semi-primitive nonmotorized – 13,763 acres
Areas in a semi-primitive nonmotorized class are in a natural appearing environment with a high probability of experiencing solitude, closeness to nature, tranquility, self-reliance, challenge and risk. There is low interaction between users. Access and travel is nonmotorized on trails, some primitive roads or cross-country.

Semi-primitive motorized – 26,843 acres
There is a moderate probability of experiencing solitude, closeness to nature and tranquility. The setting is in a predominantly natural appearing environment. There is a low concentration of users, but often evidence of others on trails. Motorized vehicles are allowed for travel.

Roaded natural – 10,418 acres
Self-reliance on outdoor skill is of only moderate importance to the recreation user with little challenge and risk. The environment is mostly natural appearing. Access and travel is motorized including sedan and trailers.

Roaded modified – 2,450 acres
In a roaded modified setting, there is opportunity to get away from others, but with easy access. There is moderate evidence of other users on roads and little evidence of others or interaction at campsites. Conventional motorized access includes sedan, trailer, atv and motorcycle travel.

Rural – 2,206 acres
The opportunity to observe and affiliate with other users is important, as is convenience of facilities and recreation opportunities. There is little challenge and risk. Interaction between users may be high as is evidence of other users.

*Areas of conflict:* The Bucking Mule Falls trail needs a reroute at the bottom. The trail is very steep and the normal person cannot hike or horseback safely.

*Special Areas:* Porcupine Creek is an eligible wild and scenic river. Suitability will be studied in the revision process.

## Grazing

In 1995 the Bighorn National Forest in conjunction with the University of Wyoming Department of Renewable Resources, University of Wyoming Extension Service, and Bighorn National Forest Grazing Permittees Association developed the ***Bighorn National Forest Vegetation Grazing Guidelines.*** These guidelines were revised in 1996 and finalized on April 9, 1997.

The Guidelines outline vegetation-monitoring requirements for riparian areas on the Forest. This monitoring is mandatory for all allotments on the Forest with penalties established if the monitoring is not completed. The Forest rangeland management personnel spot check permittee monitoring and if discrepancies are found they are resolved on the ground or Forest Service data is used as the baseline for that season. Upland vegetative standards are outlined in the 1985 Bighorn National Forest Plan and still apply to all upland use.

Bighorn National Forest staff are in the process of completing geographic area level Allotment Management Plans (AMPs). The Devil's Canyon AMP is in the process of being completed. Until the geographic area level AMPs are complete, existing AMPs will remain in affect and Annual Operating Instructions will be used to adjust the Plans to fit current resource objectives and assure management meets existing on the ground needs.

To assure objectives are being met annually the Forest Service, permittees or both complete riparian and upland monitoring. If problems occur adjustments in grazing use (changes in season of use, livestock numbers, rest periods, or deferment of on-dates) are made to allow the herbaceous vegetation to recover.

Table 17 shows selected information for the six grazing allotments in the Devil's Canyon analysis area.

**Table 17. Select Information for Grazing Allotments in the Devil's Canyon Analysis Area**

| Allotment | Livestock Permitted | Number Permitees | Total Acres | Capable Acres | Current AMP | Scheduled AMP Update | Permitted Season |
|---|---|---|---|---|---|---|---|
| Devils Canyon C&H/Little Mountain C&H | 959 C/C | 1 | 40,143 | 18850 | | 9/2002 | 7/01 - 10/09 |
| Medicine Mountain C&H | 1373 C/C | 7 | 17775 | 9611 | | 9/2002 | 7/1 - 10/15 |
| Lodge Grass C&H | 119 C/C | 1 | 4965 | 1649 | | 9/2002 | 7/1-10/15 |

The geographic area analysis was initiated in 2000. Work is beginning to update the Allotment Management Plans with the exception of Bear Creek S&G and Crystal Creek S&G. These allotments will be completed with the Hunt Mountain geographic area analysis currently scheduled for 2005. Under the current schedule the NEPA analysis is scheduled for completion in 2002 and the AMP's updated in 2003. If the cultural resource surveys are completed on schedule this timeframe should hold firm. The Decision Notice and AMP's would be delayed a year if delays are encountered with the surveys.

