Chapter 3. Affected Environment

Introduction

This chapter describes existing conditions for Bureau of Land Management (BLM) resource programs, resource uses, special designations, and the socioeconomic environment in the Lander Field Office planning area. This description of the affected environment uses the best and most recent data available. This chapter does not provide detail about environmental components that would not be affected or that are not essential to the resolution of planning issues.

In addition to describing existing conditions, where appropriate, this chapter identifies management challenges for resource programs and resource uses on BLM-administered land. The BLM Analysis of the Management Situation (AMS) and the scoping process for revising the 1987 Lander Resource Management Plan (existing plan) identified these management challenges. By describing existing conditions for resource programs in the planning area, this chapter serves as the baseline against which Chapter 4 analyzes and compares potential impacts of the alternatives.

A variety of laws, regulations, policies, and other requirements direct management of resources and resource uses on BLM-administered public lands. The Lander Field Office operates under applicable requirements and guidance provided in Appendix A (p. 1343). The Lander Field Office also requires management practices as design features to minimize environmental impact in the management of resources and resource uses on BLM-administered lands (Appendix H (p. 1431)).

Acreage and Geographic Information System Calculations

The majority of acreage and miles in this document are calculated using Geographic Information Systems (GIS). The use of GIS spatial analysis can provide precise acreage calculations. However, the acreage values are only as accurate as the data that is entered. Various factors can affect the accuracy of data including data collection and entry, scale, and timeframe. Until these calculations are confirmed through field surveys using a Global Positioning System, all GIS calculations in this document should be considered approximate.

Overview of the Lander Field Office Planning Area

The Lander Field Office planning area covers approximately 6,487,464 acres of federal, state, tribal, and private land in Carbon, Fremont, Hot Springs, Natrona, and Sweetwater Counties, Wyoming. A small portion of Teton County is within the planning area; however, there are no BLM-administered lands within Teton County in the planning area and the RMP makes no management decisions for Teton County lands. Public land in the planning area includes most of Fremont County, the southwest corner of Natrona Country, and small portions of Carbon, Sweetwater, and Hot Springs Counties. There are many isolated parcels of state and private land dispersed throughout the planning area intermingled with public land. Management decisions and prescriptions in this document apply only to BLM-administered surface lands (BLM-administered surface) and federal mineral estate in the planning area. Of the total planning area, approximately 2,394,210 acres are BLM-administered surface (Map 1) and 2,809,101 acres are BLM-administered federal mineral estate (Map 2). Approximately 2.2 million acres of the planning area are within the Wind River Indian Reservation (WRIR). Various locations referred to throughout this document are displayed on Map 142.

The BLM has a fiduciary trust responsibility for the management of minerals on the WRIR. The BLM does not make land management decisions for the WRIR, and duties associated

with trust responsibilities are performed independent of the provisions of the Lander Resource Management Plan (RMP). Information the BLM obtained and used pursuant to its exercise of duties associated with trust responsibility is considered proprietary to the WRIR and the BLM treats this information as confidential.

The geologic setting in the planning area is one of basins, separated and surrounded by mountain ranges, including the Owl Creek, Bridger, Bighorn, Ferris, Washakie, Absaroka, Wind River, Granite, and Rattlesnake Ranges. Most of the planning area is in the Wind River Basin; approximately one-third of the planning area is within the Granite Mountain Range landform, and fewer than 150,000 acres in the southern part of the planning area are in the Great Divide Basin.

There are two main hydrologic basins in the planning area: the Wind River and Popo Agie River basins, which drain most of the area north of Beaver Rim, and North Platte River Basin of which its tributary, the Sweetwater River drains the area south of Beaver Rim. There is a minor acreage drained directly to the North Platte River in the far eastern portion of the planning area in southeast Natrona County. Roughly 150,000 acres of the Great Divide Basin, a hydrologically closed basin with no external drainage, is found along the far southern boundary of the planning area; most of this basin occurs in a 7 to 9 inch annual precipitation zone.

Elevations in the planning area range from 4,750 feet to 10,400 feet, which support habitats including coniferous forests, juniper woodlands, aspen stands, mountain shrub, canyons and rim rock, badlands, sagebrush-steppe shrublands, grasslands, and riparian-wetland areas. The dominant vegetation type in the planning area is sagebrush, which is found throughout the planning area and occupies valleys and basins. Juniper and limber pine occur on slopes and in mountainous areas, and lodgepole/limber pine mixed with aspen occur in higher elevations.

BLM-administered public lands in the planning area support a variety of game and nongame wildlife species, including several special status species. These lands contain a variety of habitats that possess the biological and physical attributes important in the life-cycles of many wildlife species. The diversity of habitats and landscapes provides important areas for wildlife breeding, birthing, foraging, wintering, and migration.

The soils of the planning area are typical for arid and semiarid, cold deserts and sub-humid mountainous areas of the world that have a continental climate. Summers are generally short and hot and winters long and cold. Annual precipitation ranges from 5 to 9 inches in the Wind River Basin and 15 to 19 inches in the foothills of the Wind River Mountains. The mountain areas have a sub-humid, continental climate. Drought is common in the planning area. With drought comes increased risk of fire, decreased vegetation for forage and soil cover, accelerated soil erosion by wind, and decreased air quality from additional particulate matter (PM) in the air.

The soils in the Wind River and Great Divide Basins are typical for those of high, semiarid, cold deserts. Soils of the planning area vary greatly in potential and capability for any given use. Some soils produce abundant vegetation, other soils do not. Some soils support winter habitat for wildlife, others support summer habitat. Some soils are easier to rehabilitate after disturbance than other soils.

Economic development in the planning area has been based on resource extraction, tourism, and agriculture. Oil and gas development is an important economic component of public land use in the planning area. Tourism has historically been a substantial economic generator, primarily in the Dubois and Lander areas. Agriculture, particularly cattle and sheep ranching, has also contributed to the economy and the social fabric of communities in the planning area.

The availability of a wide spectrum of recreational opportunities on public lands is an important component of public land use, lifestyles, and communities in the planning area. Many towns in the planning area serve as "gateway cities" for recreation activities in Yellowstone and Teton National Parks and their own recreation destinations. Recreation resources in the planning area include both developed and undeveloped opportunities.

Fremont County

The Wyoming Territorial Legislature established Fremont County in 1884, and named Lander the county seat. The earliest historic records indicate that the Shoshone and Crow bands originally occupied Fremont County. In the 1820s and 1830s, fur traders explored much of Fremont County and John C. Fremont explored and mapped southern Fremont County along the Oregon Trail in 1842 and 1843. The South Pass gold rush of 1867 brought an influx of thousands of people, which accelerated the settlement of Fremont County and the development of early farms and villages. The creation of the WRIR in 1868 was another important event that accelerated the settlement of the county.

Fremont County is the second largest county in land size (after Sweetwater County, Wyoming) in the six Rocky Mountain states. The Oregon, Mormon, California, and Pony Express Trails cross the southern portion of the county, and Dubois, a gateway town for Yellowstone National Park and Grand Teton National Park, lies in the northwest corner of the county. Lander is home to the Wyoming State Life Resource Center and several non-profit organizations including the National Outdoor Leadership School, The Nature Conservancy, and the Wyoming Outdoor Council. The largest community in the county is Riverton, home of Central Wyoming College. A large portion of the western edge of the county follows the Continental Divide at the crest of the Wind River Range of the Rocky Mountains. U.S. Highway 287 crosses the southern and western portions of Fremont County, and intersects Highway 28 just south of Lander. The Sweetwater River, the second largest river in the planning area, runs east-west in the southern portion of the planning area. The southern boundary of Fremont County is south of the Sweetwater River, more or less along the northern edge of the Great Divide Basin.

Fremont County comprises 2,751,355 acres of surface area in the central portion of the planning area, of which the BLM administers approximately 1,933,364 acres. In addition, the Lander Field Office administers approximately 2,281,159 acres of federal mineral estate in the county. The WRIR, the historical home of the Eastern Shoshone and the Northern Arapaho Native American tribes, occupies approximately one-third of Fremont County. Parts of five counties are included within the planning area. Of these, Fremont County encompasses the largest amount of surface area.

Natrona County

Natrona County was officially established in 1890 after originally being a part of Carbon County. Casper, Wyoming, was designated as the county seat in 1890. Pioneers traveling west in the mid to late 1800s followed both the Mormon and Oregon Trails, which cross present-day Natrona County. Early pioneers established homesteads in the late 1800s and settlers used the open rangelands for cattle and sheep ranching.

Oil and gas prospecting began in Natrona County in the 1870s and accelerated economic and population growth in the county. Oil and gas development continues to be an important contributor to the local economy in the county. The important historical sites of Split Rock, Martin's Cove, and Devil's Gate are along portions of the Mormon and Oregon Trails in the

planning area. Wyoming Highway 220 runs in a northeast-southwest direction in the southwestern portion of the county.

Natrona County covers approximately 422,519 acres of surface area in the easternmost portion of the planning area, of which the BLM administers approximately 297,991 acres. In addition, the Lander Field Office administers approximately 364,256 acres of federal mineral estate in the county.

Carbon County

Carbon County was originally established in 1868 as a county in the Dakota Territory. Rawlins, Wyoming, was later named the county seat. Carbon County has a rich history of ranching, mining, and railroad development and use. Highway 287 runs through the northwestern portion of the county in the planning area.

Carbon County covers approximately 45,434 acres of surface area in the southeastern portion of the planning area, of which the BLM administers approximately 38,406 acres. In addition, the Lander Field Office administers approximately 41,482 acres of federal mineral estate in the county. Carbon County has the second least amount of BLM-administered surface area of the five counties in the planning area.

Sweetwater County

Sweetwater County was established in 1867, the same year Green River, Wyoming, was named the county seat. Several emigrant trails, which are now historic trails, pass through the county, including the Oregon, California, Mormon, Overland, and Pony Express Trails. Construction of the transcontinental railroad in 1868 accelerated development in the county's two major population centers, Green River and Rock Springs.

Highway 28 parallels the Oregon, Mormon, California, and Pony Express Trails. Interstate 80 crosses the southern portion of Sweetwater County in an east-west direction. Along with mineral commodities, agriculture is an important commodity and economic contributor in the county.

Sweetwater County covers approximately 128,335 acres of surface area in the southernmost portion of the planning area, of which the BLM administers approximately 122,670 acres. In addition, the Lander Field Office administers approximately 119,407 acres of federal mineral estate in the county.

Hot Springs County

Hot Springs County was established in 1911, with Thermopolis serving as the county seat. Oil and gas, as well as coal extraction, helped accelerate the growth of the county in the early 1900s. Hot Springs County is home to reputedly the world's largest mineral hot springs, located near Thermopolis in Hot Springs State Park. Hot Springs County contains a relatively large amount of paleontological resources, including dinosaur fossils. Important recreational opportunities in the county include rafting and fishing in Wind River Canyon and on the Bighorn River.

Hot Springs County covers approximately 3,244 acres of surface area in the north-central portion of the planning area, of which the BLM administers approximately 1,779 acres. In addition, the Lander Field Office administers approximately 2,796 acres of federal mineral estate in the county. Hot Springs County has the least amount of BLM-administered surface area of the five counties in the planning area.

Wind River Indian Reservation

The Bridger-Teton Treaty with the federal government in 1868 established the WRIR. In 1868, Chief Washakie signed a treaty making the WRIR home to the Eastern Shoshone. A band of Northern Arapaho moved from Colorado to the WRIR in 1868. Today the Eastern Shoshone and the Northern Arapaho share the reservation and govern it jointly, with each tribe holding 50 percent interest in the land, water, and other natural resources. Fort Washakie, the only military fort named for an American Indian chief, is now the headquarters of the Eastern Shoshone government and the U.S. Department of the Interior (DOI) Bureau of Indian Affairs.

The WRIR includes approximately one-third of Fremont County and approximately one-fifth of Hot Springs County. Encompassing approximately 2.2 million acres, the WRIR is the seventh largest Indian reservation in the United States. Within the Lander Field Office boundaries, the WRIR occupies 2,253,375 acres.

3.1. Physical Resources

This section describes the current condition of air quality, geologic resources, soil, water, cave and karst resources and lands with wilderness characteristics. Each of the resource sections includes a definition and description of the resource, the current condition of the resource, and management challenges for the resource.

3.1.1. Air Quality

This section describes the climate and existing air quality in the region potentially affected by the alternatives described in Chapter 2. Air pollutants addressed include criteria pollutants, hazardous air pollutants (HAPs), and compounds that could impair visibility or contribute to atmospheric deposition.

Wyoming Standards for Healthy Rangelands apply to all activities authorized by the Lander Field Office. Standard 6 states that air quality will meet state standards (Appendix J (p. 1437)). Standard 6 identifies the BLM's role in complying with all federal, state and other applicable regulations regarding air quality and clarifies that the State of Wyoming administers the Clean Air Act (CAA).

Air Quality Indicators

Air pollutants addressed in this section include criteria air pollutants, HAPs, and sulfur and nitrogen compounds, which could impair visibility and contribute to atmospheric deposition, including acid rain. State and National Ambient Air Quality Standards (NAAQS) set the maximum thresholds for criteria air pollutants. The Wyoming Prevention of Significant Deterioration (PSD) program establishes allowable increases of a given pollutant for a particular area from specific sources. These standards and programs typically affect Class I or Sensitive Class II Wilderness Areas.

Criteria Air Pollutants

The U.S. Environmental Protection Agency (EPA) established air quality standards for criteria pollutants (the NAAQS). Concentrations of air pollutants greater than the national standards represent a risk to human health. Criteria pollutants include carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), PM_{10} and $PM_{2.5}$, and lead (Pb).

Hazardous Air Pollutants

There is a wide variety of HAPs, including benzene, toluene, ethylbenzene, xylene (also referred to as BTEX), N-hexane, and formaldehyde. Although HAPs do not have federal air quality standards, the U.S. EPA has issued reference concentrations for evaluating the inhalation risk for cancerous and noncancerous health impacts, known as reference concentrations for chronic inhalation.

Wyoming and National Ambient Air Quality Standards

Wyoming Ambient Air Quality Standards (WAAQS) and NAAQS identify maximum limits for criteria air pollutant concentrations at all locations to which the public has access. The WAAQS and NAAQS are legally enforceable standards. Concentrations above the WAAQS and NAAQS represent a risk to human health that by law, require public safeguards be implemented. State standards must be at least as protective of human health as federal standards, and may be more restrictive than the federal standards as allowed by the CAA.

Visibility

Visibility can be expressed in terms of deciviews, a measure of perceived changes in visibility. One deciview is a change in visibility just perceptible to an average person, which is approximately a 10 percent change in light extinction. To estimate potential visibility impairment, monitored aerosol concentrations are used to reconstruct visibility conditions for each day monitored. These daily values are then ranked from clearest to haziest and divided into three categories to indicate the mean visibility for all days (average), the 20 percent of days with the clearest visibility (20 percent clearest), and the 20 percent of days with the worst visibility (20 percent haziest). Visibility can also be defined by standard visual range (SVR) measured in miles, and is the farthest distance at which an observer can see a black object viewed against the sky above the horizon; the larger the SVR, the cleaner the air.

Since 1980, the Interagency Monitoring of Protected Visual Environments (IMPROVE) network has measured visibility in national parks and wilderness areas. The CAA amendments of 1977 designated 156 areas (primarily national parks and wilderness) as federally mandated Class I areas and are accorded strict levels of air quality protection. There are six IMPROVE stations in Wyoming, but none in the planning area. One of the monitors is the North Absaroka site in the Bighorn Basin planning area to the north, and another is the Pinedale site in the Pinedale planning area to the west.

Atmospheric Deposition

Atmospheric deposition refers to processes in which air pollutants are removed from the atmosphere and deposited into terrestrial and aquatic ecosystems. Air pollutants can be deposited by either wet precipitation (via rain or snow) or dry (gravitational) settling of particles and adherence of gaseous pollutants to soil, water, and vegetation. Much of the concern about deposition surrounds the secondary formation of acids and other compounds from emitted nitrogen and sulfur species such as nitrogen oxides (NO_x) and SO_2, which can contribute to acidification of lakes, streams, and soils and affect other ecosystem characteristics, including nutrient cycling and biological diversity.

Substances deposited include:

- Acids, such as sulfuric (H_2SO_4) and nitric (HNO_3), sometimes referred to as acid rain

- Air toxics, such as pesticides, herbicides, and volatile organic compounds (VOCs)
- Heavy metals, such as mercury
- Nutrients, such as nitrates (NO_3-) and ammonium (NH_4+)

Rain, snow, cloud water, particle settling, and gaseous pollutants complicate the accurate measurement of atmospheric deposition. Deposition varies with precipitation and other meteorological variables (such as temperature, humidity, winds, and atmospheric stability), which in turn, vary with elevation and time.

Air Quality Monitoring, Visibility, and Deposition in the Lander Planning Area

Various state and federal agencies monitor air pollutant concentrations, visibility, and atmospheric deposition throughout Wyoming, and there are four monitors in the planning area (Lander, South Pass, South Pass City, and Sinks Canyon). Table 3.1, "Air Quality Monitoring Sites in or Near the Planning Area" (p. 234) lists the available air quality monitoring sites in the planning area and in other nearby planning areas. The Wyoming Department of Environmental Quality (DEQ) operates a $PM_{2.5}$ monitor as part of the State and Local Monitoring Site (SLAMS) network in Lander. The SLAMS monitor at South Pass measures ozone, nitrous oxides, PM_{10}, and SO_2. A new air quality monitoring station has been established in the Frenchie Creek area by an oil and gas operator but the Wyoming DEQ has no administrative oversight of the station. A new SLAMS air quality monitoring station was established by Wyoming DEQ in January 2010 at the Juel Spring site, which is located 20 miles northwest of Farson in Sublette County.

The U.S. Forest Service (USFS) operates an IMPROVE monitor in the North Absaroka Wilderness Area in Park County (in the Bighorn Basin planning area) and another IMPROVE monitor is operated at Pinedale in neighboring Sublette County. The Sinks Canyon and South Pass City monitors, which the BLM operate as part of the National Acid Deposition Program (NADP), measure atmospheric deposition (wet) of NH_4+, sulfate (SO_4), and various metals.

Table 3.1. Air Quality Monitoring Sites in or Near the Planning Area

County	Site Name	Type of Monitor	Parameter	Operating Schedule	Location	
					Longitude	Latitude
Fremont	Lander	SLAMS	$PM_{2.5}$	Once every 3 days	-108.733	42.833
	South Pass	SLAMS	O_3, NO_x, PM_{10}, SO_2	Hourly & once every 3 days (PM_{10})	-108.431	42.315
	South Pass City	NADP	NH_4, NO_3, SO_4 wet deposition, precipitation	Daily precipitation, weekly concentrations	-108.832	42.494
	Sinks Canyon	NADP	NH_4, NO_3, SO_4 wet deposition, precipitation	Daily precipitation, weekly concentrations	-108.850	42.734
Park	North Absaroka	IMPROVE	$PM_{2.5}$, NO_3, NH_4, nitric acid, SO_4, SO_2, and meteorology	Once every 3 days	-109.382	44.745
Sublette	Bridger Wilderness	IMPROVE	$PM_{2.5}$, NO_3, NH_4, nitric acid, SO_4, SO_2, and meteorology	Once every 3 days	-109.758	42.975
Uinta	Murphy Ridge	SLAMS	CO	Hourly	-111.042	41.373

Sources: EPA 2009a; IMPROVE Data 2009; NADP 2009

CO Carbon Monoxide
IMPROVE Interagency Monitoring of Protected Visual Environments
NADP National Acid Deposition Program
NH_4 Ammonium
NO_x Nitrogen Oxides
NO_3 Nitrate
O_3 Ozone
$PM_{2.5}$ Particulate matter less than 2.5 microns in diameter
PM_{10} Particulate matter less than 10 microns in diameter
SLAMS State and Local Monitoring Site
SO_2 Sulfur Dioxide
SO_4 Sulfate

Climate in the Planning Area

The climate in the planning area is designated as a combination of Intermountain Semi-Desert and Southern Rocky Mountain Steppe. Summers are generally short and hot and winters long and cold. Precipitation has historically been low, though greater at higher elevations, and distributed across the year, with the exception of the drier summer months. Wind speeds are variable but strong, which helps disperse airborne pollutants.

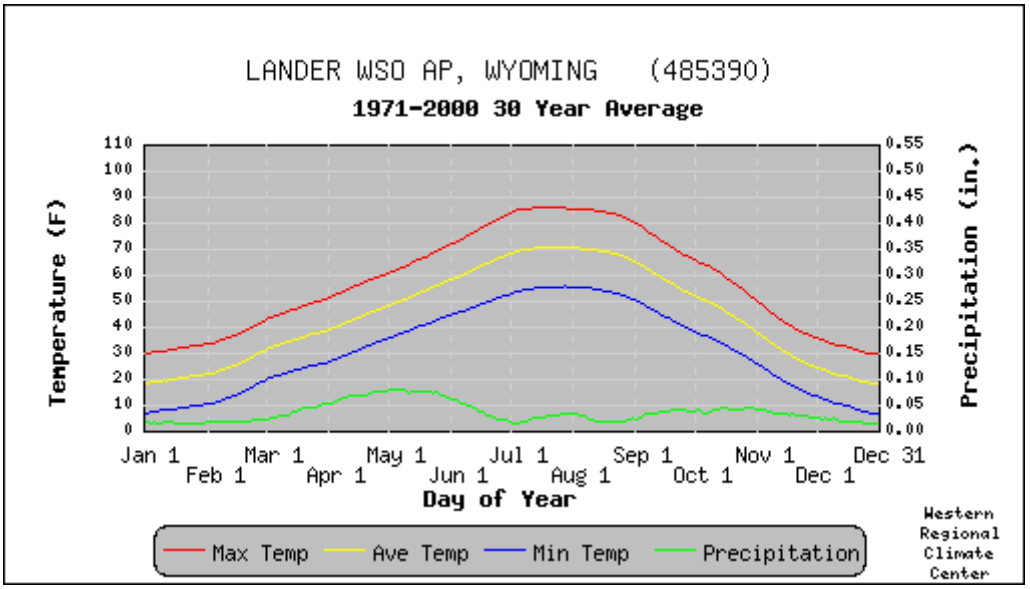
Table 3.2, "Summary of Climate in the Planning Area" (p. 235) lists temperature, precipitation, and wind speed data for the planning area. This information is derived from daily ambient measurements at the Lander monitor from 1971 through 2000.