Overall the herbaceous vegetation on the majority of the geographic area is in good condition with static to upward trends. Isolated areas occur where vegetation use exceeds standards and guides but corrective action is taken the year following the excessive use to allow these areas to recover.

## XIII. Transportation System (Roads and Trails)

A Forest-wide roads analysis will be conducted during the effects analysis part of Forest Plan revision. It will be done under the 1985 Forest Plan direction. When the revised Forest Plan is implemented, the roads analysis will be reviewed and applicable revisions made.

### Roads

There are currently approximately 129 miles of roads in the Devil's Canyon Analysis Area. This system of roads accesses an area of approximately 96 square miles, including wilderness and private lands. The road system in this analysis area varies from high standard US Highways to primitive, abandoned wheel tracks. Table 18 gives a breakdown of roads within the analysis area.

**Table 18. Miles of Road by Jurisdiction**

| Jurisdiction | Length (miles) |
|---|---|
| Forest Service | 95.7 |
| Other Local Highway | 12.8 |
| Unclassified | 20.7 |
| **Total:** | **129.4** |

The roads within the analysis area under Forest Service jurisdiction are divided into categories called maintenance levels. Maintenance levels range from 1-5, with 5 being the highest standard, and 1 being the lowest standard. There may also be additional roads no longer required for management purposes, or which have been created by off road vehicle use, but there still exists a road 'footprint'. These roads are called unclassified, and the mileage of these unclassified roads is an approximation. A description of maintenance levels is shown in Table 19.

**Table 19. Description of Road Maintenance Levels**

| Maintenance Level | Description |
|---|---|
| 1 | Closed to public travel – can be used intermittently for management purposes. |
| 2 | Maintained for use by high clearance vehicles. |
| 3 | Maintained for use by a prudent driver in a passenger car. |
| 4 | Maintained for use by passenger cars with a moderate degree of user comfort. Usually double lane, gravel roads. |
| 5 | Maintained for a high degree of user comfort, double lane, often paved. |

Figure 10 shows a breakdown of Forest Service roads within the analysis area by maintenance level, as well as other roads within the analysis area by jurisdiction.