Figure 3.1, "Average Monthly Temperature and Precipitation for Lander, Wyoming, 1971-2000" (p. 235) illustrates the general climate in Lander, Wyoming, showing long-term

monthly averages of temperature and precipitation as recorded at the Lander Airport. While there is considerable variation in temperature and precipitation throughout the planning area, the relative relationships of temperature and precipitation throughout the year are similar in most areas.

Table 3.2. Summary of Climate in the Planning Area

Climate Component	Description
Temperature	Daily maximum summer temperature: 86.3°F Daily minimum winter temperature: 8.7°F Mean annual temperature: 45°F
Precipitation	Mean annual precipitation: 13.4 inches Mean annual snowfall: 103.6 inches Mean winter snow depth: 4.25 inches (November through February)
Winds	Mean annual wind speed: 6.8 mph Prevailing wind direction: southwesterly
Source: Western Regional Climate Center Data 2009 °F degrees Fahrenheit mph miles per hour	



Source: BLM 2009b

AP Airport
°F degrees Fahrenheit
in inches
WSO Bureau of Land Management Wyoming State Office
Data are smoothed using a 29-day running average.

Figure 3.1. Average Monthly Temperature and Precipitation for Lander, Wyoming, 1971-2000

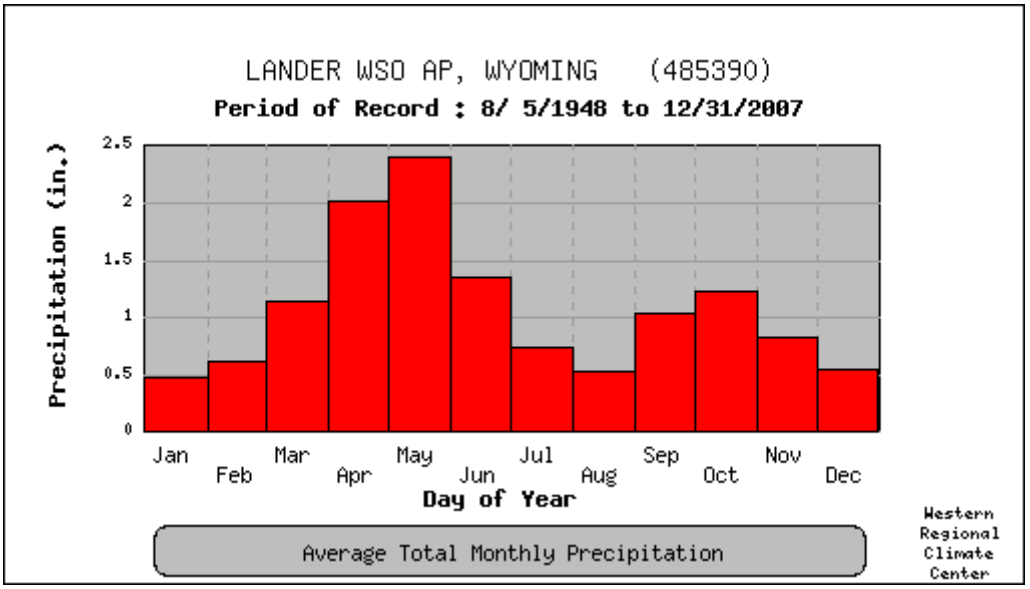
Long-term average annual precipitation varies from less than 6 inches in the area north of the town of Shoshoni, to 20 inches or more in the mountainous area near Dubois (Map 9). Away from the truly arid area north of Shoshoni, most annual precipitation occurs as snow. As a rule, the

highest elevations in the mountains receive the most precipitation and the lowest elevations the least. Table 3.3, "Average Annual Precipitation for Locations in the Planning Area" (p. 236) lists average annual precipitation data for representative locations derived from various monitors, as archived by the National Oceanic and Atmospheric Administration.

Table 3.3. Average Annual Precipitation for Locations in the Planning Area

Location	Inches of Total Precipitation (inches of snow)
South Pass	13.3 (119.4)
Muddy Gap	9.9 (50.8)
Sand Draw	9.6 (52.7)
Dubois	8.8 (41.7)
Boysen Dam	9.0 (13.7)
Lander	13.4 (98.8)
Source: BLM 2009b	

In most areas, there is a peak period of precipitation in the spring and a secondary peak in the fall. Figure 3.2, "Average Monthly Total Precipitation for Lander, Wyoming, 1948-2007" (p. 236) depicts Lander's monthly average precipitation and shows the April-May-June and mid-September to mid-November peaks.



Source: BLM 2009b

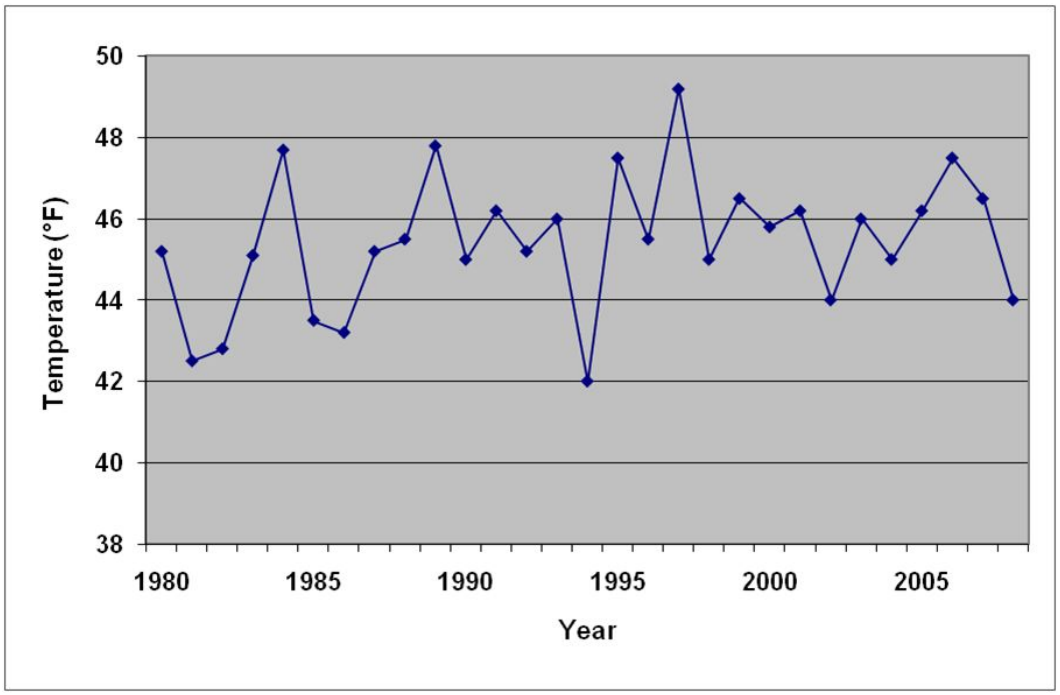
in. inches

Figure 3.2. Average Monthly Total Precipitation for Lander, Wyoming, 1948-2007

The planning area receives a high amount of sunshine, from 60 percent of the possible amount during winter to approximately 75 percent during the summer. Mountain areas receive less sunshine, and in winter the estimated amount over the mountains is approximately 45 percent. Because the altitude provides less atmosphere for the sun's rays to penetrate and because of the small amount of fog, haze, and smoke, the intensity of sunshine is especially high. The average relative humidity is low, which, with the high percentage of sunshine and rather high winds, all contribute to a high rate of evaporation. The overall average amount of evaporation ranges from 30 to approximately 50 inches (Curtis and Grimes 2004).

Although Wyoming is windy and ranks first in the United States with an annual average wind speed of 12.9 miles per hour, Lander and much of the Wind River Basin have average daily wind speeds of about half the state average.

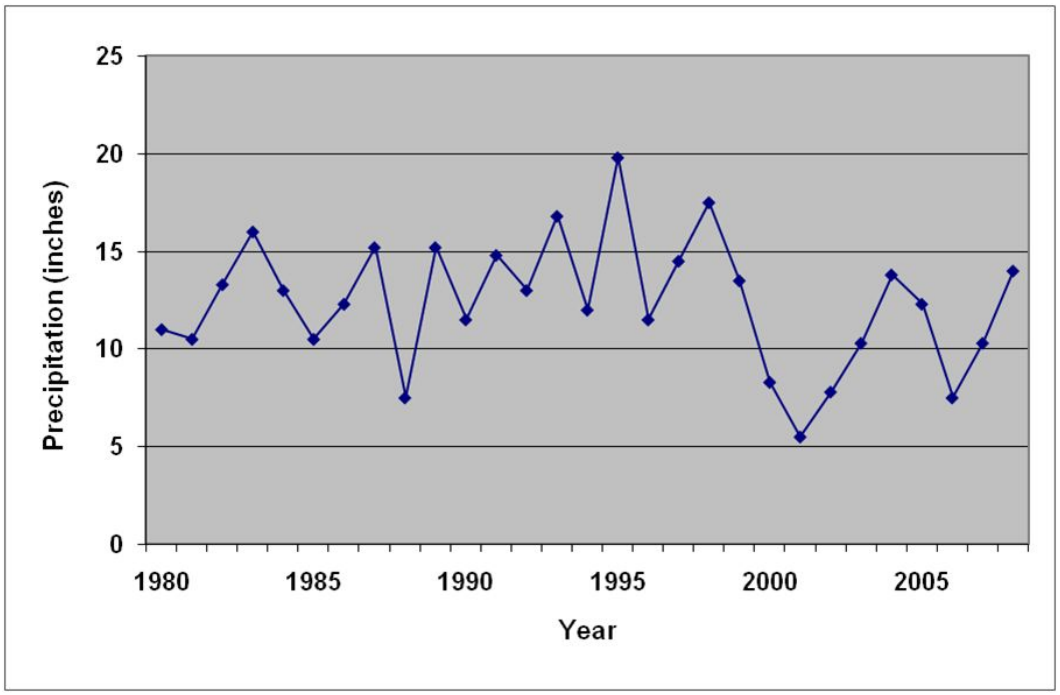
Figure 3.3, "Average Annual Temperature (°F) for Hunt Field, Lander, Wyoming, 1979-2008" (p. 237) and Figure 3.4, "Average Annual Precipitation (inches) for Hunt Field, Lander, Wyoming, 1979-2008" (p. 237) show 30-year trends in annual average temperature and precipitation for the Hunt Field site in Lander. The figures indicate a slight increase in average temperature over the 30-year period and a decrease in annual average precipitation over this period. The below average precipitation during the last 10 years is a reflection of drought conditions that have been pervasive throughout the western United States.



Source: NOAA 2009

°F degrees Fahrenheit

Figure 3.3. Average Annual Temperature (°F) for Hunt Field, Lander, Wyoming, 1979-2008



Source: NOAA 2009

Figure 3.4. Average Annual Precipitation (inches) for Hunt Field, Lander, Wyoming, 1979-2008

Air Quality

With a limited number of air quality monitors in the planning area, it is difficult to accurately assess existing air quality conditions throughout the area. As previously noted, a new SLAMS monitoring station was established in January 2010 at the Juel Spring site in Sublette County. However, air quality, visibility, and atmospheric deposition are monitored throughout Wyoming, including adjacent planning areas. Therefore, the assessment of recent air quality conditions in the Lander planning area has been conducted by examining data collected at the monitors within the area supplemented by various monitors in neighboring planning areas, as summarized in Table 3.4, "Applicable National and State Primary Air Quality Standards for Criteria Pollutants and Existing Representative Concentrations for the Planning Area" (p. 239). The examination of these data indicates that the current air quality for criteria pollutants in the planning area is considered good overall. Based on measurements within the area, visibility in the planning area is considered excellent.

Table 3.4, "Applicable National and State Primary Air Quality Standards for Criteria Pollutants and Existing Representative Concentrations for the Planning Area" (p. 239) provides an overview of applicable primary WAAQS and NAAQS and recent representative pollutant concentrations measured in the planning area and at nearby sites.

Table 3.4. Applicable National and State Primary Air Quality Standards for Criteria Pollutants and Existing Representative Concentrations for the Planning Area

Pollutant	Averaging Time	National Ambient Air Quality Standards (NAAQS)			Wyoming Ambient Air Quality Standards (WAAQS)			Representative Concentrations		
		(ppm)	(ppb)	(µg/m³)	(ppm)	(ppb)	(µg/m³)	(ppm)	(ppb)	(µg/m³)
Carbon Monoxide	1 hour[1]	**35**	35,000	40,000	35	35,000	40,000 (µg/m³)	0.7	700	801
	8 hour[1]	**9**	9,000	10,000	9	9,000	10,000 (µg/m³)	0.9	900	1,029
Nitrogen Dioxide	1 hour[2]	0.1	**100**	189	---	---	---	---	---	---
	Annual (Arithmetic Mean)	**0.053**	53	100	0.05	50	**100**	0.002	2	3.4
PM_{10}	24 hour[3]	---	---	**150**	---	---	**150** [(c)]	---	---	78
	Annual (Arithmetic Mean)	None			---	---	**50**	---	---	---
$PM_{2.5}$	24 hour[4]	---	---	35	---	---	**35**	---	---	24.2
	Annual (Arithmetic Mean)[5]	---	---	15.0	---	---	**15.0**	---	---	7.6
Ozone	8 hour[6]	**0.075**	75	147	**0.08**	80	157	0.066	66	129
Sulfur Dioxide	1 hour[7]	0.075	**75**	197	---	---	---	---	---	---
	3 hour[1]	None			0.50	500	**1,300**	---	---	---
	24 hour[8]	**0.14**	140	365	0.10	100	**260**	0.001	0.57	1.48
	Annual (Arithmetic Mean)	**0.03**	30	80	0.02	20	**60**	0.0003	0.25	0.66

Note: **Bold** indicates the standard as written in the corresponding regulation. Other values are conversions.

Source: BLM 2009b
NAAQS National Ambient Air Quality Standards
$PM_{2.5}$ particulate matter less than 2.5 microns in diameter
PM_{10} particulate matter less than 10 microns in diameter
ppm parts per million
ppb parts per billion
µg/m³ micrograms per cubic meter
SLAMS State and Local Air Monitoring Station
WAAQS Wyoming Ambient Air Quality Standards
WARMS Wyoming Air Resource Monitoring System

[1]Not to be exceeded more than once per year. Data collected at Murphy Ridge in 2008.
[2]To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 100 ppb. Data collected at Thunder Basin in 2008.
[3]Not to be exceeded more than once per year on average over three years. Maximum 24-hour average for 2008 at the South Pass site.
[4]To attain this standard, the three-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor in an area must not exceed 35 µg/m³. Maximum 24-hour average for 2006 for the Lander SLAMS site.
[5]To attain this standard, the three-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m³. Annual average for 2008 for the Lander SLAMS site.
[6]To attain this standard, the three-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor in an area over each year must not exceed 75 ppb. Measured fourth highest concentration for 2008 for the South Pass site.
[7]To attain this standard, the 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 75 ppb.

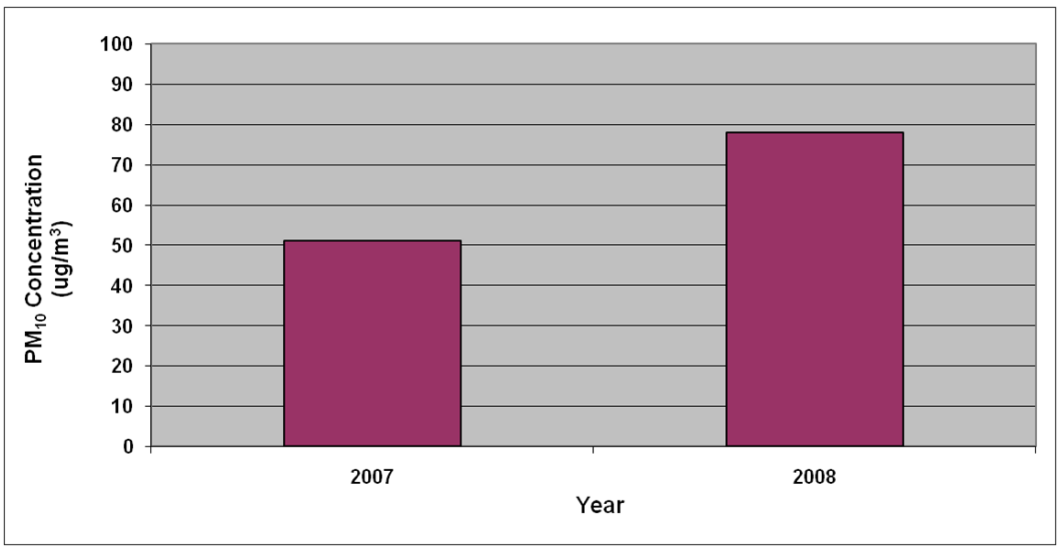
Pollutant	Averaging Time	National Ambient Air Quality Standards (NAAQS)			Wyoming Ambient Air Quality Standards (WAAQS)			Representative Concentrations		
		(ppm)	(ppb)	(µg/m³)	(ppm)	(ppb)	(µg/m³)	(ppm)	(ppb)	(µg/m³)
[8]Not to be exceeded more than once per year. Maximum 24-hour and annual averages for 2008 for the Sheridan WARMS site.										

Trends in Air Quality

This section evaluates recent trends in air quality by examining data collected at the Lander, South Pass, South Pass City, and Sinks Canyon monitors in the Lander planning area, and as best as can be inferred by examining criteria pollutant, visibility, and deposition data collected at other monitoring sites in adjacent planning areas.

Air Pollutant Concentrations

Air quality data collected at the various monitors in and near the Lander planning area (Table 3.4, "Applicable National and State Primary Air Quality Standards for Criteria Pollutants and Existing Representative Concentrations for the Planning Area" (p. 239)) are presented for PM_{10}, $PM_{2.5}$, SO_2, and ozone. Figure 3.5, "Peak 24-Hour Average PM_{10} Concentrations (µg/m³) at the South Pass, Wyoming Site" (p. 240) shows annual peak 24-hour average PM_{10} concentrations at the South Pass site for 2007 and 2008. For these years, peak 24-hour average measurements of PM_{10} are well below the standard (150 micrograms per cubic meter [µg/m³)]), and no real trend can be discerned.

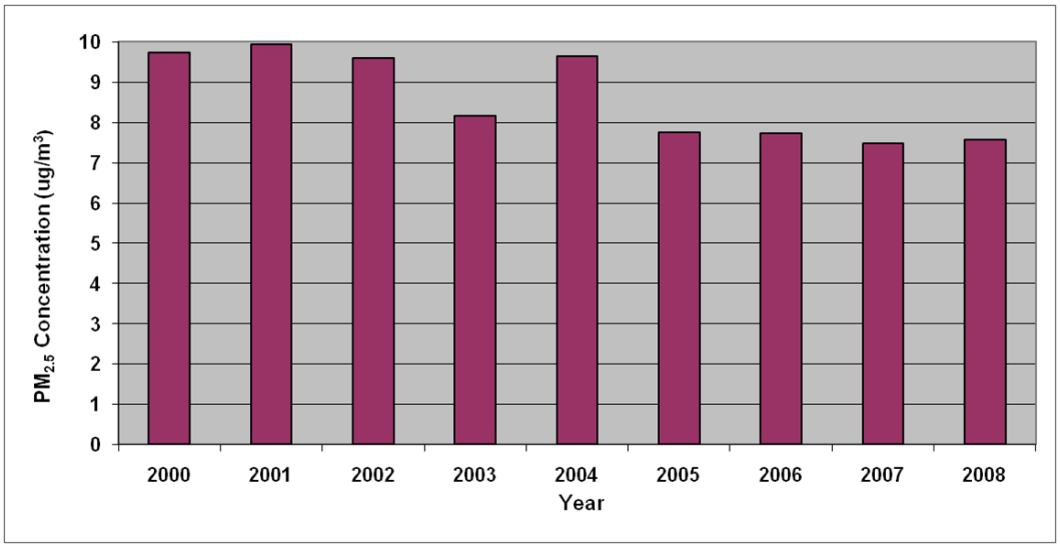


Source: EPA 2009a

PM_{10} Particulate matter less than 10 microns in diameter
µg/m³ micrograms per cubic meter

Figure 3.5. Peak 24-Hour Average PM_{10} Concentrations (µg/m³) at the South Pass, Wyoming Site

Figure 3.6, "Annual Average $PM_{2.5}$ Concentrations (µg/m³) at the Lander, Wyoming Site" (p. 240) shows annual average $PM_{2.5}$ data collected at the Lander monitor from 2000 through 2008. The data indicate that annual average $PM_{2.5}$ concentrations in the Lander area are well below the NAAQS, and trends are relatively flat during the last four years.