**Figure 10. Roads by Forest Service Maintenance Level and Roads by Other Jurisdiction**

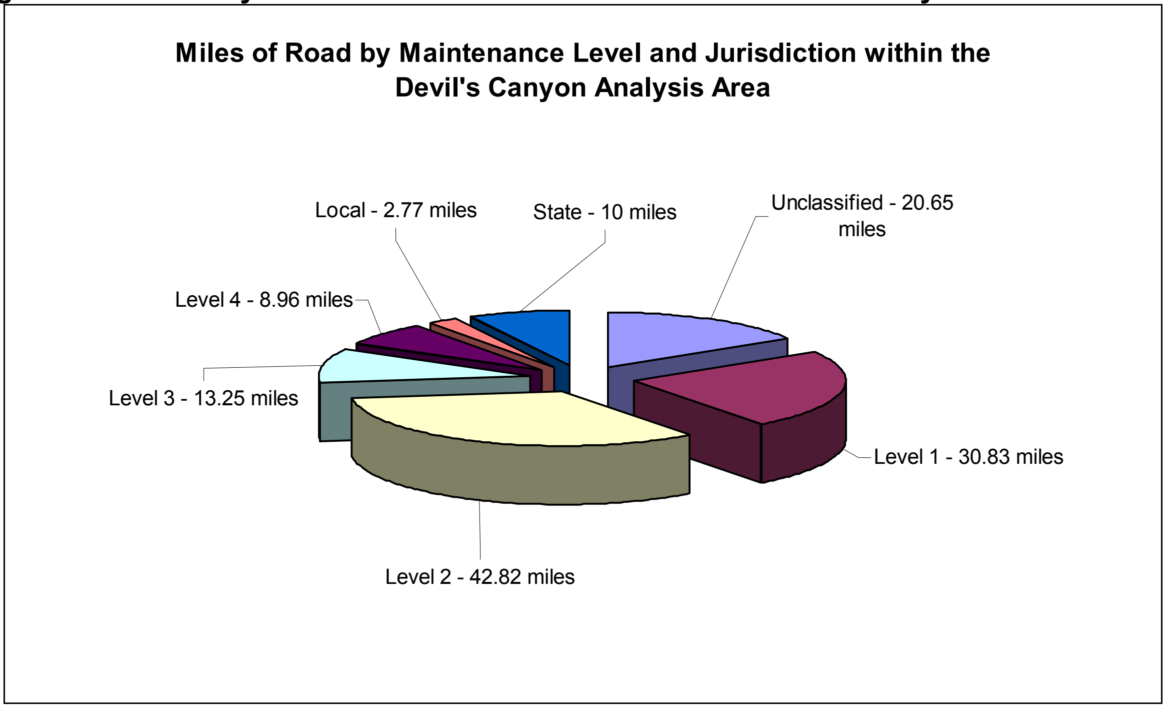



Table 20 lists the road density in the Devil's Canyon analysis area. These figures do not include wilderness and private land. The open road density does not include unclassified roads.

**Table 20. Road Density in Devil's Canyon Analysis Area (National Forest System, Non-wilderness land only)**

| | |
|---|---|
| Total Road Density | 1.36 miles per square mile |
| Open Road Density | 0.81 miles per square mile |

Various structures and components are needed to manage and operate those roads under Forest Service jurisdiction. These structures include bridges, culverts, cattleguards, water bars, rolling dips, gates, and signs. These structures along with the roads themselves represent a great investment in the transportation system, as well as a great cost for annual maintenance and, over the years, a resulting backlog of maintenance needs. Table 21 shows the breakdown of annual and deferred maintenance needs by maintenance level[8].

**Table 21. Annual and Deferred Maintenance Needs by Maintenance Level**

| Maintenance Level | Miles | Annual Cost/Mile | Deferred Cost/Mile |
|---|---|---|---|
| 1 | 30.83 | $683 | $886 |
| 2 | 42.82 | $920 | $2,316 |
| 3 | 13.25 | $6,561 | $8,109 |
| 4 | 8.96 | $5,991 | $14,730 |
| Total needs for annual maintenance in Devil's Canyon = $201,064 | | | |
| Total needs for deferred maintenance in Devil's Canyon = $365,912 | | | |

[8] Costs arrived from performing condition surveys on each level 3, 4, and 5 road on the Bighorn National Forest in 1999, and from a random sample of level 1 and 2 roads in 2000. Costs per mile were interpolated from these surveys. Also, these costs do not reflect annual and deferred costs for bridges. Those costs are not yet readily available.