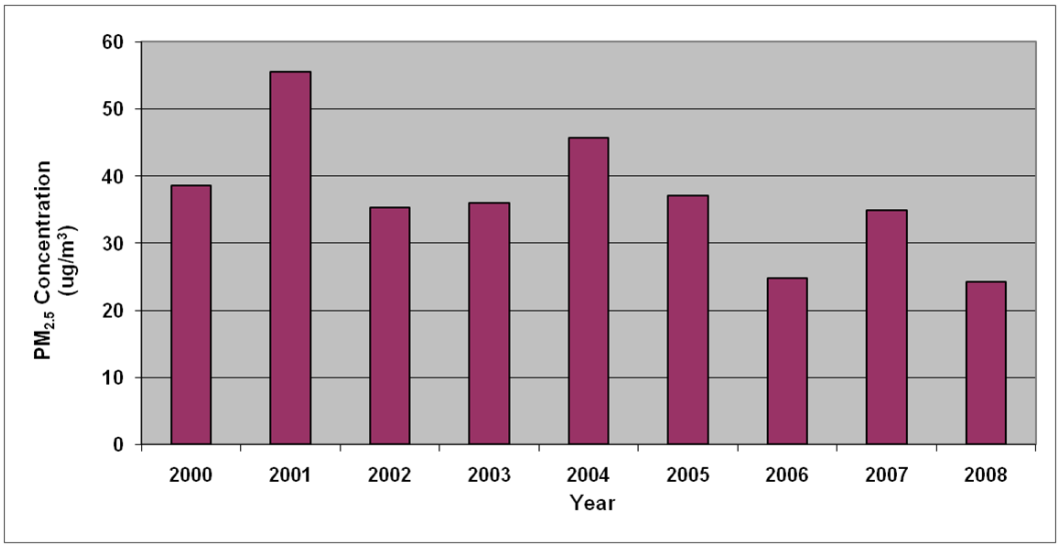


Source: EPA 2009a

$PM_{2.5}$ Particulate matter less than 2.5 microns in diameter
µg/m³ micrograms per cubic meter

Figure 3.6. Annual Average $PM_{2.5}$ Concentrations (µg/m³) at the Lander, Wyoming Site

Figure 3.7, "Peak 24-hour Average $PM_{2.5}$ Concentrations (µg/m³) at the Lander, Wyoming Site" (p. 241) shows 24-hour average $PM_{2.5}$ data collected at the Lander monitor from 2000 through 2008. The data indicate that from 2000 through 2005, the peak 24-hour average $PM_{2.5}$ concentration in the Lander area was at or above the standard, with a maximum concentration in 2001 of 55 µg/m³, which is nearly 60 percent higher than the standard. However, measurements for the three most recent years are lower and show a slight downward trend, with concentrations below the standard.

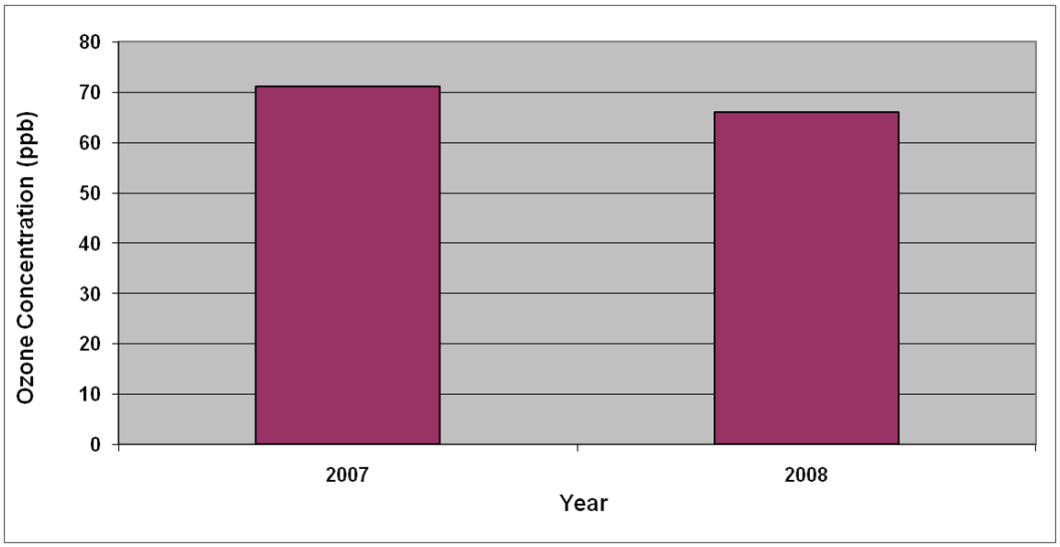


Source: EPA 2009a

$PM_{2.5}$ Particulate matter less than 2.5 microns in diameter
µg/m^3 micrograms per cubic meter

Figure 3.7. Peak 24-hour Average $PM_{2.5}$ Concentrations (µg/m^3) at the Lander, Wyoming Site

Figure 3.8, "Fourth Highest Eight-Hour Average Ozone Concentrations (ppb) at the South Pass, Wyoming SLAMS Site" (p. 242) shows the fourth highest 8-hour average ozone data for the South Pass site for 2007 and 2008. These data are used to determine the area's ozone "design value," which is calculated as the three-year average of the fourth highest observed concentration. The design value is used to assess compliance with the national standard. Given that there are only two years of available data, it is not possible to properly calculate the design value. However, given these measurements, the estimated (two-year) design value is less than 70 parts per billion (ppb), which is below the 8-hour average ozone standard of 75 ppb.

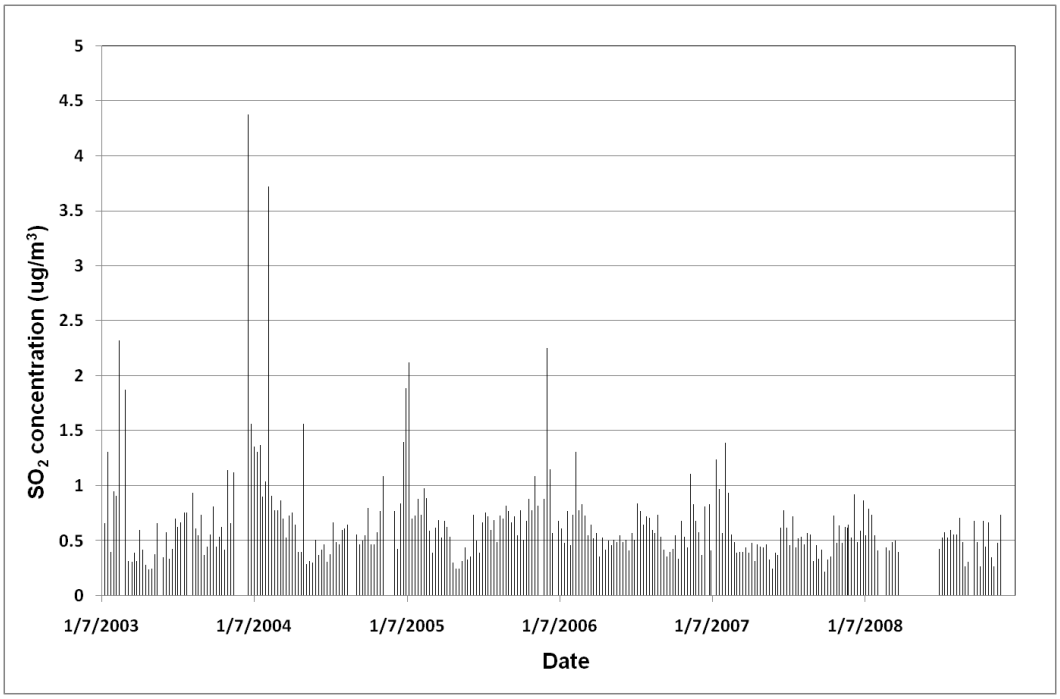


Source: Wyoming DEQ 2009

ppb parts per billion
SLAMS State and Local Air Monitoring Station

Figure 3.8. Fourth Highest Eight-Hour Average Ozone Concentrations (ppb) at the South Pass, Wyoming SLAMS Site

Although not in the planning area, monitoring data from the Buffalo site (in the Buffalo planning area) as part of the Wyoming Air Resource Monitoring System (WARMS) network provides a summary of observed concentrations of SO_2. Figure 3.9, "Weekly SO_2 Concentration in Buffalo WARMS site" (p. 243) shows weekly average concentrations of SO_2 for the Buffalo site from 2003 to 2008. Although there are missing data for a number of weeks throughout this period, especially in 2008, the data show weekly and seasonal variations in SO_2, with no discernable long-term trend over this period. Also, given its location and distance in relation to the Lander planning area, these data might not accurately reflect SO_2 concentrations in the Lander planning area.



Source: WARMS 2009

µg/m^3 micrograms per cubic meter
SO_2 sulfur dioxide
WARMS Wyoming Air Resource Monitoring System

Figure 3.9. Weekly SO_2 Concentration in Buffalo WARMS site

Visibility

An environmental concern in the United States is the improvement and/or maintenance of visibility conditions, especially in national parks, recreation areas, wilderness areas, and national forests. There are several such areas in the vicinity of the planning area. The WRIR is within the Lander Field Office boundaries and although the WRIR has not yet chosen to identify itself as a PSD Class I area, it is considering doing so. A list of these areas, which are designated either Class I or Class II areas, is presented in Table 3.5, "Class I and Class II Areas in the Vicinity of the Planning Area" (p. 245).

Table 3.5. Class I and Class II Areas in the Vicinity of the Planning Area

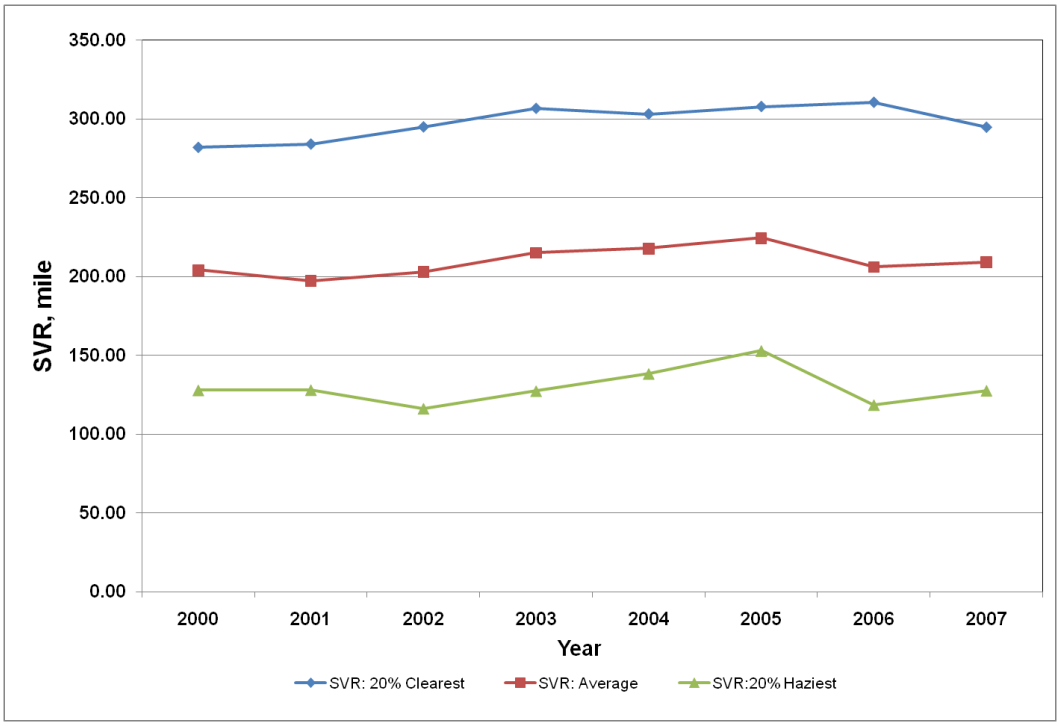
Area Type	Area Name	Closest Distance to the Lander Planning Area (miles)	Direction from the Lander Planning Area	Clean Air Act Status of the Area
National Park	Grand Teton National Park	20	West	Class I
	Yellowstone National Park	25	West	Class I
Recreation Area	Bighorn Canyon National Recreation Area	90	North	Class II
Wilderness Area	Cloud Peak Wilderness Area	60	Northeast	Class II
	North Absaroka Wilderness Area	80	Northwest	Class I
	Washakie Wilderness Area	40	Northwest	Class I
	Fitzpatrick Wilderness Area	In	N/A	Class I
	Popo Agie Wilderness Area	In	N/A	Class II
	Bridger Wilderness Area	Adjacent	West	Class I
	Teton Wilderness Area	30	Northwest	Class II
National Forest	Bighorn National Forest	60	Northeast	Class II
	Thunder Basin National Grassland	90	East	Class II

Source: NPS 2006

N/A Not Applicable

Because there are no IMPROVE monitors in the Lander planning area, estimates of visibility in the area are primarily derived from air quality and meteorological measurements from the Bridger Wilderness IMPROVE monitor to the west in the adjacent Pinedale planning area and the North Absaroka IMPROVE monitor to the north in the Bighorn Basin planning area. This document includes data from these IMPROVE monitors to provide the most available data for visibility in areas close to the Lander planning area.

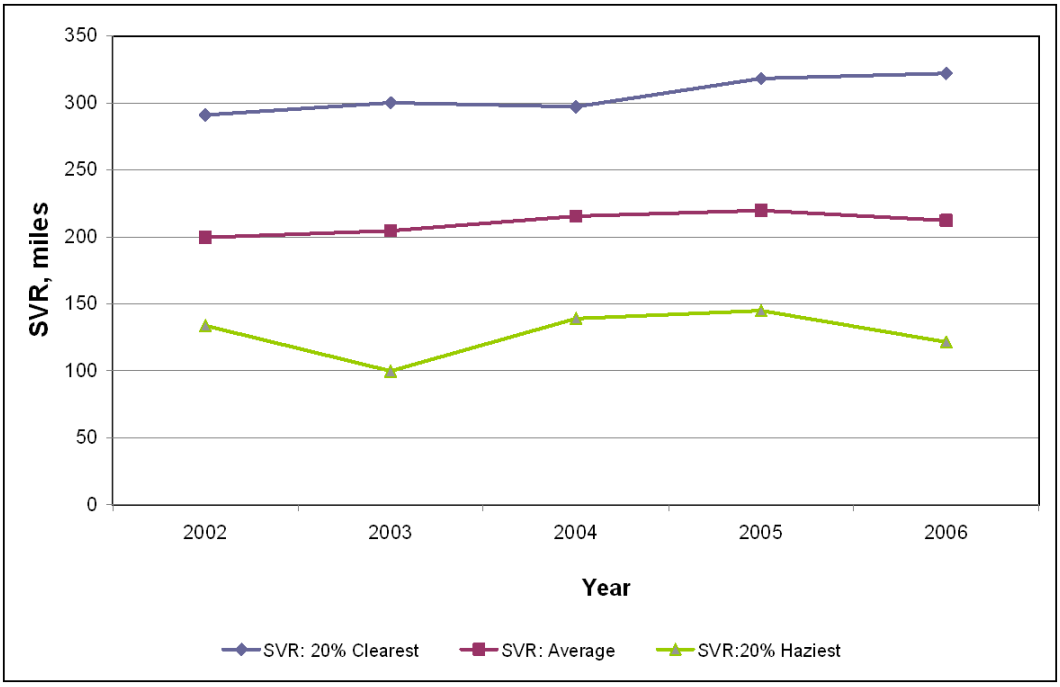
Figure 3.10, "Annual Visibility (SVR) at the Bridger Wilderness Wyoming IMPROVE Site" (p. 245) shows visibility estimates for the Bridger Wilderness IMPROVE site for the period 2000-2007. The data indicate excellent visibility conditions with no real trend in this period. Figure 3.11, "Annual Visibility (SVR) at the North Absaroka Wyoming IMPROVE Site" (p. 246) presents visibility estimates for the North Absaroka site for 2002 through 2006. These data also indicate excellent visibility conditions to the north of the area and no real trends in this limited period.



Source: IMPROVE Data 2009

IMPROVE Interagency Monitoring of Protected Visual Environments
SVR Standard Visual Range

Figure 3.10. Annual Visibility (SVR) at the Bridger Wilderness Wyoming IMPROVE Site



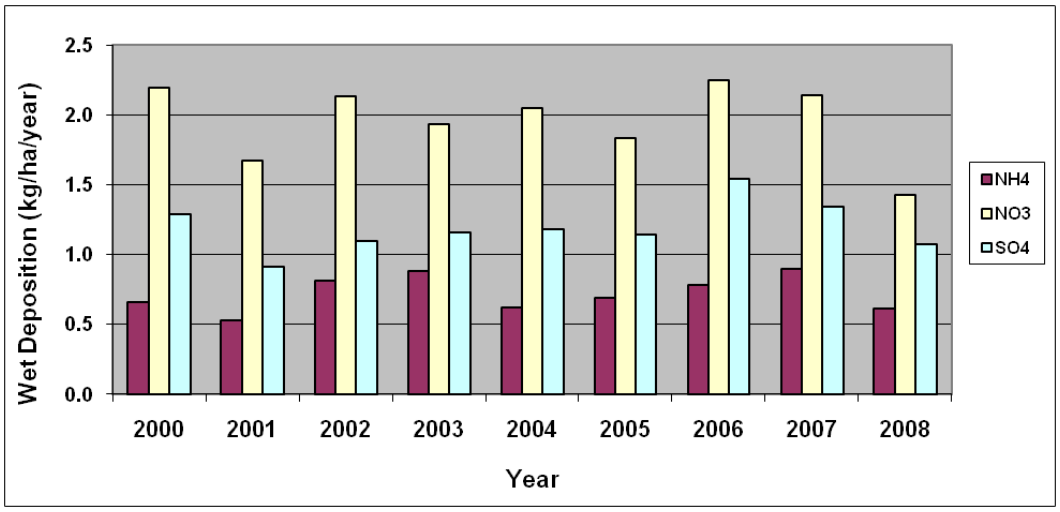
Source: IMPROVE Data 2009

IMPROVE Interagency Monitoring of Protected Visual Environments
SVR standard visual range

Figure 3.11. Annual Visibility (SVR) at the North Absaroka Wyoming IMPROVE Site

Atmospheric Deposition

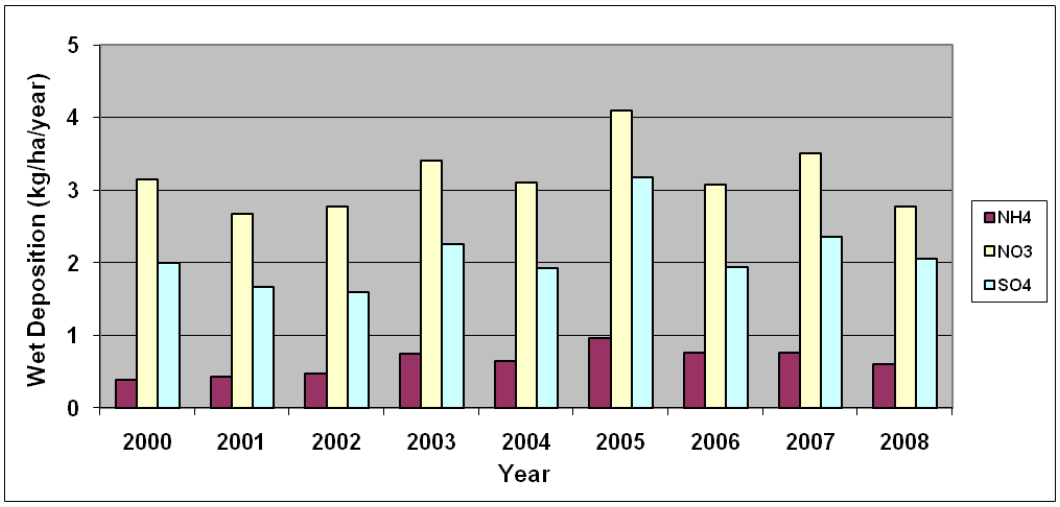
There are two NADP stations located within the planning area, one at Sinks Canyon and one at South Pass City. Figure 3.12, "Total Annual Wet Deposition (kilograms per hectare per year) at the Sinks Canyon Wyoming NADP Site" (p. 247) and Figure 3.13, "Total Annual Wet Deposition (kilograms per hectare per year) at the South Pass City Wyoming NADP Site" (p. 248) show total annual wet deposition for NH_4, NO_3, and SO_4 for 2000 through 2008 for the Sinks Canyon and South Pass sites. There are no discernable trends in these measurements over this period.



Source: NADP 2009

Kg/ha/year kilograms per hectare per year
NADP National Acid Deposition Program
NH_4 ammonium
NO_3 nitrate
SO_4 sulfate

Figure 3.12. Total Annual Wet Deposition (kilograms per hectare per year) at the Sinks Canyon Wyoming NADP Site



Source: NADP 2009

Kg/ha/year kilograms per hectare per year
NADP National Acid Deposition Program
NH_4 ammonium
NO_3 nitrate
SO_4 sulfate

Figure 3.13. Total Annual Wet Deposition (kilograms per hectare per year) at the South Pass City Wyoming NADP Site

Sources of Hazardous Air Pollutants (HAPs) and Criteria Pollutants

Existing sources of HAPs, criteria pollutants and Greenhouse Gases (GHGs) in the planning area include fossil-fuel combustion that emits HAPs; oil, gas, and coal development operations that emit VOCs; NO_X; and hydrogen sulfide (H_2S). In addition, large fires are a source of HAPs emissions. The growth in resource development and accompanying increases in emissions from these types of sources will depend on a number of external factors that make it difficult to estimate actual trends in concentrations of these pollutants in the planning area.

Summary of Air Quality Trends

Available air quality data for a number of criteria pollutants that were examined at various monitors in and near the planning area do not show any major upward or downward trends over the various periods of record. With only two years of available data at the South Pass site for PM_{10}, it is not possible to identify trends. Concentrations of $PM_{2.5}$ at the Lander site show a relatively flat trend during the last four years of record (2005 through 2008). For the South Pass site, the fourth highest 8-hour average ozone concentrations for 2007 and 2008 are below the national standard; however, it is not possible to identify trends using only two data points. Visibility data collected at the Bridger Wilderness site show very good to excellent visibility, even for the 20 percent haziest days. Wet deposition data for NH_4, NO_3, and SO_4 from the Sinks Canyon and South Pass City sites also show no distinct trend in deposition over the nine-year period of record (2000 through 2008) examined in this analysis.

Greenhouse Gases

Refer to the *Climate Change* section at the end of this chapter for information on historical and projected climate change in the planning area, potential impacts of climate change in the planning area, and activities in the planning area that may be contributing to climate change.

Management Challenges for Air Quality

Limited air quality data for the planning area makes it difficult to fully assess air quality conditions. Except for ozone, the limited monitoring data available from the few sites in the planning area and data collected at monitors in nearby areas reflect good to excellent air quality and visibility. With only two years of 8-hour ozone data at the South Pass site (2007 and 2008), it is not possible to calculate the design value, which is used to assess compliance with the NAAQS. The estimated design value for South Pass using the two available years of data is 68 ppb, which is below the current level of the standard (75 ppb). However, EPA is currently evaluating the level of the standard and may reduce the standard to between 60 and 70 ppb. If the 8-hour ozone NAAQS is reduced within this range, it is possible that the nonattainment area proposed for Sublette County (Pinedale planning area) may be expanded to include the planning area. One of the management challenges for the planning area is related to the accuracy of characterization of air quality conditions based only on limited data. Given this, continued maintenance of the applicable federal and state air quality standards is an issue. As additional resource development scenarios are considered for the planning area, it would be important to evaluate the impacts that emissions from development sources will have on criteria pollutants, visibility, and atmospheric deposition. The BLM expects to work cooperatively with the Wyoming DEQ, the EPA, and other federal agencies such as the National Park Service and USFS to address these issues.

Additional challenges for the planning area will be to continue to characterize air quality conditions and track trends using limited monitoring data. Because of the limited data available to properly characterize air quality in the planning area, it would be prudent to establish additional

monitoring sites throughout the planning area. Other challenges include developing effective rules and management actions aimed to maintain compliance with standards and improve air quality.

3.1.2. Geologic Resources

Regional Context

The planning area is in the regional geologic provinces of the Wyoming plains and the Rocky Mountains. Igneous, metamorphic, and sedimentary rocks of all geologic periods, except the Silurian, are present and represent a span from 3 billion years ago to the very recent – 10,000 years ago. The geologic setting consists of basins separated and surrounded by mountain ranges, including the Owl Creek, Washakie, Absaroka, Wind River, Granite, and Rattlesnake. Basins include most of the Wind River and the northern portion of the Great Divide Basin. Most of the planning area is in the Wind River Basin, with less than 150,000 acres in the Great Divide Basin.

The geologic setting contributes to the formation of numerous important geologic resources such as Red Canyon, Beaver Rim, Lander Slope and Table Mountain, Sweetwater Canyon, and Sweetwater Rocks. There also are unique geologic settings responsible for hosting certain mineral resource types and occurrences such as oil and gas, hard rock and placer gold, uranium, phosphate, and bentonite.

Several geologic features in the planning area are of special interest because of their unusual characteristics. These features include, but are not limited to the following:

- The Red Canyon Area approximately 24 miles south of Lander on Highway 28 offers one of the most accessible and dramatic examples of Laramide-age range-front structures in the Rocky Mountains. The canyon is an erosional feature, sited on the flank of the Wind River Range, which were uplifted during the Laramide Orogeny between 90 and 50 million years ago. Subsequent erosion and exposure beginning primarily in the Neogene (about 23 million years ago) and continuing to the present has created the landscape as viewed today.

- The Beaver Rim is a scenic feature that was formed by the continuing erosion and excavation of sediments from the Wind River Basin by the Wind River. This feature is geologically important because it represents an unusually complete sequence of Tertiary deposits that are exposed along the slopes of the rim. This sequence includes representative exposures of virtually complete Early Eocene Epoch (approximately 53 million years ago) through Middle Miocene Epoch (approximately 10 million years ago) stratigraphy. This nearly complete sequence is rarely exposed as a unit and is important to the understanding of Wyoming Tertiary geology. Its significance is increased by its proximity to U.S. Highway 287, where travelers can easily view the most intact section, which occurs near Green Cove.

- The Dubois Badlands area consists of approximately 4,903 acres of BLM-administered surface with badlands characterized by extensive erosion patterns and colorful soil banding, starting two miles north of Dubois and extending to the east.

Physiography

The planning area is generally contained within the boundary of the larger Wind River basin, a representative example of the numerous structural and sedimentary basins that formed in the Rocky Mountain region in response to Laramide-age tectonic activity (Keefer 1965). The Wind River Basin is also a physiographic basin, with drainage primarily out of the basin to

the north and southeast and with most of the streamflow originating in the high country of the Wind River Range. Streams flowing out of the planning area actually contribute to two major drainages: the Missouri River drainage, which flows into the Gulf of Mexico, and much less significantly, the Snake River drainage, a tributary to the Columbia River system, which flows into the Pacific Ocean.

The major streams of the Missouri River drainage basin which drain the planning area include the Wind River system (Wind River, Little Wind River, north, south and middle forks of the Popo Agie River) and the Sweetwater River. The Wind River flows north out of the Wind River Basin and through the Owl Creek Mountains, where it is renamed the Bighorn River as it emerges from the north side of the canyon. The Bighorn River continues to flow north and eventually connects to the Yellowstone River, which is tributary to the Missouri River. The Sweetwater River drains the southern portion of the planning area from South Pass east to Pathfinder Reservoir, where it meets the North Platte River, a tributary to the Missouri River. Beaver Divide separates surface water that flows into the Wind River watershed from surface water that flows into the Sweetwater River watershed.

Near Dubois, Fish Creek drains approximately 30 square miles of the planning area to the west. The waters of Fish Creek flow to the Gros Ventre River, which in turn, makes confluence with the Snake River near Jackson, Wyoming. There is also a small portion of the planning area near a half-mile stretch of Wallace Creek in the Rattlesnake Hills that drains north to the Powder River Basin. The Powder River is a tributary to the Yellowstone River which drains to the Missouri River.

Structural Geology

The configuration of structural geologic features of the Wind River Basin that impact the nature and occurrence of mineral resources presently found in the planning area is closely controlled by events dating back to the Laramide orogeny. During the late Cretaceous Period, tectonic activity that represented the initial stages of the Laramide orogeny began in the form of down warping of the basin and broad doming of other areas peripheral to the basin (Keefer 1970). These structural events and those occurring during the bulk of the Laramide event exerted substantial influence on the style and pattern of sedimentation during all subsequent Tertiary time (Keefer 1965).

A major feature of the Laramide-age deformation is the Wind River uplift. This uplift is responsible for the Wind River Range and started as a large fold. As movement progressed, deformation continued as faulting where the upper crust acted as a rigid slab and the lower crust behaved more fluidly (Smithson et al. 1979). Predominately horizontal movement caused crustal shortening. This compression and resulting shortening along moderately dipping thrust faults can be related to plate movements during the Laramide orogeny (Brewer et al. 1980). The modern topographic Wind River Range resulted from the uplift and subsequent erosion of a doubly plunging, asymmetrical anticline cored by Archean-age crystalline rocks. The axis of this folded belt of rocks was breached by erosion, which exposed the crystalline core of the uplifted block, present at surface in the central part of the Wind River Range.

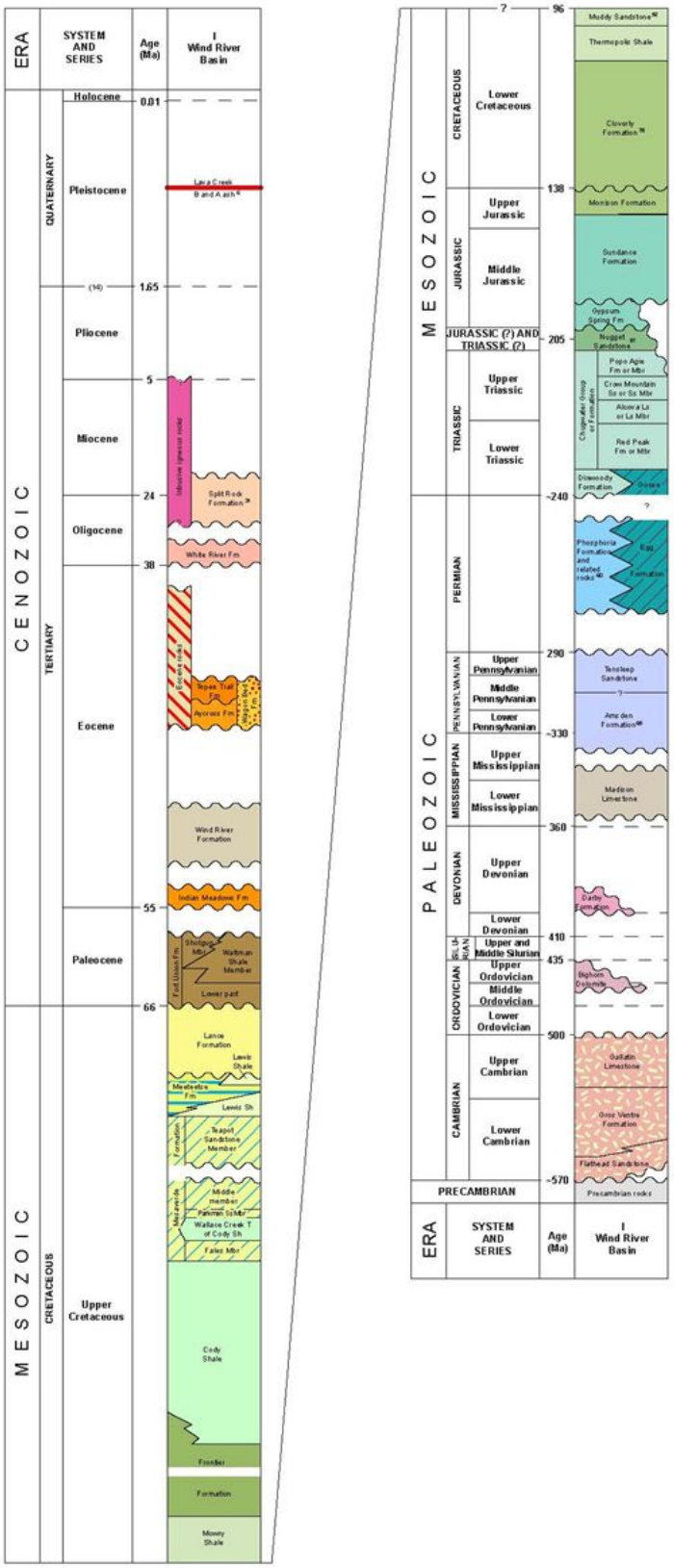
Parallel to and toward the center of the basin from the mountain uplifts there are many smaller structures such as the asymmetrical syncline in which the city of Lander is sited. On the west margin of the basin, the Sheep Mountain anticline, Lander-Hudson anticline, Derby Dome, and Dallas Dome are examples of smaller anticlinal features from which oil and gas are produced. In fact, the first commercial oil well in Wyoming was at Dallas Dome on the western edge of the Wind River Basin approximately 8 miles south of Lander. Many structural features are

unconformably covered with several hundred feet of younger, flat-lying sediments, generally of Tertiary age. Numerous faults of all variations are found in the planning area. Over-thrusting along major faults throughout the planning area represents good prospects for future oil and gas exploration.

Geologic Formations

Rocks can be roughly grouped into two main categories based on their presumed ages: the pre-Cambrian eon and the later Phanerozoic eon, which contains the eon corresponding to the present timeframe in the geologic timescale. Phanerozoic time began 542 million years before present (BP) and is the eon during which abundant vertebrate animal life has existed. This document employs the term pre-Cambrian to describe the age of all rocks originating before Phanerozoic time.

Rocks in the planning area range in age from pre-Cambrian to recent (see Figure 3.14, "Generalized Stratigraphic Column for the Planning Area" (p. 252)). Rocks from practically every Phanerozoic period except the Silurian (408 to 438 million years ago) are present in the planning area. Pre-Cambrian rocks generally consist of crystalline and metamorphic rocks exposed mostly in the core of uplifted areas, usually near the periphery of the basin, while Phanerozoic rocks include various kinds of sandstones, siltstones, carbonates, shales, and mudstones. In the Wind River Basin, the thickest accumulation of Phanerozoic sedimentary rocks is generally in the range of 20,000 to 30,000 feet. Tertiary-age sediments, generally of Eocene age, cover most of the central basin floor and in places abut crystalline rock exposures, as in the Granite Mountains area. Paleozoic and Mesozoic sedimentary rocks are exposed most often where structural conditions permit (for example, along mountain fronts, uplifts, and eroded canyons). For a more detailed description of the formations in the planning area, see the *Final Mineral Occurrence and Development Potential Report* (BLM 2009c).



Source: Love et al. 1993

Figure 3.14. Generalized Stratigraphic Column for the Planning Area

3.1.3. Soil

Soils in the planning area are highly variable. Soil characteristics can differ over relatively short distances, reflecting differences in parent material, position on the landscape, elevation, aspect, and local variation in precipitation and temperature.

Reconnaissance level soil surveys cover most of the planning area. These soil surveys include the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Cooperative Soil Surveys of Fremont County East and the Dubois Area Soil Survey of 1993; Natrona County Soil Survey of 1997; and Lander Area Soil Survey of 1981, which is in the process of being updated. There is no NRCS soil survey coverage for those portions of the planning area in Sweetwater and Carbon Counties.

General Description of Soils in the Planning Area

The planning area includes soils typical of cold, mountainous continental areas with arid, semi-arid, and sub-humid climates.

Soils in the arid, cold desert portions of the planning area can be found in the lowest parts of the Wind River Basin and in a second area known as the Great Divide Basin, most of which is in the Sweetwater County portion of the planning area. These soils receive the least annual precipitation, less than 10 inches and in some locations less than 5 inches. This area begins a few miles west of Dubois, follows the Wind River to Boysen Reservoir, and continues east to about Waltman in Natrona County. The northern boundary is the footslope of the Bridger Mountains and southern Big Horn Mountains, and the southern boundary is formed by the base of the Beaver Rim escarpment. Most of the badland, rock outcrop, and sand dune areas occur in arid areas. Topsoils in arid areas are thin and organic matter content is typically less than 1 percent in the surface horizon.

Soils in the semiarid portions of the planning area most commonly formed in mixed alluvium, primarily derived from sedimentary rock. The Split Rock Formation and the Wind River Formation are the source sedimentary rocks for much of this alluvium. The Amsden and Chugwater Formations, with their distinctive reddish sandstones, provide parent material for soils in certain locales such as scenic Sinks Canyon. There are also soils derived from granitic rock associated with the Louis Lake Batholith (Lewiston Lakes area), some of the upper slopes of the Wind River Mountains, as well as, the Bridger, Green, and Granite Mountains/Sweetwater Rocks and the Rattlesnake Hills. There are limited areas of badlands, rock outcrops, and sand dunes in the semiarid portions of the planning area. Topsoils in semiarid areas are thin and organic content is low, typically ranging from 1 to 2 percent in the surface horizon.

In both arid and semiarid environments, soils on stable land surfaces outside stream depositional areas commonly contain a horizon of clay accumulation immediately beneath the topsoil, underlain in turn by a zone of carbonate accumulation.

Arid and semiarid riparian-wetland soils are generally young and undeveloped, lacking developed subsoils, with similar organic matter levels in the topsoil as the upland soils. Some of the planning area's low swales, nivation hollows, and wet meadow/spring areas have developed soils with organic matter in the topsoil averaging from 2 to 5 percent.

Generally, soils above 8,000 feet in open meadows and areas where the climax vegetation is aspen have a thick topsoil horizon with high organic matter content, typically from 2 to 5 percent. These

soils occur on slopes ranging from nearly level to very steep. Coarse fragment content varies greatly. Soils above 8,000 feet range from well drained as in the dry meadows, to somewhat poorly drained as in some aspen stands, or poorly drained as in wet meadows.

Evergreen forested areas are typically composed of lodgepole pine, with minor amounts of Engelmann spruce and Douglas fir found primarily in drainages. The thin topsoils that support forest commonly contain organic matter averaging from 1 to 4 percent, and soil drainage varies from well drained to poorly drained. Aspen is often a pioneer species that is transitional to a climax lodgepole pine community on these sites. Soil slope ranges from nearly level to very steep, and coarse fragment content can vary from none to being extremely (more than 60 percent by weight course fragments) gravelly, cobbly, stony, or bouldery. These mountain soils are found in areas that receive 15 or more inches of annual precipitation. Giant boulder conglomerate forms the parent material for the forest soils on the Green Mountains. Parent material for the mountain soils on the slopes of the Wind River Mountains is typically alluvium, colluvium, residuum, and glacial deposits most commonly derived from igneous granitic and mafic rocks, and metamorphic such as gneiss and schist. The parent material for soils of the higher foothills and low mountain slopes of the Wind River Mountains on the Lander Slope are formed largely in sedimentary rocks of the Phosphoria Formation, Madison Limestone, and Ten Sleep Sandstone. Topsoils are thicker here than those of forest soils but not as thick as the wet meadow/aspen pocket soils. These topsoils typically average from 2 to 4 percent in the surface horizon.

Resource Condition

There has not been a comprehensive survey of soil/site stability and health in the planning area. Published reconnaissance-level soil surveys do not routinely map or note eroded phases of soil series. The BLM does some limited soil health monitoring including proper functioning condition (PFC) inventories, project inspection reports, and analysis of reclamation success to release bonds. The BLM does perform qualitative soil assessments by evaluating livestock grazing allotment compliance with the Wyoming Standards for Healthy Rangelands (Appendix J (p. 1437)). Standard 1 provides that, "Within the potential of the ecological site (soil type, landform, climate and geology), soils are stable and allow for water infiltration to provide for optimal plant growth and minimal surface runoff" (BLM 1997b). The BLM evaluates rangelands for compliance with Standard 1 by measuring appropriate indicators such as plant community composition and distribution in relation to infiltration and runoff; litter amount; functional/structural groups; plant mortality and decadence; vegetative annual production; invasive plants; soil compaction; erosion; and soil microorganisms. Standard 1 assessments provide the BLM with an overall picture of soil health for individual grazing allotments. Refer to the *Livestock Grazing Management* section of this chapter for additional information on the Wyoming Standards for Healthy Rangelands.

The existing condition of soil resources in the planning area varies greatly. There are still relatively undisturbed areas. These are typically areas livestock lightly use because of slope steepness or distance from water. Many of the soils types in the planning area are in good condition and capable of producing forage for wildlife and livestock, maintaining watershed integrity, and recovering from impacts associated with surface-disturbing activities. However, historic improper livestock grazing management, drought, extensive soil erosion, mineral development activities, rights-of-way (ROWs), off-highway vehicle (OHV) use and other recreational activities, timber harvesting, rangeland improvements, and other activities have affected localized areas in the planning area. Soil compaction resulting from surface-disturbing activities and associated development can reduce infiltration, increase runoff, and hamper reclamation. Reclamation of areas affected by surface disturbance can ensure that the Wyoming

Standards for Healthy Rangelands are met. In the planning area, there are mining exploration roads that have not been reclaimed, which could be contributing to continued soil impacts that lead to a failure in meeting Standard 2 of the Wyoming Standards for Healthy Rangelands.

Livestock grazing is a major source of soil compaction around range improvement projects in the planning area. Ninety-seven percent of the planning area is open to grazing, and areas of high-density grazing such as around water developments are subject to soil compaction. Typically, affected areas range in size from one-half acre to approximately 5 acres (University of Wyoming 2008). Heavy utilization of vegetation by livestock in riparian-wetland zones has also resulted in soil compaction in the nearby transition zones to the uplands, and in the formation of hummocks within the riparian-wetland zone. Studies have shown that soil compaction from grazing can have the effect of reducing water infiltration, thereby limiting the growth of rangeland vegetation (Castellano and Valone 2007).

One of the primary regional and national demands placed on soils in the planning area is mineral development and exploration. Well pad construction, road building, pipeline installation, and the discharge of produced water all have the potential to lead to soil degradation. The discharge of produced water can cause increased erosion and salinization. The Wyoming Pollutant Discharge Elimination System (WYPDES), operated by Wyoming DEQ, regulates the release of produced water, and imposes requirements for sediment control, spill containment planning, monitoring, and eventual reclamation of disturbed areas. In the last few years, the storm water discharge requirements have been imposed for most surface-disturbing activities that would affect one acre or more. Storm water discharge permit requirements have substantially reduced impacts from erosion from major surface-disturbing activities.

Other land uses, such as recreation and ROW development, also have the potential to affect soils. Motorized travel that does not follow travel management designations appears to be on the increase in certain areas in the planning area, including Government Draw and the Dubois Badlands. Increased interest in communication site ROW permits and renewable energy development also has the potential to lead to soil degradation. Conversely, timber harvesting activity is decreasing in the planning area due to decreased economic demand; therefore both short-term and long-term adverse impacts associated with this resource use have also decreased.

Invasive plant infestations in the planning area are expected to increase, which can alter soil health, although this depends on other factors such as soil disturbance and climatic conditions. Invasive plant infestations can force out native vegetation and replace it with weedy plants that provide inferior protection to the soil surface. Invasive plant species typically do not have root systems adequate to stabilize soils and sites dominated with invasive plants are often subject to accelerated erosion.

On a landscape scale, vegetation cover has undergone a net decrease in the last decade due to a prolonged drought. Vegetative cover is one of the most critical variables affecting soil erosion that land managers can control. Soil erosion accelerates substantially once a threshold of loss of healthy vegetative cover is exceeded. Generally, rangeland soils have thin topsoil and little organic matter, and are susceptible to accelerated erosion with a loss of vegetative cover. This can result in reduced fertility, invasive plant invasion, and excessive amounts of bare ground.

Wildland fires are increasing in size, intensity, and frequency. All indications are that this trend will continue. Larger fires lead to increased soil erosion and a shifting from native herbaceous communities to communities dominated by cheatgrass and annual invasive plant species. Species such as cheatgrass and Russian thistle are known to change the fire regime to favor a fire cycle

of more frequent and intense fires. If this trend continues, these plant communities would facilitate further soil loss.