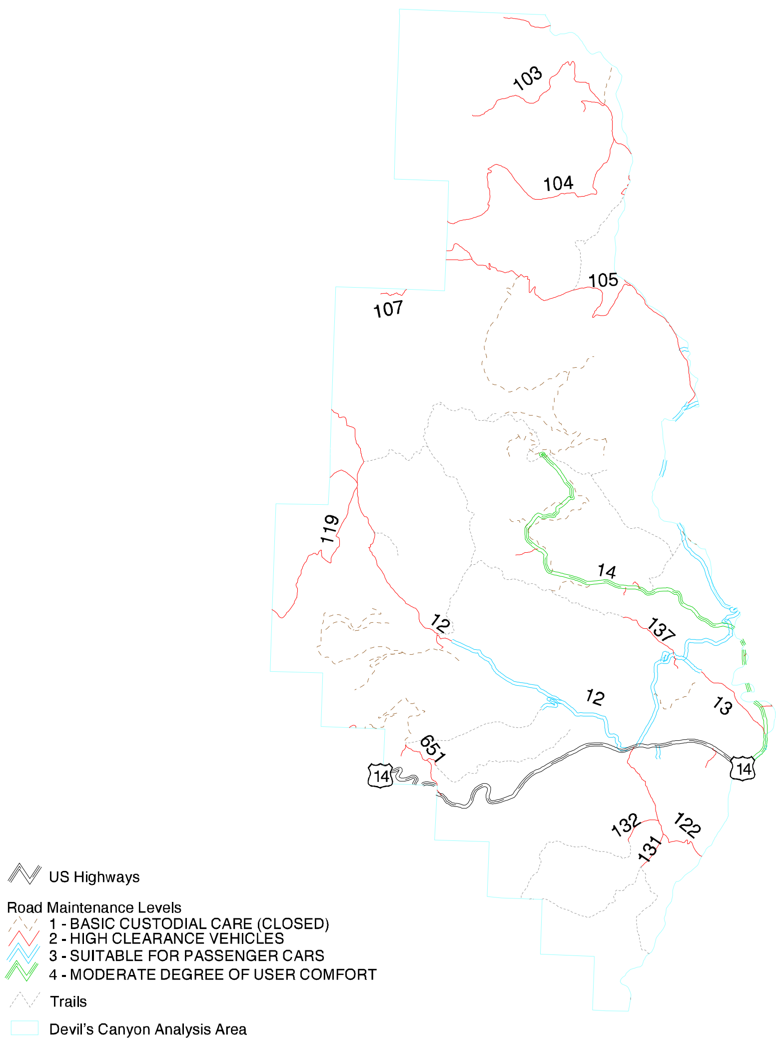
Current funding levels for road maintenance over the past 3 years have remained fairly constant, with an approximate allocation of $460,000. This amount is far below the level needed for full implementation of the current transportation system forest wide. Current forest plan standard for full maintenance is also not being met under current allocations. Currently, general plan direction states to keep roads open to public use unless financing is not available to maintain the facility, or use is causing unacceptable damage to soil and water resources. Based on current deferred maintenance and annual maintenance needs, plan direction is not being met.

Forest Plan Goals/Desired Conditions

Forest Plan direction for road management and operations are primarily based on resource needs rather than the road systems as a separate entity. In other words, the driving force behind road management decisions are primarily based on the management directions resource needs for an area. The Forest Plan does, however, give direction that roads may be closed if financing is not available to maintain the facility, if use is causing unacceptable resource damage, if they are unsafe, or if their use conflicts with the management objectives for an area. The Forest Plan also states that arterial and collector roads shall be maintained to a minimum maintenance level of 3, and all open local roads shall be maintained to a minimum maintenance level of 2. In contrast, forest plan goals to provide additional road and trail access to the National Forest boundary are being met.

The map on page 42 shows the current Forest Service Road system by maintenance level in the Devil's Canyon analysis area.

# Road Display by Maintenance Level for the Devil's Canyon Analysis Area



## Trails

There are currently approximately 52 miles of trail in the Devil's Canyon Analysis Area. This trail system accesses an area of approximately 96 square miles. The trail system in the analysis area varies from high standard ATV trails to primitive single-track trails. The majority of the trails within the analysis area are constructed and maintained by the forest service. However, there is also a small length of trails in the analysis that are user created, or are abandoned trails that still have an existing footprint. These trails are referred to as unclassified. Table 2 shows the breakdown of classified and unclassified trails within the analysis area.

**Table 22. Miles of Trail by Status in Devil's Canyon**

| Trail Status | Length (Miles) |
|---|---|
| Forest Service | 33.0 |
| Unclassified | 19.1 |
| Total | 52.1 |