Soil Erosion Potential

Soil landscape position, steepness of slope, physical properties (including texture and structure), and chemical properties contribute to susceptibility to wind and water erosion. Soils in the planning area with slight, moderate, and severe erosion potential have been identified where county soil survey data are available. On BLM-administered surface within the planning area, approximately 889,612 acres of soils have severe wind erosion potential and 1,229,683 acres have severe water erosion potential. Map 7 and Map 8 show wind and water erosion potential in the planning area; Table 3.6, "Soils with Slight, Moderate, and Severe Wind and Water Erosion Potential in the Planning Area" (p. 257) summarizes this information by land ownership. Maps 7 and 8 use the most restrictive rating for the soil component; for example, if a soil map unit contains 50 percent of a soil rated as slight for wind erosion and 35 percent of another soil rated as severe, the whole map unit is rated as severe. Thus, these maps provide only a general guide to soil erosion potential. Soil conditions for BLM-authorized activities must be considered on a site-specific basis.

Table 3.6. Soils with Slight, Moderate, and Severe Wind and Water Erosion Potential in the Planning Area

Erosion Type		BLM-administered Surface		Federal Mineral Estate		All Land Ownership	
		Acres	Percent of BLM-administered Surface	Acres	Percent of Federal Mineral Estate	Acres	Percent of Lands within Planning Area
Wind	Slight	171,202	7	199,879	7	239,132	7
	Moderate	648,789	27	769,984	27	1,394,641	42
	Severe	1,229,683	51	1,411,830	50	1,605,774	48
Water	Slight	585,804	24	702,894	25	876,634	26
	Moderate	565,770	24	661,391	24	770,738	23
	Severe	889,612	37	1,021,449	36	1,149,815	34

Source: BLM 2009a

BLM Bureau of Land Management

Management Challenges for Soils

Successful reclamation after surface-disturbing activities is a major management challenge for soils in the planning area. A function of climate and low nutrient soils, low reclamation potential in the planning area makes it difficult to fully rehabilitate disturbed areas. Low reclamation soils are those soils that possess soil textures prone to excessive amounts of erosion by wind or water; high levels of salts that interfere with plant growth; soil textures with poor water holding capacity; excess steepness or coarse fragments that limit common rehabilitation practices and equipment; or those soils that have suffered topsoil losses to the point where they can no longer support the characteristic kinds and amounts of vegetation they once did. Recent drought has also led to increased susceptibility to erosion. With arid and semiarid moisture regimes covering much of the planning area, once topsoil is lost it can be irretrievable or slow to rebuild. Adherence to the Wyoming BLM mitigation guidelines for surface-disturbing and disruptive activities aids in reducing soil erosion from BLM-authorized activities (Appendix M (p. 1489)). Site-specific mitigation practices, including timely reclamation, also minimize soil erosion and protect

long-term soil productivity. Areas such as sand dunes and badlands are especially difficult to reclaim because of the high potential for erosion and general ruggedness of terrain.

Major erosive events that often occur after droughts can be difficult to mitigate due to a lack of vegetative cover. In the absence of vegetation, soils tend to dry hard and form a crust at the surface. This, along with a general absence of roots to aid in transmitting water from the soil surface into the soil profile, leads to reduced infiltration rates; thus, runoff from average precipitation events creates abnormally large amounts of runoff. Increased flood frequency and size would lead to more soil erosion. Controlling erosion from the discharge of produced water from oil and gas development is an additional challenge.

Implementation of various rangeland improvement projects also poses a management challenge for the BLM. Installation of fences, water developments, and provision of supplemental feed and salt blocks has the effect of concentrating grazing and degrading the soil resource through compaction. Compaction can result in decreased pasture yield and water infiltration and increased soil erosion.

3.1.4. Water

This section characterizes surface water and groundwater resources and describes existing water use and water management practices in the planning area.

Surface Water

Watersheds in the planning area consist almost entirely of semiarid rangelands with small areas of alpine and high elevation forest. Because annual evaporation rates exceed annual precipitation, there is a water deficit on these rangelands. There are few perennial streams, and discharge from many streams is largely intermittent or ephemeral. Most of the precipitation is lost through evapotranspiration and sublimation instead of creating runoff or recharging groundwater aquifers (BLM 2009b).

There are two major hydrologic basins and one minor basin in the planning area (Map 4):

- The largest hydrologic basin in the planning area is the Wind River Basin, a subdivision of the Yellowstone River Basin, which is a subdivision of the Missouri River Basin.
- The second largest hydrologic basin is the North Platte River, of which the Sweetwater River is a tributary. This watershed covers most of the area on top of the Beaver Rim escarpment; it flows east to Pathfinder Reservoir on the North Platte River. A minor area in Natrona County drains directly to the North Platte River, which ultimately flows east to the Missouri River.
- The Great Divide Basin is a smaller hydrologic basin in the southern part of the planning area. This is a hydrologically closed basin in Wyoming's Red Desert region that does not drain to either the Pacific or the Atlantic Ocean.

In addition, a half-mile stretch of Wallace Creek in the Rattlesnake Hills drains to the Powder River, a tributary to the Yellowstone River, which flows to the Missouri River. Also, near Dubois, Fish Creek drains approximately 30 square miles of non-BLM-administered lands in the planning area to the west. Fish Creek flows to the Gros Ventre River, which meets the Snake River near Jackson; the Snake River flows to the Columbia River and into the Pacific Ocean.

Table 3.7, "Sub-basins in the Planning Area" (p. 259) summarizes the sub-basins and some of their associated water quality issues with information from the Wyoming DEQ 2006 305(b) report (Wyoming DEQ 2006).

Table 3.7. Sub-basins in the Planning Area

Sub-basin	Location	Uses	Status	Plan
Upper Wind Sub-basin (HUC-10080001)	Shoshone National Forest in the Dubois area.	Livestock grazing, irrigated agriculture, recreation, limited logging.	Fecal coliform; erosion; needed improvement for recreation and fishing; habitat degradation of Brooks Lake Creek.	Shoshone National Forest and DCCD have watershed improvement plans; DCCD will do further monitoring.
Little Wind Sub-basin (HUC 10080002)	Drainage into Little Wind River.	Livestock grazing, irrigated agriculture, oil and gas.	Degradation along Beaver Creek and fecal coliform.	Wyoming DEQ is monitoring; BLM data shows improvement.
Popo Agie Sub-basin (HUC 10080003)	Headwaters in Shoshone National Forest.	Agriculture (96% of use), livestock grazing, recreation, residential. Lander municipal water source.	Fecal coliform (livestock grazing, septic systems).	Popo Agie Conservation District has a watershed plan to identify pollution sources and remedy. Squaw and Baldwin Creek drainage rehabilitation successful.
Muskrat Creek Sub-basin (HUC 10080004)	South Gas Hills east of Riverton.	Livestock grazing, oil and gas, uranium.	AML remediation.	Lower Wind River Conservation District has established a monitoring location and plan.
Lower Wind Sub-basin (HUC 10080005)	Wing shaped with Muddy and Fivemile Creeks on the west side of Boysen Reservoir and Poison Creek on east.	Livestock grazing, oil and gas.	Fecal coliform.	Lower Wind River Conservation District has submitted data to Wyoming DEQ and is awaiting a plan.
Badwater Creek Sub-basin (HUC 10080006)	Northeast side of Bosyen Reservoir.	Livestock grazing and oil and gas in Lysite/Lost Cabin area.	AML remediation; limited water data.	It appears that large amounts of sediment are transported to Boysen during runoff events.
Nowood Sub-basin (HUC 10080008)	Headwaters are on southwestern side of the Big Horn Mountains.	Livestock grazing, irrigated agriculture and oil and gas. Small amount of bentonite.	Fecal coliform, including untreated human sewage.	Washakie County Conservation District is monitoring and remediating. South Big Horn Conservation District is monitoring Paintrock Creek.
Sweetwater Sub-basin (HUC 10180006)	Headwaters in the South Pass area draining to the Platte.	Livestock grazing, irrigated hay, mining including uranium, oil and gas and recreation.	More than 100 AML sites have been remediated; more remain. Mercury in Willow Creek, oil in Crooks Creek.	Additional monitoring and TMDLs.

Sub-basin	Location	Uses	Status	Plan
South Fork Powder Sub-basin (HUC 10090203)	Natrona County, extending to the Waltman area.	Grazing and oil and gas (and possibly other minerals).	BLM manages less than 300 acres in this basin.	-
Great Divide Basin (HUC 10)	Red Desert in south of planning area.	Mostly intermittent and ephemeral reaches.	None identified.	Impacts from uranium and oil and gas need to be considered.

Sources: Wyoming DEQ 2006; DCCD 2004; Lower Wind River Conservation District 2010; BLM 2009b

AML Abandoned Mine Land
BLM Bureau of Land Management
DCCD Dubois Crowheart Conservation District
DEQ Department of Environmental Quality
HUC Hydrologic Unit Code
USFS United States Forest Service
TMDL Total Maximum Daily Load

Reductions in annual streamflow throughout the planning area due to the recent drought have affected water quality parameters such as water temperature, total dissolved solids, dissolved oxygen, and other factors. As precipitation patterns change (below normal snowfall, earlier snow melts, substantial losses from sublimation before melting, etc.) and as glaciers in the Wind River Mountains recede, annual spring runoff would occur sooner and have smaller discharges. This would result in lower, or in some cases no, natural flows in late spring, summer, and fall. Lower levels of water could result in degradation of water quality, including warming, loss of high flows needed to flush pollutants, and degradation or loss of habitats. Reductions in runoff also impact water use for summer irrigation in the planning area. These water quantity and quality impacts reflect potential impacts of climate change in the planning area. Refer to the *Climate Change* section at the end of this chapter for additional information on climate change.

Water Quality

Water quality is strongly influenced by geology and terrain. Natural water quality characteristics of streams coming off the Wind River Range are generally good, but because natural erosion and stream processes increase sediment and total dissolved solids loads, water quality can change as streams flow across the basin. Accelerated erosion, runoff from irrigated agriculture, produced water discharge from oil and gas development, and discharges from other human activities have the potential to further degrade water quality (Colby et al. 1956, USGS 1999). The Sweetwater Sub-basin headwaters are in the South Pass area of the southern Wind River Mountains. Land uses in this sub-basin include grazing, irrigated hay production, and mineral development.

Natural processes and human actions influence the chemical, physical, and biological characteristics of water. Indicators of water quality include:

- Chemical characteristics (e.g., pH, conductivity, dissolved oxygen)
- Physical characteristics (e.g., sediment, temperature, color)
- Biological characteristics (e.g., macro- and micro-invertebrates, fecal coliform, and plant and animal species)

Standards for water quality are promulgated by standards set forth in the Clean Water Act (33 United States Code [U.S.C.] 1215 et seq.), which requires that water quality be maintained or improved for outstanding (Class 1) and most of the high-quality (Class 2) waters. All other waters must be maintained against degradation and are assessed by Wyoming DEQ to determine

if water quality meets the requirements for the class into which Wyoming has assigned the waterbody. For example, Class 2AB waters support game fish (Wyoming DEQ 2008a). Water quality is evaluated to see if it supports the use identified for that class of water. Meeting this "use support" is an indicator of water quality.

The Sweetwater River is the only waterbody Wyoming DEQ classifies as a Class 1 water quality stream that flows through BLM-administered public lands in the planning area. This designation begins at the Sweetwater River's confluence with Alkali Creek south of Sweetwater Station, and proceeds upstream to its source on the western slope of the southern Wind River Mountains.

Point source and nonpoint source pollution affect water quality. Point source pollution is conveyed from a discrete location such as a pipe, tank, pit, or ditch. Discharge of produced water, which contains high levels of salt, can cause water quality problems and soil salinization from the deposition of salts. Nonpoint source pollution is from a diffuse source, such as runoff from cultivated fields or grazed land.

Clean Water Act Section 305(b) requires a biennial report from the state that presents a summary of water quality conditions. This report includes the Clean Water Act Section 303(d) List, which identifies waters of the state that have been found to have impaired water quality and require a total maximum daily load (TMDL) allocation. Table 3.8, "Waters Requiring TMDLs on BLM-Administered Land in the Planning Area" (p. 261) lists the waters in the planning area requiring TMDLs.

Table 3.8. Waters Requiring TMDLs on BLM-Administered Land in the Planning Area

Waterbody Name	Location	Use Not Supported	Cause of Impairment
Popo Agie Middle Fork (TMDL Date – 2010)	Undetermined distances upstream and 4 miles downstream of Lander.	Recreation	Fecal coliform
Poison Creek (TMDL Date Priority – Low) This rating indicates TMDLs will not be completed within the next four years.	From Boysen Reservoir upstream an undetermined distance.	Recreation	Fecal coliform
Crooks Creek (TMDL Date – 2008)	From T28N, R92W Sec. 18 SWNE undetermined distance downstream.	Aquatic life, cold-water fish	Oil and grease
Source: Wyoming DEQ 2006 E East N North R Range		S South T Township TMDL Total Maximum Daily Load W West	

The goal of the development and application of the Wyoming Standards for Healthy Rangelands (Appendix J (p. 1437)) is to achieve the four fundamentals of rangeland health: 1) watersheds are functioning properly, 2) water, nutrients, and energy are cycling properly, 3) water quality meets state standards, and 4) habitat for special status species is protected. As identified in the fundamentals above, water is an important factor in meeting rangeland health. Standard 5 identifies the BLM's role in complying with all federal, state and other applicable regulations regarding water quality and clarifies that the State of Wyoming administers the Clean Water Act (with the EPA administering the Clean Water Act on the WRIR). Standard 5 recognizes the impacts of natural processes and human actions on water quality and the variations in water

quality based on seasons, climate, and the substrate through which water moves. Wyoming BLM evaluates rangelands for compliance with Standard 5 as per guidance given in Wyoming Instruction Memorandum (IM) WY-98-061 that outlines a determination process. This process requires consulting the Wyoming DEQ's impaired waterbody list, also called the 303(d) list after that part of the 1977 Clean Water Act. Also, if a stream is delisted that too is noted, as now it has been demonstrated to meet state, and federal, water quality standards. For all other waterbodies Standard 5 is considered to be "Unknown" and all available information such as PFC inventory, fisheries inventory, and other agency data are consulted to determine if there might be suspected water quality impairments that we must bring to the attention of the Wyoming DEQ for them to include such waterbodies in their scheduled monitoring. Refer to the *Livestock Grazing Management* section of this chapter for additional information on the Wyoming Standards for Healthy Rangelands.

Surface Water Trends

The sub-basin summaries in Table 3.7, "Sub-basins in the Planning Area" (p. 259) provide trend information where it is available. In general, as water levels have dropped due to the drought this decade, such parameters as water temperature, total dissolved solids, dissolved oxygen, and other factors have typically become unfavorable to supporting the designated biological and recreational uses assigned. Drought impacts, whenever they occur, will be considered as BLM authorizes activities by specifying specific project design features including appropriate WYPDES Stormwater Discharge Permitting, Pollution Prevention Plans, and BMP application; stipulations; mitigation; and through the remediation of known water quality impairments. BLM will protect, maintain, or enhance water quality and quantity as necessary to the mission of our agency and to comply with federal and state statutes.

Cities such as Lander that rely on surface water for a substantial percentage of domestic water also face increasing water demands that correspond to increases in local urban populations and industrial development. The fastest growing population segment locally is that of the small acreage (2 to 40 acres) rural ranchette, or ex-urban, landowner. The development of subdivisions on former ranch land, especially in the Dubois area and on the Lander Slope, is at historically high levels. Small subdivision water systems, cisterns, and individual wells supply domestic water in these areas.

Because the major consumer of water is irrigated agriculture on privately owned lands, population increase is not expected to be a major factor in changing water usage. The BLM does not authorize irrigated agriculture use of public lands in the planning area. Trends in irrigated agriculture are generally limited to the water rights attached to property or those perfected through the current state process. Surface water is the source for the majority of irrigated acres. Annual agricultural water supplies can be highly variable if local streams are the sources of water.

Water quality is expected to decrease due to increased development of all types. Development almost always results in soil disturbance, which can cause erosion and loss of fertility necessary to sustain vegetative cover. As invasive species become established and outcompete native vegetation, water infiltration into the soil is reduced.

Point source discharges of produced water can cause soil erosion. The BLM preferred method to discharge produced water in the planning area is reinjection. However, the State of Wyoming permits point source discharges where water containing high levels of selenium is being discharged pursuant to WYPDES permits, such as in the Gun Barrel Oil and Gas Unit in the

northeast portion of the planning area. The BLM is working with the operator in the Gun Barrel Unit area to decrease soil erosion resulting from state-authorized discharges.

Adverse impacts to soil and vegetation resources are likely to result in reduced water quality. Maintaining proper vegetative cover and sustaining healthy root systems optimizes a soil's water infiltration capability. Improved water disposal, riparian-wetland exclosures, aggressive reclamation activities, diligent compliance with Wyoming DEQ storm water permitting requirements, and grazing systems designed for light use and the incorporation of rest help to mitigate adverse impacts to water quality, as would mitigation projects that improve riparian-wetlands degraded by earlier activities.

Early in the management of BLM-administered lands, riparian-wetland areas were not valued for their non-agricultural and non-industrial values. Prior to the 1980s year-long and season-long grazing systems, that allow livestock to spend a maximum amount of time loitering in riparian-wetland areas, were common in the planning area. However, with increased knowledge of the value of riparian-wetland areas for other uses, such grazing systems were revised in favor of rotation systems that allow for rest for at least part of the year and shift livestock use to different time periods from one year to the next to improve plant health. In some cases riparian-wetland pastures, exclosures, and spring source protection fencing has been created to more rapidly restore specific areas. Generally speaking, riparian-wetland water quality and quantity trends have improved in many locations since the riparian initiatives that began in the early 1980s.

Inflows to the major reservoirs at the planning area boundaries are gauges of the impact from drought conditions beginning in 1999 to 2000. The harvest of water from the Wind River watershed at Boysen Dam can be used to index the capabilities and ultimate outputs from the BLM-administered public lands in this basin. Table 3.9, "Comparison of Historical and Recent Inflow at Boysen Reservoir" (p. 263) compares the historic data with data from 2000 to 2006. As shown, water supply downstream and power generation at Boysen Dam were reduced to nearly one-half of previous years.

Table 3.9. Comparison of Historical and Recent Inflow at Boysen Reservoir

Period	Average Inflow (acre feet)
1970-1999	1,094,100
2000-2006	570,500
Source: BOR 2007	

The reduction by almost 47 percent is similar to the reduction in flow as measured on the Sweetwater River, as shown in Table 3.10, "Comparison of Historical and Recent Flows in the Sweetwater River" (p. 263). In 2001, mean monthly flows from May to September decreased by approximately 90 percent and decreased by approximately 64 percent from June to September.

Table 3.10. Comparison of Historical and Recent Flows in the Sweetwater River

Period	Mean Annual Flow Measures (cubic feet per second)		
	Peak Maximum Flow (May)	Peak Maximum Flow (June)	Minimum Flow (September)
1914-2001	413	391	29.8
2001	133	36.5	13.1
Source: USGS 2001			

Impacts to water quantity are primarily a function of agricultural use, which accounts for 97 percent of usage, and not population size. Fremont County had a substantial population decrease from a high in 1980. Since 1990, however, population has grown steadily, almost reaching the

1980 level by 2006. While this population increase has affected domestic water usage, it has little effect on overall water use. All irrigation water rights have been allocated.

In general, as water levels have dropped due to the drought this decade, such parameters as water temperature, total dissolved solids, and dissolved oxygen typically become unfavorable for supporting the designated biological and recreational uses assigned.

Groundwater

An aquifer is defined as a groundwater resource contained in the pore space of geologic media in such quality and quantity that it may be readily available for use via springs or wells. The United States can be divided into numerous groundwater provinces (regions) (Meinzer 1923, McGuinness 1963); the planning area is in the Unglaciated Central Region. This region encompasses a large area of the interior United States and is generally underlain by level or gently tilted and folded sedimentary rocks ranging in age from Paleozoic to middle Tertiary (Fetter 1980). Groundwater resources in the planning area primarily occur in unconsolidated deposits of Quaternary age consisting of floodplain alluvium; the Tertiary Wind River Formation; and older Mesozoic, Paleozoic, and Precambrian rocks (Plafcan et al. 1995).

The Wind River Formation is the most extensive water-bearing unit occurring at land surface and contains groundwater under both unconfined and artesian conditions (Plafcan et al. 1995). In the older Mesozoic and Paleozoic rocks, aquifers can be present where sufficient permeability is present, for example, in porous sandstones or fractured carbonate rocks. These groundwater-bearing units yield water under confined conditions, except where such water-bearing zones intersect the land surface along outcrops or faults.

Confining units within the Wind River Formation include numerous siltstones and thick shales and mudstones. There is also unconfined groundwater in water table aquifers such as those in alluvium and windblown sand deposits (Whitcomb and Lowry 1968) and in the aforementioned outcrop areas of otherwise confined aquifers.

Geologic units in Fremont County are recharged by one or a combination of the following sources: (1) precipitation that infiltrates the geologic unit in its outcrop area, (2) infiltration of surface water, (3) infiltration of irrigation water, and (4) leakage from another geologic unit either from above or below (Plafcan et al. 1995). Almost all geologic units are recharged to some degree by precipitation (Plafcan et al. 1995).

Uses of groundwater in the planning area include public supply (municipal), domestic, commercial (thermoelectric), industrial (including mining), irrigation, and agricultural.

Surficial Unconsolidated Aquifers

Surficial unconsolidated aquifers generally consist of glacial, stream, and terrace sediments (alluvium) along floodplains of rivers and streams and surficial windblown sand deposits. Recharge to shallower aquifers occurs through direct infiltration (rainfall, snowmelt, irrigation) and leakage through adjacent water-bearing zones. Discharge occurs through springs, baseflow contributions to streams and rivers, and withdrawal through shallow wells. The surficial unconsolidated aquifer system is the second most developed aquifer system in the planning area (ranking behind the Wind River Formation), although its occurrence is limited to areas near streams and is therefore disconnected areally (Plafcan et al. 1995).

Table 3.11, "Uppermost Unconsolidated Water-Bearing Formations and their Characteristics" (p. 265) lists the characteristics of surficial unconsolidated aquifers in the planning area. The alluvial deposits are represented mainly by the Wind River, Popo Agie, and Sweetwater Rivers and their tributaries.

Table 3.11. Uppermost Unconsolidated Water-Bearing Formations and their Characteristics

Description/Formation	Lithology and Distribution	Aquifer Characteristics
Alluvial deposits	0 to 65 feet thick, unconsolidated sand, clay, and gravel. Includes terrace, floodplain, and pediment deposits along major streams.	Yields small to large supplies of water to wells where deposits are porous and permeable. Water quality is susceptible to impacts (such as high salinity) caused by agricultural practices (livestock and irrigation).
Windblown sand	Present in northeastern part of the planning area, consisting of a 0- to 40-foot thickness of unconsolidated fine to very fine sand.	Yields small supplies of water suitable for stock or domestic use. It is considered an important source of water in areas underlain by Cody Shale.
Source: Whitcomb and Lowry 1968		

Windblown sand deposits are primarily present between Riverton and Moneta, along Poison and Muskrat Creeks, where they are an important source of small quantities of groundwater (Whitcomb and Lowry 1968). While yields are small, the water quality is good because it is derived mainly from local precipitation. One spring in this area that issued from dune sand and loess was inventoried on August 1991 with a measured discharge of 28 gallons per minute, which is adequate for domestic or stock supplies (Plafcan et al. 1995).

Water Quality in Surficial and Shallow Unconsolidated Aquifers

Water quality in surficial alluvial aquifers can differ markedly compared to other types of groundwater systems, depending on the source and amount of recharge, the composition of the porous medium, and man-made factors present in the area. Water quality also commonly fluctuates seasonally in alluvial aquifers due to the amount of influence from direct precipitation and runoff. It should also be noted that surficial unconsolidated aquifers are most at risk for degradation from the cumulative impacts of domestic, industrial, agricultural, stock-raising, and storm-water disposal practices, all of which affect water quality to some degree.

Water quality data for the surficial unconsolidated aquifers are limited; the most recent data available were collected in 1995 (Plafcan et al. 1995). These data were obtained from 47 wells completed in Quaternary deposits throughout Fremont County. Thirty-three of the wells sampled were completed in alluvium and colluvium; 10 were completed in terrace deposits; and four were completed in glacial, landslide, or eolian sand deposits. Samples obtained from shallow unconsolidated aquifers represented by Quaternary-age alluvium, colluvium, terrace deposits, glacial deposits, and dune sand and loess deposits had water quality parameters mostly within acceptable limits and no samples had detectable quantities of selected pesticides (Plafcan et al. 1995). Groundwater from alluvial and colluvial deposits in Fremont County has total dissolved solids (TDS) ranging from 141 to 1,430 micrograms per liter (mg/L) and dissolved-solids concentrations from 10 water samples from terrace deposits ranged from 293 to 1,670 mg/L. For comparison, the EPA secondary maximum contaminant level for dissolved-solids concentrations in drinking water supplies is 500 mg/L. Generally, concentrations of TDS are lower in the upstream floodplain deposits than in the deposits farther downstream. Most of the groundwater samples are classified as calcium-carbonate type waters in upper reaches of the floodplain and

change to sodium-calcium carbonate-sulfate type waters with moderate to very high hardness farther downstream.

Studies done by Bartos and others (Bartos et al. 2008) demonstrated the impact that land use has on the quality of shallow groundwater in unsewered areas of low-density development and focused on three areas in the intermountain west, one of which was near Lander. Results of the study are specific to the Lander area, but can be extrapolated to areas with similar hydrogeology in the planning area. Ten wells were installed in two general areas, one north of Lander along the floodplain of the North Fork of the Popo Agie River and the other along the floodplain of the Middle Fork of the Popo Agie River between Sinks Canyon and the city of Lander. Land use and land cover in the North Fork area generally consist of wetlands, pasture/hay, and occasional row crops; land use and land cover along the Middle Fork area consists of shrubland/grassland, forested land, wetlands, pasture/hay, and occasional crops. Water levels in these areas ranged from less than 1 foot to almost 7 feet below land surface. Recharge to shallow groundwater is not only from areal infiltration but also from infiltration of unlined irrigation canals and ditches; water applied to cropland, hayfields and gardens; and leakage from domestic septic systems.

While impacts of human activities on the quality of shallow groundwater were indicated in the planning area, shallow groundwater is suitable for most uses without treatment, and impacts (groundwater contamination) from human activities generally were minimal and limited in areal extent at the time of sampling (Bartos et al. 2008).

Upper Regional Aquifer System

The uppermost hydrologic unit is represented by aquifers contained in Tertiary-age sediments (e.g., the Wind River Formation) through uppermost Cretaceous rocks (e.g., Lance Formation) or equivalents where present. Table 3.12, "Description of Water-bearing Formations in the Uppermost Regional Hydrologic Unit" (p. 268) lists characteristics of water-bearing formations that can be included in the uppermost hydrologic unit (Whitcomb and Lowry 1968; Arneson et al. 1998).

Regional Hydrologic Units

There are three regional hydrologic units through the majority of the planning area (Arneson et al. 1998). Hydrologic units are regional stratigraphically adjacent formations with similar hydraulic properties and recharge/discharge characteristics. They can function as regional aquifer systems or regional aquitards, even while they might be lithologically dissimilar. Recharge to shallow hydrologic units occurs over large areas in response to direct infiltration or leakage from adjacent water-bearing zones; recharge to deeper units is often substantial where mountain uplift has exposed the units on the margins of the Wind River Basin, or where geologic structures are present (e.g., Rogers Mountain Anticline, Dutton Anticline, and Rattlesnake Hills Anticline).

Principal among these water-bearing units in terms of exploitation are the Wind River Formation throughout the upper two thirds of the planning area and the Split Rock Formation aquifer system (also known as Arikaree) in the southern third of the planning area. The Split Rock Formation contains water under mostly unconfined (water table) conditions, with depth to water governed by topography (Whitcomb and Lowry 1968). Past studies have indicated well depths ranging from 65 to 1,080 feet below land surface. Depth to water data collected for a study released in 1968 indicated a range of 12 to 220 feet below land surface (Whitcomb and Lowry 1968), while more recent data indicate water levels ranging from 24 to 94 feet below land surface (Plafcan et al. 1995).

The largest number of well completions in the uppermost regional hydrologic unit is in the Wind River Formation, making it an important source of groundwater and the most areally extensive water-bearing surficial formation in the planning area (Plafcan et al. 1995). Its water-bearing characteristics are variable throughout the planning area, occurring under both confined and unconfined conditions (Plafcan et al. 1995). In general, well yields vary from more than 300 gallons per minute in wells in the Riverton and Gas Hills area constructed for irrigation, industrial, and public supply purposes, to less than 50 gallons per minute in wells developed for livestock and domestic purposes (Plafcan et al. 1995). A maximum yield of 3,000 gallons per minute was reported from a well completed in the Wind River Formation (Richter 1981).

Data, obtained from more than 115 samples taken from wells and springs, showed that samples obtained from Miocene-age formations (e.g., Split Rock Formation) and the Oligocene-age White River Formation did not exceed the 500 mg/L secondary maximum containment level for dissolved solids (Plafcan et al. 1995). However, radium-226 and uranium were detected at low levels in the one White River Formation sample analyzed for those constituents. Samples from the Eocene Wagon Bed Formation indicated dissolved-solids concentrations just above the secondary maximum containment level at 572 mg/L; radium-226 and uranium also were detected at low levels in one sample.

In comparison, groundwater in the Wind River Formation was substantially lower in quality as measured in 80 samples that contained dissolved-solids concentrations ranging from 248 to 5,110 mg/L. In addition, one sample contained selenium at a concentration of 58 mg/L, which is above the EPA maximum contaminant level. One sample of seven contained detectable radium-226 and uranium, and one sample of 10 contained detectable levels of two selected pesticides.

Wind River Formation water chemistry is variable due to the formation's variable lithology, permeability, recharge conditions, and land use. Dissolved-solids concentrations in water samples from these wells and springs ranged from 248 to 5,110 mg/L, and some samples contained variable amounts of dissolved metals and radiochemical constituents such as radium-226 and uranium. One sample contained a detectable level of two (2,4-D and dicamba) of the selected pesticides (Plafcan et al. 1995).

Table 3.12. Description of Water-bearing Formations in the Uppermost Regional Hydrologic Unit

Description/Formation	Lithology and Distribution	Aquifer Characteristics
Moonstone Formation	Present only in the Granite Mountains area, consisting of a 0 to 1,350 feet thickness of soft claystone, shale, and tuffaceous sandstone containing some interbedded limestone, conglomerate, and pumicite.	Yields small quantity of water to many stock and domestic wells; large supplies could be obtained where saturated thicknesses are great or where permeability is enhanced by fractures. Water quality is generally good.
Split Rock Formation ("Arikaree")	Present in southeastern portion of the planning area, consisting of 0- to 2,700-foot thick cemented sandstone, containing lesser amounts of conglomerate, claystone, limestone, tuff, and pumicite.	
White River Formation	Present in the southern portion of the planning area, consisting of 0 to 650 feet thickness of Bentonitic and tuffaceous mudstone with lenses of arkose and conglomerate, and beds of tuff.	
Wagon Bed Formation	Present in the southern portion of the planning area, consisting of 0 to 700 feet of bentonitic mudstone, locally tuffaceous, zeolitic mudstone and sandstone in persistent beds, volcanoclastics and conglomerates.	Probably would yield at least small quantity of water and possible larger supplies from sandstone and conglomerate beds.
Wasatch/Battle Spring Formation	Present in Great Divide Basin area of portion of the planning area, consisting of large boulders in a soft sandstone and shale matrix.	Known to yield only small amounts of water. However, large yields may be possible. Quality of water likely good.
Wind River and Indian Meadows Formations	Present at land surface throughout majority of planning area, consisting of 0 to 8,000 feet of interbedded siltstone, and sandstone and conglomerate containing some carbonaceous shale and thin coal seams.	Large supplies have been developed in the Riverton and Gas Hills area, and could be developed elsewhere, especially along the margins of the Wind River Basin. Yields small quantities to numerous and widely distributed stock and domestic wells. The quality of the water ranges from unfit for stock to good for domestic uses.
Fort Union Formation	Consists of 0 to 8,000 feet of conglomerate, sandstone, shale and carbonaceous shale in lower part grading to very fine grained clastics and upper part. Present at depth throughout most of the planning area.	Sandstones yield small supplies of water that is generally unsuitable for domestic use and might be marginal for stock.
Lance Formation	Sandstone interbedded with light to dark gray carbonaceous shale and thin coalbeds. Coarse intervals present at formation base.	Sandstones yield small supplies of water that is generally unsuitable for domestic use and might be marginal for stock.
Sources: Arneson et al. 1998; Whitcomb and Lowry 1968		

Regional Aquitard

Below the uppermost hydrologic unit, there is a thick sequence of Cretaceous age fine-grained rocks of marine origin such as shales and mudstones (e.g., Cody Shale) that comprise a regional

aquitard or confining layer. This aquitard isolates the upper aquifer system from the lower aquifer system, which is represented by lower Cretaceous to Paleozoic rocks. Table 3.13, "Geologic Formations Comprising the Regional Aquitard" (p. 269) lists the characteristics of regionally confining formations, which in general correspond to the regional aquitard hydrologic unit (Whitcomb and Lowry 1968; Arneson et al. 1998).

Samples from Mesozoic rocks, which are included in the regional aquitard, generally indicated low water quality (Plafcan et al. 1995). All water samples collected from wells completed in the Cody Shale and Frontier Formation had dissolved-solids concentrations from one-half to approximately 14 times greater than the EPA secondary maximum containment level of 500 mg/L. Water quality from wells and springs tapping water from the Cloverly and Chugwater formations was generally better, with dissolved-solids concentrations ranging from approximately 400 to 1,500 mg/L. Dissolved-solids concentrations in 10 samples obtained from wells and springs in the Phosphoria Formation ranged from 215 to 3,690 mg/L.

Table 3.13. Geologic Formations Comprising the Regional Aquitard

Description/Formation	Lithology and Distribution	Aquifer Characteristics
Meeteetse/Lewis Shale	Sandstone, siltstone, shale carbonaceous shale, claystone and coal.	Sandstones yield small supplies of water that are generally unsuitable for domestic use and might be marginal for stock.
Mesaverde Formation	Consists of 0 to 1,575 feet of Sandstone, shale, siltstone, carbonaceous shale, and coal.	
Cody/Niobrara Shale	Consists of 3,000- to 5,000-foot thickness of shale with minor sandstone interbeds.	Not a source of groundwater. Forms a regional aquitard throughout the planning area.
Frontier Formation	Consists of 600 to 1,040 feet of lenticular sandstones interbedded with shale.	Yields small quantities of generally poor quality water although some supplies are usable for domestic use.
Mowry Shale	Consists of several hundred feet of hard, thin-bedded, siliceous bentonitic shale.	Not a source of groundwater.
Muddy Sandstone	Consists of 0- to 150-foot thick coarse-grained sandstone.	Known to locally yield small supplies of water suitable for stock.
Thermopolis Shale	Consists of several hundred feet of hard, thin-bedded, siliceous bentonitic shale.	Not a source of groundwater.
Sources: Arneson et al. 1998; Whitcomb and Lowry 1968		

Lower Regional Aquifer System

Below the regional aquitard layer there is a series of Jurassic through Permian age formations that locally contain permeable zones that can yield appreciable amounts of groundwater. These units do not always contain water-bearing zones that are regionally extensive and can include leaky confining units and aquitards. These formations provide a transition from the aquitard layer to the lower hydrologic unit. Dissolved solids in groundwater from upper Mesozoic rocks in Fremont County generally range between 280 and 6,000 mg/L, but can be higher when associated with oil-field produced water. Table 3.14, "Transitional Hydrologic Unit Formations" (p. 270) describes these transitional hydrologic units (Whitcomb and Lowry 1968; Arneson et al. 1998).

Table 3.14. Transitional Hydrologic Unit Formations

Description/Formation	Lithology and Distribution	Aquifer Characteristics
Cloverly and Morrison Formations	Consists of 200 to 700 feet of sandstone, siltstone, and shale in upper part; claystone and medium-to-coarse-grained sandstone in lower part.	Near outcrops, yields small to moderate quantities of water suitable for domestic use. Mineralization of water increases with distance from outcrops.
Sundance Formation	Consists of 300 to 435 feet of shale, siltstone, sandstone, and limestone.	
Gypsum Springs Formation	Consists of 0 to 230 feet of dolomite, limestone, gypsum and siltstone.	Not known to be a source of groundwater. Any yieldable water would likely be poor quality.
Nugget Sandstone	Consists of 0 to 425 feet of fine-to-medium grained, well-sorted sandstone.	Little water-bearing data are available, but probably would yield satisfactory amounts of water for domestic or stock use based on surface outcrop characteristics.
Chugwater Group	Siltstone, sandstone, and shale; limestone (Alcova Limestone member).	Yields small amounts of good-quality water in and near outcrops.
Dinwoody Formation	Consists of 10 to 155 feet of fine-grained sandstone in western part of planning area grading eastward to upper part of Goose Egg Formation, which consists of 0 to 300 feet of shale and siltstone interbedded with limestone.	
Phosphoria/Park City/Lower Goose Egg Formations	Interbedded dolomite, chert, limestone, siltstone, and sandstone, commonly containing intervals of phosphate bearing minerals.	Probably would yield small amounts of mineralized poor quality water.
Sources: Arneson et al. 1998; Whitcomb and Lowry 1968		

Below the transitional units, the lower hydrologic unit includes a series of carbonate and sandstone aquifers with great water yielding capacity. Transmissivities for the lower hydrologic unit typically range from 1,000 to 60,000 gallons per day per foot (Arneson et al. 1998). Most wells completed in the Tensleep Sandstone or Madison Limestone aquifers were reported to be in or near the outcrop area (Plafcan et al. 1995). Of the wells inventoried, well depths in the Tensleep aquifer ranged from 450 to 6,590 feet below land surface, with some wells displaying flowing artesian or near flowing conditions. Table 3.15, "Characteristics of Water-Bearing Formations Included in the Lower Hydrologic Unit" (p. 271) lists the main water-bearing formations in the lower hydrologic unit.

Table 3.15. Characteristics of Water-Bearing Formations Included in the Lower Hydrologic Unit

Description/Formation	Lithology and Distribution	Aquifer Characteristics
Tensleep Sandstone	Consists of 200 to 600 feet of medium-grained well-sorted sandstone. Present throughout the planning area.	Excellent aquifer yielding water under artesian to flowing artesian conditions near range front. Well yield increased quantities where fractured. Water quality decreases away from recharge area (with distance from range front).
Amsden Formation	Consists of 100 to 250 feet of limestone, dolomite, and shale interbedded with minor sandstone underlain by basal sandstone unit (Darwin Sandstone).	Water-bearing properties are not well known. Quality and quantity might be sufficient to supply domestic needs, but well completion depth required would likely be cost prohibitive in most places.
Madison Limestone	Consists of 300 to 700 feet of massive to thin-bedded limestone, containing some thin beds of chert and shale near the top. Present throughout the area.	Potentially voluminous producer where extensive fracturing and cavities are known to exist. Water quality data are sparse. Completion could be cost prohibitive basin-ward.
Darby Formation	Consists of 20 to 190 feet of dolomite, siltstone, sandstone and shale.	Known fetid odor when rock is broken might indicate water quality issues. Would likely yield sufficient quantities of water at least for stock use, but depth to completion could be cost prohibitive basin-ward.
Bighorn Dolomite	Consists of up 0 to 300 feet of dolomite with thin basal sandstone unit (Lander Sandstone).	Potentially voluminous producer where extensive fracturing and cavities are known to exist. Water quality data are sparse. Depth to completion could be cost prohibitive basin-ward.
Gallatin Limestone	Consists of resistant limestone beds interbedded with shaly units.	Water quality data are sparse. Depth to completion could be cost prohibitive basin-ward.
Gros Ventre Formation	Consists of up to 700 feet of interbedded shale, limestone, and micaceous sandy shale.	Water-bearing characteristics are largely unknown. Lithology suggests poor source of water. Depth to completion could be cost prohibitive.
Flathead Sandstone	Consists of approximately 200 feet of fine to coarse-grain sandstone with conglomeritic basal unit.	Might be good source of groundwater where weathered or fractured, yielding high-quality water near outcrops. Depth to completion could be cost prohibitive basin-ward.
Pre-Cambrian	Granitic crystalline rocks, metamorphic rocks.	Yields good quality water in sufficient quantity where fractured or weathered. Only cost-effective near outcrops.
Sources: Arneson et al. 1998; Whitcomb and Lowry 1968		

Where significant karst has developed (as in the upper Madison limestone in the Sinks Canyon area) or where interconnected fractures are present, yields are reported to be as high as 2,000 gallons per minute. Based on an inventory published in 1995, Madison aquifer well depths range from 1,400 to 4,210 feet below land surface, with some wells flowing at land surface (Plafcan et al. 1995).

Certain older and deeper formations, such as the Phosphoria and Tensleep, can be used to a limited extent as supplies of groundwater and have suitable groundwater characteristics. However, they generally occur below economical drilling depths in most of the Wind River Basin. Measured TDS in groundwater in Paleozoic formations generally ranges from 300 to 3,000 mg/L, but Permian rocks have been known to have groundwater with dissolved solids of more than 10,000 mg/L (Plafcan et al. 1995).

Existing groundwater supply conditions appear to be adequate for most anticipated uses (such as mineral exploration and stock water) on BLM-administered public lands in the planning area. Although climatic conditions resulting in periods of below average precipitation would be expected to impact groundwater levels, there is no apparent shortage of available water at the current rate of consumption.

Existing groundwater quality conditions are generally good, although quality is degraded in localized areas due to natural conditions related to the aquifer porous medium (e.g., hardness, radioactive solutes, and selenium), land use (e.g., domestic leach fields, livestock waste, agriculture, and wildlife), and reduced recharge due to factors such as drought or development over recharge zones. Depending on the toxicity and the concentration, a compound released into the environment may be considered a contaminant or pollutant. While the Safe Drinking Water Act currently specifically excludes hydraulic fracturing from Underground Injection Control (UIC) regulation under SDWA 1421 (d)(I), the use of diesel fuel during hydraulic fracturing is still regulated by the Underground Injection Control program (see http://water.epa.gov/type/groundwater/uic/class2/hydraulicfracturing/index.cfm). Without appropriate site assessment, engineering, mitigation and monitoring, activities associated with oil and gas development and production may have the potential to contaminate ground and surface waters. However, all alternatives assume that BMPs and the requirements of the oil and gas program will be met which should prevent contamination.

Eleven samples obtained from wells and springs issuing from the Tensleep Sandstone aquifer indicated dissolved-solids concentrations ranging from 196 to 1,410 mg/L, while samples from the Madison Limestone aquifer ranged from 188 to 920 mg/L. Ten groundwater samples obtained from springs emanating from Precambrian rocks showed dissolved-solids concentrations ranging from 81 to 714 mg/L. The water samples in these rocks had the lowest average concentration of dissolved solids of any other water-bearing unit for which five or more samples were collected.

Groundwater Quality Susceptibility

Water system susceptibility is the potential for a public water supply to draw water contaminated at concentrations that pose a threat or concern to human health. The EPA developed a Source Water Assessment Program (SWAP) in 1996 to help public water systems protect their water supplies from contamination. The EPA directed each state to develop and implement a SWAP. Participation in the program in Wyoming was voluntary; participants in the planning area include Lander, Riverton, Shoshoni, Hudson, Jeffrey City, Dubois, and several state parks. Participants' SWAP information reports were completed in 2004 and are available on the Wyoming DEQ webpage. The determination of susceptibility was based in part on the presence of potential contaminants or "land-use susceptibility" (BLM 2009b). For example, in South Pass City (historical site), susceptibility in one zone was deemed to be high because of high point-source contamination from a solid/hazardous waste site. Other factors such as water supply integrity and sensitivity were considered. Additionally, recent groundwater sampling conducted by the EPA near Pavillion, Wyoming detected several petroleum hydrocarbons, including benzene and

methane, in wells and groundwater. EPA also found low levels of petroleum compounds in 17 of 19 drinking water wells sampled. Wyoming DEQ is utilizing the information from the SWAP and its Wellhead Protection Program to develop monitoring and remediation plans that will provide valuable information for the BLM to consider when permitting activities.