Forest Plan Goals/Desired Conditions

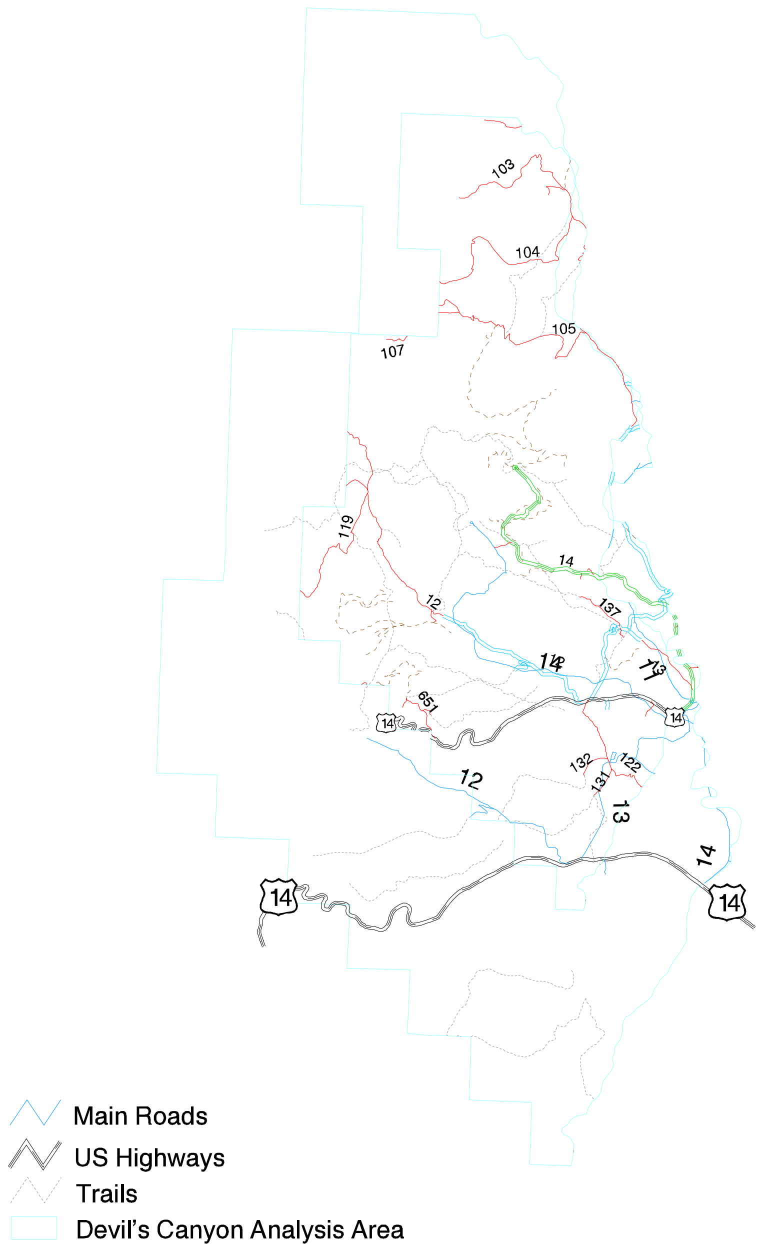
Forest Plan direction for transportation facilities are primarily based on resource needs rather than the road systems as a separate entity. In other words, the driving force behind road management decisions are primarily based on the management directions resource needs for an area. Currently, general plan direction states to maintain all trails to certain minimum requirements, including maintaining drainage structures to prevent unacceptable resource damage, and to remove all hazards from trails to allow safe passage for specified classes of users. For the most part, this direction of the plan is being met, however, deferred maintenance surveys have revealed that a lack of a steady budget in trail maintenance has caused some degradation of the trail system that is not consistent with current plan direction. In contrast, plan direction for providing full ranges of trail opportunities in coordination with other state, federal and county municipal jurisdictions and private industries is generally being met.

The current annual trail maintenance need is estimated to be $1,217 per mile and deferred maintenance costs are estimated to be $13,125 per mile[9]. Total trial maintenance needs in the Devil's Canyon analysis area are estimated to be $40,161 annually maintenance, with a $443,125 deferred maintenance backlog.

The map on page 44 shows the current trail system within the Devil's Canyon analysis area.

[9] These costs are interpolated from the forest wide condition survey assessments done in 2000 and 2001.

Trail Display for Devil's Canyon Analysis Area



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