Groundwater Trends

The State of Wyoming authorizes water wells. It is unusual (less than once per year) for a BLM-authorized oil and gas operation to require drilling a water well on public lands, although the operators may contract with private sources of water as part of drilling operations (BLM 2009b). However, groundwater wells are almost always a required component of uranium exploration activity to supply makeup water for drilling operations. Groundwater for these operations is typically supplied from existing wells from previous uranium exploration activities, converted oil and gas wells, or in some cases, new purpose-built water wells drilled onsite by the uranium exploration operator. Generally, impacts from these types of wells are limited because of the relatively small amounts of groundwater required for exploration operations. However, improperly completed or abandoned water wells or monitoring wells can contribute to degraded groundwater quality where waters of differing quality are allowed to communicate through the borehole.

Produced water from oil and gas operations is a disposal issue, not an impact to water quantity, because these wells do not produce from aquifers meeting the EPA drinking-water standards. The Madison Formation, for example, contains potentially potable water, but the EPA has deemed it to be too deep to be considered a potential source of drinking water (BLM 2009b). A modification of the Safe Drinking Water Act (Public Law 95-523) might include consideration of fracking chemicals; at present, these are not directly monitored.

Surface Water and Groundwater Quantity and Use

To understand trends related to groundwater use and to better plan for the future, long-term water level data from wells and flow rates from springs are critical. However, historical groundwater level data for the planning area either does not exist or is limited to surficial alluvial aquifers.

The most recent usage data for Fremont County (covering most of the planning area) was compiled by the U.S. Geological Survey (USGS) in 1990 (Plafcan et al. 1995). Table 3.16, "Estimated Groundwater Use in 1990 in Fremont County" (p. 273) lists these data; it is likely that these data understate current use. No information is available on surface water withdrawal volumes in the planning area.

Table 3.16. Estimated Groundwater Use in 1990 in Fremont County

Water Use	Groundwater (million gallons per day)
Public Supply	2.5
Domestic	1.1
Commercial	0.1
Mining	1.7
Irrigation	0
Livestock	0.2
Industrial	0.3
Source: Plafcan et al. 1995	

The Wyoming State Engineers Office is charged with regulation and administration of water resources in Wyoming. The Surface Water and Engineering Division is responsible for reviewing

permit applications for any request to put Wyoming surface waters to beneficial use. The Ground Water Division is charged with registering groundwater rights for all uses except stock and domestic. The Wyoming DEQ is responsible for enforcing state and federal water laws, including the Clean Water Act, National Pollutant Discharge Elimination System, Environmental Quality Act, and Federal Surface Mining Reclamation and Control Act. BLM management actions or use authorizations must comply with all federal and state water quality laws, rules, and regulations to address water quality issues that originate on public lands.

Management Challenges for Water

Waterbodies listed in the Wyoming DEQ 305(b) Report impose a management challenge. In 2006 there were three streams listed:

1. Crook's Creek is listed due to oil from an unknown source in the sediment on private land near Jeffrey City. It is a high priority scheduled for TMDL development.

2. Poison Creek is listed due to fecal coliform bacteria levels from below the town of Shoshoni to Boysen Reservoir. The Lower Wind River Conservation District is developing a watershed plan, so Poison Creek is a low priority for TMDL development.

3. The Middle Fork of the Popo Agie River near Lander is listed due to fecal coliform. It is a low priority for TMDL development because the Popo Agie Conservation District has developed a watershed plan to identify sources of fecal contamination and voluntarily remediate them.

Protecting sole source domestic water supplies is a management challenge. The city of Lander obtains most of its domestic water needs from the Middle Fork of the Popo Agie River, so authorized activities here would require an extra level of scrutiny to ensure that water quality is not compromised (Lower Wind River Conservation District 2010). Other municipal sources of water are currently being considered, including deep wells targeting Paleozoic formations in the Middle Fork watershed. When fully developed, these wells would provide additional sources of water in low-runoff years or supplement the surface water supply.

Increasing interest for in situ recovery (ISR) uranium mining imposes a management challenge because it has the potential to degrade groundwater quality and quantity. Wyoming DEQ does not allow water quality to be degraded below what is required for the previously classified level, but does not require that the water quality return to its predisturbance condition. ISR uranium mining operations consume groundwater, because approximately 10 percent of all water pumped from subsurface mine units is typically bled to surface impoundments where it is allowed to evaporate. A substantial concentration of these operations in parts of the planning area with limited recharge would be expected to lower the head in upper regional hydrologic units, such as the Wind River or Battle Springs Formations.

Oil and gas operations have the potential to impact groundwater quality. In general, however, safeguards such as casing design and selection of injection well receiving horizons protect groundwater quality. The recent interest in Coalbed Natural Gas (CBNG) development is expected to impact the amount or the configuration of groundwater supplies through the withdrawal of groundwater and the subsequent reinjection to other aquifers or direct discharge to the land surface.

Water developments for livestock grazing use is an additional management challenge. The availability and use of water is a limiting factor in locating and managing livestock grazing. Limiting the depletion of the Platte River water to protect downstream special status species is another important management challenge for water resources in the planning area.

3.1.5. Cave and Karst Resources

Karst topography consists of landforms produced by the dissolution of rock, creating a variety of landscape features including caves and sinks. Cave and karst resources are fragile because of their association with other resources such as groundwater systems and biological communities. They can also be considered nonrenewable resources due to paleontological and archeological deposits, speleothems (formations inside caves), and biological resources.

A cave is defined as any naturally occurring void, cavity, recess, or system of interconnected passages beneath the surface of the Earth, or within a cliff or ledge large enough to permit an individual to enter, whether or not the entrance is naturally formed or man-made (The Federal Cave Resources Protection Act [FCRPA], Sec. 3[1]). The FCRPA of 1988 was the first federal legislation to recognize caves and their contents as whole, integrated ecosystems. The FCRPA declares significant caves on federal lands as an invaluable and irreplaceable part of the nation's heritage. The DOI implementation regulations for FCRPA require that federal lands be managed in a manner that, to the extent practical, protects and maintains significant caves and cave resources (43 Code of Federal Regulations [CFR] Part 37.2). BLM policy and guidance for managing cave resources is to protect sensitive, fragile, biological, ecological, hydrological, geological, scientific, recreational, cultural, and other cave values from damage and to ensure they are maintained for use by the public, both now and in the future (BLM 2008b).

Under the FCRPA, a cave is considered significant if it meets one or more of the following six criteria (43 CFR Part 37):

- **Biota** – The cave serves as seasonal or yearlong habitat for organisms or animals, or contains species or subspecies of flora or fauna native to caves, or is sensitive to disruption, or contains species found on state or federal sensitive, threatened, or endangered species lists.

- **Cultural** – The cave contains historic or archeological resources included in or eligible for inclusion in the National Register of Historic Places (NRHP) because of its research importance for history or prehistory, its historical association, or other historical or traditional significance.

- **Geological/Mineralogical/Paleontological** – The cave possesses one or more geologic or mineralogical features that are fragile or exhibit interesting formations.

- **Hydrologic** – The cave is part of a hydrologic system or contains water important to humans, biota, or development of cave resources.

- **Recreational** – The cave provides recreational opportunities or scenic values.

- **Educational or Scientific** – The resource offers opportunities for educational or scientific use or is in a virtually pristine state, lacking evidence of contemporary human disturbance or impact, or the length, height, volume, total depth, or similar measurements are notable.

No significant caves have been identified in the planning area; however, there has been no formal inventory of cave and karst resources. Limestone geology in the planning area is conducive to cave and karst resources and inventories may identity additional cave and karst resources. Known locations of natural caves in the planning area include Sinks Canyon, Baldwin Creek Canyon, Popo Agie Canyon, North Fork Canyon, Sawmill Canyon, and portions of the Beaver Creek drainage.

The Sinks in Sinks Canyon State Park (adjacent to and downstream of BLM-administered land) is one of the best known sinks in the area. Typical of a karst river, the Popo Agie disappears in the Sinks as it flows into a cave formation in Madison Limestone and then rises again into a pool one-half mile down canyon. Other karst formations are known to exist in the planning area, such as the sinkholes on Auer Ranch on Beaver Creek and south of the hot spring, and in Dubois near the airport.

Management Challenges for Cave and Karst Resources

No cave and karst resources in the planning area have been reviewed for significance under the FCRPA, nor are they managed as such. Management challenges include performing a formal inventory to identify significant caves and, as needed, managing these resources according to FCRPA requirements and BLM policy.

3.1.6. Lands with Wilderness Characteristics

The BLM inventories and manages lands with wilderness characteristics. These lands are distinct from Wilderness Study Areas (WSAs); WSAs are discussed in the *Wilderness Study Areas* section. This EIS incorporates by reference the Lander Field Office wilderness inventory files.

Pursuant to the 2011 Continuing Resolution, the Secretary of the Interior issued guidance stating that the BLM will not designate any lands as "Wild Lands," as had previously been provided for under Secretarial Order 3310. However, the guidance also stated:

> As required by law, the BLM will continue to maintain inventories of lands under its jurisdiction, including lands with wilderness characteristics. Also, consistent with [section 201 and 202 of] FLPMA and other applicable authorities, the BLM will [inventory and] consider the wilderness characteristics of public lands when undertaking its multiple use land use planning and when making project-level decisions...

The process that the Lander Field Office used to develop the RMP is consistent with the latest direction issued as a result of the 2011 Continuing Resolution and the associated direction contained in FLPMA. During the planning process, the Lander Field Office identified lands with wilderness characteristics through the inventory process described below. The criteria used to evaluate lands with wilderness characteristics is derived from the Wilderness Act. In order for an area to qualify as lands with wilderness characteristics, it must possess sufficient size, naturalness, and outstanding opportunities for either solitude or primitive and unconfined recreation. In addition, it may also possess supplemental values. This RMP includes a full range of alternatives regarding management of lands with wilderness characteristics.

To support the RMP revision, the Lander Field Office has maintained the original 1980s (conducted in support of identifying WSAs) inventory. The first step in the inventory process was to identify roadless areas over 5,000 acres or meeting one of the size requirements. Nearly

all of the areas that were found to meet one or more of the size requirements corresponded with Citizen Proposed Wilderness (CPW) and/or were reviewed in the existing inventory files. In addition, every CPW was reviewed independent of the size criteria determinations. The BLM also conducted an extensive review of the citizens' proposal and other information to determine whether the situation on the ground had changed or new information had come to light since the original inventory. The Lander Field Office AMS documented and served as an update for Lander Field Office wilderness characteristics inventory. No public comments were received disagreeing with these findings.

In support of this planning effort the BLM is in the process of updating its wilderness files to ensure consistency with the direction contained in the Wilderness Act and FLPMA. Since the criteria to evaluate lands with wilderness characteristics has not changed, it is anticipated that minimal changes will result from this update. Initial findings indicate 20 areas warrant additional inventory review. Nearly all of these areas were inventoried in the 1980s and found not to contain wilderness character and/or correspond with the CPWs discussed below.

In order for an area to be classified as land with wilderness characteristics, it must possess sufficient size, naturalness, and outstanding opportunities for either solitude or primitive and unconfined recreation. In addition, it may also possess supplemental values. In parts of the United States with more precipitation and rapid vegetation growth, conditions can change dramatically over several decades. The semi-arid conditions and slower vegetation growth in the planning area mean that conditions change more slowly. For example, reclaimed or abandoned roads are often visible as roads for many decades (e.g., the National Historic Trail [NHT] used during the westward pioneer migration) and might never return to a primitive condition. In addition, over the last 20 years, the amount of area containing wilderness characteristics has declined. Other resource uses, such as motorized or developed recreation, have affected the number of areas that contain wilderness characteristics. The recent recreation setting inventory found that the planning area does not contain "primitive" physical settings and contains only a limited number of locations with "back country" physical settings. The recreation setting inventory found that although some portions of the planning area provide situations in which the likelihood of visitor-to-visitor contacts and development is low, the overall trend is one of increasing urbanization (BLM 2009b). This trend, in addition to the slow reclamation of disturbed areas discussed previously, indicates a potential threat to the continuation of wilderness characteristics under current management.

The rest of this section provides a discussion of some key areas in the planning area that the citizens' proposals recommended for consideration as lands with wilderness characteristics.

Fuller/Greer Peak

The Fuller/Greer Peak area reviewed for wilderness characteristics consists of 14,341 acres of BLM-administered surface. Upon review of available data, the BLM determined that the area did not possess naturalness, outstanding opportunities for solitude, or outstanding opportunities for primitive/unconfined recreation. Influential factors on this determination included: numerous motorized ways, constructed roads, fences, digs and scrapes in support of mining activities, a lack of screening vegetation or topography, and the area being located within a H_2S gas plant influence area. In addition, the citizens' proposal did not contain sufficient information to indicate the BLM's inventory findings were deficient or outdated. Recreation opportunities, visual resources, vegetation, and other resource values in the area might warrant additional management consideration; however, this would need to be considered under other program areas.

Lysite Badlands

The Lysite Badlands area reviewed for wilderness characteristics consists of 14,745 acres of BLM-administered surface. Upon review of available data, the BLM determined that the area did not possess naturalness, outstanding opportunities for solitude, or outstanding opportunities for primitive/unconfined recreation. Influential factors on this determination included: numerous motorized ways, constructed roads, fences, producing gas wells, lack of screening vegetation or topography, omnipresent visual and auditory human influences occurring outside the unit, and the area being located within a H_2S gas plant influence area. The citizens' proposal does not contain sufficient information that would indicate the BLM's inventory findings were deficient or outdated. Recreation opportunities, visual resources, vegetation, and other resource values in the area might warrant additional management consideration; however, this would need to be considered under other program areas.

Lysite Mountain

The Lysite Mountain area reviewed for wilderness characteristics consists of 8,401 acres of BLM-administered surface. Upon review of available data, the BLM determined that the area did not possess naturalness, outstanding opportunities for solitude, or outstanding opportunities for primitive/unconfined recreation. Influential factors on this determination included: constructed roads, fences, unnatural vegetation treatments, lack of screening vegetation or topography, and the area being located within a H_2S gas plant influence area. The citizens' proposal did not contain sufficient information that would indicate the BLM's inventory was deficient or outdated. Recreation opportunities, visual resources, vegetation, and other resource values in the area might warrant additional management consideration; however, this would need to be considered under other program areas.

Whiskey Mountain Complex: Red Creek, Torrey Rim, Whiskey Mountain, Glacier Trail

Since the original inventory and citizens' proposal, the BLM split the complex into two inventory units discussed below:

- **Little Red Creek Complex** (including: Little Red Creek, Torrey Rim, and Glacier Trail): As part of this inventory update and planning process the Little Red Creek, Torrey Rim, and Glacier Trail units are combined to form the Little Red Creek Complex (5,492 acres). The citizens' proposal cited the need to conduct a review of the area due to land acquisitions since the original inventory. As a result of the land acquisition all of these units are connected either by contiguous boundary (as is the case with Little Red Creek and Torrey Rim) or are in close proximity to one another (the Glacier Trail area is less than 2.5 miles from the other units and recreationists can utilize the Glacier Trail to access other portions of the complex). Since the Torrey Rim and Little Red Creek units are no longer separate land tracts, the units are now combined into the Little Red Creek Complex. The Glacier Trail unit will remain a distinct unit within the Little Red Creek Complex due to its geographic isolation from the rest of the unit. All of these lands share a contiguous boundary with the USFS Fitzpatrick Wilderness Area; the Glacier Trail unit has a nonmotorized trail along its eastern edge. This trail is a well used thoroughfare into the adjacent Wilderness Area. All of these units have been found to contain naturalness, and with the acquisition, now have outstanding opportunities for primitive and unconfined recreation that mimic those of the Wilderness Area. The area is also currently managed as an Area of Critical Environmental Concern (ACEC) to protect the important seasonal ranges of bighorn sheep and scenic values. Current management is

complementary to maintaining the wilderness characteristics of the area. As such, the Little Red Creek Complex is recognized as land with wilderness characteristics.

- **Whiskey Mountain**: The citizens' proposal encompasses the Whiskey Mountain WSA and an area to the east of the WSA. This CPW totals 1,589 acres. The citizen's proposal cherry stems an active road and communication tower; and also encompasses a rehabilitated motorized way and an existing motorized way used on an intermittent basis. The cherry stem of the citizens' proposal creates approximately a .25 mile bottleneck area between the designated wilderness and the area proposed for wilderness. The original BLM inventory removed this area from WSA consideration and intensive inventory due to the impacts to wilderness characteristics from the human modification, and the lack of screening vegetation and topography of the unit. Since these impacts and attributes still exist today, the wilderness characteristics of the area were found not to be contiguous with the WSA or Fitzpatrick Wilderness Area. Therefore, the area does not meet any of the size requirements and does not contain lands with wilderness characteristics.

Sweetwater Rocks Wilderness Study Area Complex

The citizens' proposal recommends acquisition of several parcels of state land adjacent to the existing WSAs. These state lands are not evaluated as part of this effort. The proposal also recommends managing 3 public land units (totaling 11,420 acres) on the northeast and eastern boundaries of the Savage Peak WSA to preserve wilderness characteristics. Two of these parcels are not contiguous with the WSA, do not meet any of the size criteria, are less than 5,000 acres of contiguous BLM-administered land, and are narrow land masses which are not practical to preserve and use in an unimpaired condition. Management of these additional public lands would only be possible if state lands separating the areas were acquired. The Devil's Gate extension did, however, share a contiguous boundary with the WSA.

The BLM review found that the Devil's Gate area, which was recommended in the citizens' proposal, and met the size criteria, did not possess naturalness and outstanding opportunities for solitude or primitive and unconfined recreation. This determination was due in part to the heavy existing developed recreational use occurring within the area and the fact that the areas shared only a ¼ section of public land that connects the area to the larger Savage Peak WSA. Such a bottleneck and extensive recreation developments do not represent outstanding opportunities for solitude and result in confinement of recreationists. Recreation opportunities, visual resources, vegetation, and other resource values in the area might warrant additional management consideration; however, this would need to be considered under other program areas. Refer to the *Wilderness Study Areas* section of this document for additional information on existing WSAs in the planning area.

Copper Mountain Wilderness Study Area

The citizens' proposal included 165 acres located outside of the existing WSA. This area was originally excluded from the WSA due to an existing gas well and road. Upon review of 2009 aerial photos, the BLM found the road and well pad still exist in the area, and therefore the area is not contiguous to the WSA. Since the area does not meet any of the size requirements it is not considered a land with wilderness characteristics.

Area North of Honeycomb Buttes, Oil Mountain, and Antelope Hills

General scoping input suggesting the presence of wilderness characteristics was received for the portion of the planning area located to the northeast of the Honeycomb Buttes WSA,

which is managed by the Rock Springs Field Office. Other general suggestions of wilderness characteristics included Oil Mountain and the Antelope hills. Evaluation determined that the areas contained several constructed roads and therefore did not meet the size requirements necessary to contain wilderness characteristics. However, the BLM determined through scoping comments that there is widespread public interest in having the Antelope Hills/Area North of Honeycomb Buttes areas managed for recreational value and also for its proximity to the Congressionally Designated Trails. The areas support recreational opportunities involving solitude and primitive experience and other unique experiences. See Chapter 2 for recreation and trails management.

3.2. Mineral Resources

The BLM manages a total of 2,809,101 acres of federal mineral estate in the planning area which does not include mineral estate underlying USFS or WRIR lands (Map 2). In addition, the BLM has a fiduciary trust responsibility for the administration of minerals on the WRIR. The BLM supervises operational activities (e.g., inspection and enforcement) on Native American mineral leases, and provides advice on leasing and operational matters to the Bureau of Indian Affairs, Native American tribes, and Native American mineral owners. The BLM does not make land management decisions on the Reservation; however, where applicable, this section includes the current condition and activity of mineral development on the WRIR to set a baseline for the cumulative effects analysis in Chapter 4.

Mineral resource types in the planning area include locatable (uranium, bentonite, gold, gypsum, etc.), leasable (coal, oil shale, geothermal, oil and gas, other solid leasable minerals such as phosphate), and salable (sand, gravel, moss rock, etc.) minerals. Each individual resource section below defines and describes these resources, their existing conditions, and management challenges.

Development and extraction of mineral resources from federal mineral estate are authorized under federal legislation including:

- The General Mining Law of 1872, as amended, which authorizes the location of mining claims and mill sites on public lands, and the exploration for and mining of "locatable" minerals such as gold, silver, uranium, bentonite, gypsum, metallurgical-grade limestone, and gemstones.

- The Mineral Leasing Act of 1920, as amended, which authorizes the BLM to issue leases for developing "leasable" minerals such as coal, oil, natural gas, oil shale and other hydrocarbons, and phosphates, sodium, and other specific mineral commodities on public lands.

- The Materials Act of 1947, as amended by the Surface Resources Act of 1955, which authorizes the BLM to sell at fair market value or allow the free use of mineral materials ("salable" minerals) such as common varieties of sand, gravel, pumice, cinders, clay, and stone through contracts or free-use permits, as well as petrified wood under the Petrified Wood Act of 1962.

The management authority of the BLM varies substantially depending upon the type of legislation that allows the mineral development. These differences are discussed below.

3.2.1. Locatable Minerals

Locatable minerals known to occur in the planning area include, but are not limited to, uranium, bentonite, gold (both lode and placer deposits), silver, gypsum, copper, tungsten, tantalum, zeolites, iron, and gemstones (precious and semi-precious) such as agate, opal, jade, sapphire, beryl, and garnet.

Most of the commercial locatable mineral activity in the planning area focuses on uranium, bentonite, and gold exploration. There are currently no operating uranium mines and one-BLM permitted, but inactive, bentonite mine in the planning area. Gold panning is a popular activity in the South Pass/Atlantic City area.

Opal and agate collecting attracts hobbyists to the planning area. In 2005, a large deposit of opal was discovered near Cedar Rim, north of Sweetwater Station. This discovery was publicized by the Wyoming State Geological Survey and touched off a modern-day "land rush" that resulted in more than 1,000 mining claims registered at the Fremont County Courthouse in a span of two months (BLM 2009c). Most of the opal found in the planning area is "common opal," but some of the highly valued "precious opal" was reportedly found (BLM 2009c). This activity has substantially abated over the last few years and only a few mining claims remain.

Statutory and Regulatory Authorities

The General Mining Law of 1872, as amended, opens public lands to exploration and development of "locatable" minerals. The 1872 Mining Law allows U.S. citizens or corporations to decide where and when to locate (stake) mining claims and mill sites on public lands that are open to (not withdrawn from) operation under the General Mining Law.

Leaving such decisions to citizens or corporations is characterized as being "non-discretionary," meaning that the Secretary of the Interior, or the BLM as the agency delegated with the responsibility to oversee implementation of the General Mining Law, has no discretion or authority to direct where or when placer or lode mining claims, mill sites, or tunnel sites can be located on open public lands. In addition, because the General Mining Law, as amended, authorizes location of mining claims, exploration, and mining that are in conformance with statutes and implementing regulations, the BLM does not have the discretion to disapprove such actions unless the actions do not comply with the requirements.

Section 302(b) of the FLPMA requires that the Secretary of the Interior take any action necessary to prevent unnecessary or undue degradation of federal lands. Therefore, the BLM may not allow unnecessary or undue degradation of public lands resulting from operations under the General Mining Law (see also 43 CFR 3809 for General Mining Law implementing regulations). If the BLM is notified of pending operations at the "notice" level under 43 CFR 3809 (see below) that the agency believes would cause unnecessary or undue degradation of public lands, the agency must notify the proponent that it may not proceed without modifying the proposal to comply with requirements to prevent such degradation. Similarly, the BLM may not approve a Plan of Operations under 43 CFR 3809 that would cause unnecessary or undue degradation to public lands. However, if a notice or Plan of Operations meets all requirements, the agency must allow operations to proceed.

Unlike other mineral resources such as leasable minerals (e.g., oil and gas) or salable minerals (e.g., sand and gravel), withdrawal of land is the only management prescription available for controlling the location of locatable mineral development. The BLM may propose to withdraw

portions of public lands from operation under the General Mining Law, subject to valid existing rights and certain limitations (FLPMA, Sec. 204). Map 21 shows existing areas withdrawn from operation under the General Mining Law.

The regulations at 43 CFR 3809 allow for three levels of General Mining Law operations: casual use, notice-level operations, and plans of operations.

- **Casual Use.** Casual use activities are locatable mining activities that result in no or negligible disturbance of public lands or resources. Gold panning is a typical example of a casual use activity. Note that where the cumulative effects of casual use by individuals or groups will result in more than negligible disturbance, the BLM may establish specific areas wherein such persons must contact the agency 15 days before start-up to determine whether a notice or Plan of Operations might be required (see 43 CFR 3809.31).

- **Notice-Level Operations.** Notice-level operations include exploration causing surface disturbance of 5 or fewer acres of public lands, and bulk sampling in which operators remove less than 1,000 tons of presumed ore for testing. Notification via a written "notice" to the BLM is required 15 calendar days before commencing operations. No BLM approval is required for notice-level operations.

- **Plan of Operations.** A Plan of Operations is required for all locatable mineral activities exceeding casual use. For exploration-only operations disturbing less than five acres, a notice is the only requirement which does not require BLM approval. In the notice or Plan of Operations, the operator must disclose occupancy or uses they believe are reasonably incident to mining as described in 43 CFR § 3715.0-5.

Locatable Mineral Activity

Uranium related mining activities have the most notice-level operations in the planning area, followed by gold and bentonite (Table 3.17, "Notices and Plans of Operations in the Planning Area, as of the End of 2008" (p. 282)). Gold-related mining activities account for the greatest number of plans of operations in the planning area (Table 3.17, "Notices and Plans of Operations in the Planning Area, as of the End of 2008" (p. 282)).

Table 3.17. Notices and Plans of Operations in the Planning Area, as of the End of 2008

Commodity	Number of Notices	Number of Plans of Operations	Disturbed Area (acres)
Bentonite	5	1	121
Gemstones and lapidary material[1]	1	0	4.5
Gold, lode[2]	2	4	10.6
Gold, placer[3]	4	3	145
Uranium[4]	16	2	80
Zeolites[5]	1	0	1

Source: BLM 2009c
[1] Includes diamonds, rubies, sapphires, emeralds, jade, opal, and other precious and semi-precious stones.
[2] Does not include nine notices and one plan with a pending status for an additional 169 acres.
[3] Does not include four notices with a pending status for an additional 3 acres.
[4] Does not include two notices and five plans with a pending status for an additional 8,017 acres.
[5] This case is pending.

The sub-sections below further describe the primary types of locatable minerals in the planning area.

Locatable – Uranium

Uranium occurs geologically in four main classes of deposits, one of which is dominant in the planning area (the "roll front" deposit). The "fronts" form when a uranium rich source rock is leached when groundwater passes through. The uranium is dissolved and re-deposited when the groundwater loses its dissolved oxygen. These geologically favorable areas occur in certain groundwater basins in southwestern Wyoming as well as the Powder River Basin in northeast Wyoming, and are the host for uranium deposits in the planning area.

Roll type deposits are the most important uranium deposit type being extracted by ISR technology. Roll-front deposits with the simplest form occur as classical rolls formed in sands of uniform lithology and permeability.

Uranium deposits in the Gas Hills area are hosted in the Eocene Wind River Formation. In the Crooks Gap area, roll-front deposits are found in the Eocene Battle Springs Formation, while roll-front deposits in the Bison Basin region are found within sandstones in the Eocene Wasatch-Green River Formation (Map 15). Another important deposit in the Copper Mountain area contains low-grade uranium in the Eocene Teepee Trails Formation, and igneous rocks including Precambrian granites and quartz monzonites.

Uranium Mining and Exploration Activities

Fremont County has accounted for more than 26 million tons of uranium ore since mining began in the 1950s. Fremont County ranks second in the state for total uranium produced. There are three major uranium districts in the planning area: Gas Hills, Crooks Gap (including Green Mountain) and informally, the Bison/Great Divide Basin district (Map 15). At present, various entities are exploring all three districts though no mining is occurring as of late 2009.

Mining in the Gas Hills District has been predominately by open-pit methods. In the Crooks Gap District, mining occurred by both open-pit and underground operations. Mining at the Bison Basin Project in the Bison/Great Divide District was conducted using ISR methods.

There was new major development activity in the Crooks Gap District through the 1990s when the Jackpot Mine at the base of Green Mountain was developed and subsequently reclaimed (with no mining occurring). Minor exploration drilling on Green Mountain then occurred during 2007. Some projects, such as Big Eagle Mine on Green Mountain, attempted to enter interim management to wait for better market conditions to return, but eventually all producing mining ventures began reclamation activities. Of the mines that began reclamation activities, most are administered under the state Abandoned Mine Lands (AML) program for a variety of reasons, including bankruptcy of mine operators, insufficient bond to complete reclamation, or the fact that many operations were initiated long before mining laws required reclamation and bonding.

Since the early 1980s, there has been little actual mining as uranium market conditions have declined. The last production in the Gas Hills District was in 1984, in Crooks Gap at Sheep Mountain in 1985, and in 1982 at the ISR uranium mining project in Bison Basin. There are several other known occurrences of uranium bearing ore bodies in the planning area; however, these are of lesser importance and only produced small volumes of ore. Slowly increasing uranium prices in the past several years have caused renewed interest in exploration and mining, as evidenced by the number of notices for uranium filed with the BLM under 43 CFR 3809 (Table 3.17, "Notices and Plans of Operations in the Planning Area, as of the End of 2008" (p. 282)).

Uranium Milling

The process of uranium recovery focuses on extracting (or mining) natural uranium ore from the earth and concentrating (or milling) that ore. These recovery operations produce a product called "yellowcake," which is then transported to a fuel cycle facility. Uranium recovery typically involves several types of milling methods.

Conventional milling refers to the process in which uranium ore is removed (mined) from deep underground shafts or shallow open pits and then crushed and subjected to physical and chemical processes to extract uranium from the mined ore. Heap leach is a process similar to conventional milling in which physical and chemical processes are used to extract uranium from mined ore that has been crushed and piled in a heap. The solution drains through the heap and is captured in a system of drains for further processing. The ISR process utilizes a chemical process to extract uranium from underground deposits. The chemical solution is delivered directly to the ore body by injection wells, circulated, and then pumped out. The solution, once laden or "pregnant" with soluble uranium, is processed further to precipitate the uranium.

The challenge in operating any uranium milling facility is to mitigate groundwater impacts. In some cases, alternate concentration limits are used as standards for restoring groundwater quality affected by the operation of uranium milling facilities. Alternate concentration limits are risk-based concentration limits used to establish alternative groundwater protection standards.

Conventional Uranium Mill Site Disposition

In the past 50 years, numerous conventional uranium milling facilities have been in operation in the planning area, including several in Gas Hills, one in Riverton, and the Split Rock Mill in Crooks Gap, which was the first uranium mill in Wyoming. At present, with the exception of one mill, all mills in the State of Wyoming are undergoing or have been decommissioned. The still existing Sweetwater Mill is the only conventional uranium mill left in the State of Wyoming and is located south of the planning area approximately 45 miles northwest of Rawlins. This mill is one of six operational conventional mills left in the United States and has been on standby status since 1983.

It is the policy of the Nuclear Regulatory Commission to transfer lands used for uranium mill sites, processing, and the storage of processing waste (tailings) to the U.S. Department of Energy (DOE) for long-term monitoring and oversight. Table 3.18, "Segregated Lands at Uranium Mill Sites in the Planning Area" (p. 284) identifies lands segregated from land use laws in preparation for withdrawal and transfer to DOE. Mill specific information can be found in the *Final Mineral Occurrence and Development Potential Report* (BLM 2009c).

Table 3.18. Segregated Lands at Uranium Mill Sites in the Planning Area

Mill Site	Township/Range	Section(s)	Acreage[1]
Western Nuclear – Split Rock Mill (WYW172386)	T 29 N, R 91 W	Sec. 6, lots 8 through 13, inclusive, E1/2SE1/4	749.09
	T 29 N, R 92 W	Sec. 1, lots 1 and 2, S1/2NE1/4, SE1/4SE1/4; Sec. 2, SE1/4SW1/4, SW1/4SE1/4; Sec. 11, NW1/4NE1/4, NE1/4NW1/4; Sec. 12, W1/2NE1/4	

Mill Site	Township/Range	Section(s)	Acreage[1]
Pathfinder – Lucky Mac Mill (WYW161764)	T 33 N, R 90 W	Sec. 9, lots 1 and 2, and NE1/4SE1/4; Sec. 10, lots 1 through 3, inclusive, NW1/4, W1/2SE1/4, and that unpatented portion of Mineral Survey No. 644 lying within sec.10; Sec. 15, lots 1 through 8, inclusive, S1/2NE1/4, NW1/4NE1/4, N1/2SE1/4, SE1/4SE1/4, and those unpatented portions of Mineral Survey Nos. 587 and 644 lying within sec. 15; Sec. 21, E1/2NE1/4, and NE1/4SE1/4; Sec. 22, lots 1 through 4, inclusive, NE1/4NE1/4, and those unpatented portions of Mineral Survey Nos. 582, 584, and 587 lying within the N1/2, NW1/4SW1/4 and N1/2SE1/4	1,091
Umetco – East Gas Hills Mill (WYW164606)	T 33 N, R 89 W	Sec. 9, SE1/4; Sec. 10, S1/2; Sec. 15, N1/2, SE1/4SE1/4; Sec. 21, NE1/4; and Sec. 22, N1/2	1,320
American Nuclear – Gas Hills Mill	T 33 N, R 93 W	Unknown, under Wyoming DEQ reclamation responsibility	Unknown

Source: BLM 2009c
[1] Values shown are for public surface (any additional subsurface mineral estate not included).

DEQ Department of Environmental Quality
E East
N North
NE Northeast
NW Northwest
R Range
Sec. Section
S South
SE Southeast
SW Southwest
T Township
W West

Locatable – Gold

Gold deposits are typically found in the planning area in two forms, lode and placer. These gold deposits are found in varied geologic settings. In the South Pass/Atlantic City area, most of the lode gold is orientated along shear zones trending east-northeast in a suite of granitic and metamorphic rocks, including banded iron formation, quartzite, schist, and other rocks referred to as greenstone. Placer deposits are found in streams which are mostly sourced in the Wind River Range. Two Tertiary-age paleoplacer deposits have also been identified in the vicinity of the South Pass/Atlantic City District. These include the Dickie Springs-Oregon Gulch paleoplacer and the Twin Creek conglomerate. These placers are notable because they could represent the

greatest potential for a major gold accumulation in the planning area. The Dickie Springs placer also extends into the administrative boundaries of the BLM Rock Springs Field Office.

The Rattlesnake Hills District is north of the Granite Mountains on the north side of the east-west trending North Granite Mountains Fault, and encompasses an area of approximately 150 square miles. This area includes more than 40 discrete volcanic vents and igneous bodies of Eocene age. The Rattlesnake Hills were formed by a northwest plunging anticline of Laramide age, cored by Precambrian rocks, and intruded by Tertiary igneous rocks (Hausel 1989). Apparently, there are some precious metals in the Precambrian metamorphic rocks, which also include band iron formations. Jasperoid rocks are also reported in the area, which is important because jasperoid is a well-known mineralization indicator rock in other mining districts, especially in the Great Basin of Nevada. In 1981, the Wyoming State Geological Survey discovered important gold anomalies in the Rattlesnake Hills District.

Additional information on gold in the planning area can be found in the *Final Mineral Occurrence and Development Potential Report* (BLM 2009c).

Gold Mining and Exploration Activities

Mining operations for precious metallic ores, particularly gold, has a long and varied history in the planning area. The most well known district is the South Pass/Atlantic City area. Metals mining districts of lesser prominence include the Lewiston District, the Granite Mountains, the Copper Mountains, and various placers on streams mostly sourced in the Wind River Range (Hausel 1989). At present, most of the mining activity in the South Pass/Atlantic City area is recreational.

The South Pass/Atlantic City District lies along the northwestern flank of the South Pass Precambrian greenstone belt and has been Wyoming's most prolific source of gold and iron ore (Hausel 1989). Gold was discovered here in the 1860s, touching off a gold rush in 1867 that resulted in more than 1,000 inhabitants settling in South Pass City. By 1872, only a few hundred people remained and the boom was over. Optimistic estimates of the total gold production in the district range as high as 334,000 ounces (Hausel 1987). Historically, approximately 50 mines were in operation at one time or another. However, most gold mining efforts in the district met with disappointment, although several did produce for a number of years. Most of these mines had total gold production amounting to a little over a few hundred ounces. Little is known about ore grades in the district and most available figures vary. In the 1970s, several properties were explored with modern methods, with numerous boreholes drilled at both the Carissa and Duncan mines. Although the boreholes did intersect zones of gold mineralization, the grade and areal extent of the mineralization was apparently not sufficient for additional development. The State of Wyoming purchased the Carissa Mine for historical purposes; the state is performing stabilization work and has plans for public access and onsite interpretation. Although its future status appears to be settled, the Carissa Mine areas host some of the more promising possibilities for gold mineralization in the district (Hausel 2004). Most of the mines in the district are now undergoing AML reclamation and/or preservation. Several properties remain privately owned and are open to operation at little more than a hobbyist's level.

Modern stream placers in the South Pass/Atlantic City District were relatively productive and may have recovered up to 100,000 ounces of gold (Hausel 1989). Principal placers include Rock Creek, Meadow Gulch, and Yankee Gulch.

The South Pass/Atlantic City Mining District has seen no major change in mining-related activities over the last planning cycle, and continues to experience several hundred visitors

engaged in casual use mining activity (surface panning and sluicing). Many people converge on the area during summer to stake claims and try their hand at recreational gold panning. Several clubs operate claims in the South Pass area for the sole use of their members, and these activities do result in recoverable amounts of gold dust, flakes, and small nuggets. In addition, small operators explore for gold or take bulk samples using backhoes. There is some management concern in the South Pass area about the cumulative impact of these activities.

Increased interest in the Rattlesnake Hills District by several major gold mining companies began with a limited surface and drilling program between 1983 and 1987, and again by another company from 1993 to 1995. This activity led to several discoveries, including a large-tonnage, low-grade deposit that has the potential to host more than 1 million ounces of gold (WSGS 2002). Subsequent drilling by the latter company targeted diatreme breccias, which border one of the alkali stocks in the area. Gold grades reported by the company ranged up to 485 feet averaging 0.07 ounce per short ton, with higher-grade intervals over narrower widths.

The potential for gold uncovered thus far in the Rattlesnake Hills District has resulted in a third company taking options on approximately 2,600 acres of claims. This company filed a mining notice under 43 CFR 3809 with the Lander Field Office and started a drilling program in the summer of 2008. Preliminary results indicate that drilling during the summer 2008 drilling program intersected anomalous values of gold in two core holes 65 meters (approximately 213 feet) apart (BLM 2009c). As of 2009, the company is operating an expanded core-drilling project under a BLM-approved Plan of Operations. If mined, it is anticipated that this deposit would be mined by either surface (open pit) or underground mining methods, in contrast to the panning, sluicing, and backhoe methods employed in the South Pass/Atlantic City area.

Locatable – Bentonite

Bentonite is an aluminum phyllosilicate, essentially a type of impure clay usually formed from the weathering of volcanic ash, most often in the presence of water. Bentonite deposits were formed from the alteration of volcanic ash deposited primarily during the Cretaceous Period. This volcanic ash was deposited into the epeiric seas that covered much of Wyoming, forming sediments as much as 50 feet deep. The weathering and alteration of these sediments formed the clay (bentonite). Bentonite is widespread in the planning area and primarily occurs as discrete beds within shales and sandstones, most notably the Cretaceous Mowry Shale, the Frontier Formation, and the Eocene Wind River Formation. Bentonite is able to absorb large amounts of fluid and is used for absorbents, animal feed, drilling fluids, foundry, iron ore pelletizing, sealants, pet litter, crayons, medicines, food thickeners, cosmetics, and other applications.

Bentonite Mining and Exploration Activities

At present, there are no commercial bentonite mining operations in the planning area. One bentonite mine, in the Gas Hills area, has an approved Plan of Operations and holds a mine permit from the Wyoming DEQ. The mine facility came online in 2010.

Bentonite exploration is ongoing in the planning area, targeting certain beds in the Cretaceous Mowry and Frontier Formations.

Management Challenges for Locatable Minerals

There are considerable management challenges associated with locatable minerals mining in the planning area. The primary management challenges are associated with surface disturbance

resulting from mining activities and impacts to other resources and resource uses from locatable mineral mining. There are also management challenges associated with reclamation of historic mining activities, mixed land ownership patterns, mining in special designation areas, and trespass issues associated with locatable minerals mining.

The greater sage-grouse is a candidate species for listing under provisions of the Endangered Species Act (ESA) (USFWS 2010). The BLM, in coordination with other federal and state agencies, local government, local working groups, and public land users, is taking measures to conserve greater sage-grouse habitat and populations. Some areas with locatable mineral development potential (especially areas with uranium potential) in the planning area lie within high quality habitat for the greater sage-grouse. Therefore, the BLM faces challenges managing locatable mineral development while protecting greater sage-grouse habitat.

Holders of grazing permits and leases on public lands can be affected by locatable mineral operations taking lands out of production short- or long-term. Surface disturbance necessary to extract locatable mineral resources can directly reduce the availability of livestock forage until either interim or final reclamation of mineral operations is completed. Such reductions can range from minor acreage related to a single drill hole, to hundreds of acres related to surface mining or milling. In the case of open pit mining, "reclamation" may involve protection of water quality but not the replacement of vegetation, so that the area is permanently lost as grazing and browsing habitat. This may be observed in the former iron mine on Highway 28 between South Pass and Red Canyon or the old uranium mines and mill sites that do not support vegetation.

Several mining districts in the planning area, such as the South Pass/Atlantic City and Copper Mountains, are undergoing extensive reclamation of historic surface disturbance under the Wyoming DEQ, AML Division. Many of these mining districts contain historic mining features worthy of preservation. However, some of the areas undergoing reclamation and immediately adjacent lands have some potential for the presence of gold and other locatable minerals, thus generating interest in exploration under the Surface Management Regulations (43 CFR 3809). These issues pose management challenges for the disposition and future management of such lands. The need to restore and clean up mines associated with previous mining activities and a limited amount of funds provided for the AML program pose additional challenges associated with historic mining and reclamation of mines.

The land ownership pattern in the planning area consists of mixed ownership between BLM-administered lands, the WRIR, state trust lands, private lands, private surface overlying federal mineral estate, National Forest System Lands, and lands managed by the Bureau of Reclamation. Management of locatable mineral operations becomes more complex where projects are proposed in areas of mixed ownership. In addition, segregations and withdrawals of public lands from operations under the General Mining Law, including those segregated in preparation for withdrawal and transfer to DOE (see the discussion of mill sites under the uranium sub-section above) add to management complexity, especially when addressing valid existing rights.

Additional management challenges for locatable minerals mining in the planning area include locatable mineral operations within special management areas such as ACECs and NHTs. Allowing operations in these specially designated areas and mitigating impacts to the areas consistent with management objectives are a management challenge in the planning area. Trespassing of public pursuing unauthorized mining (beyond scope of staking or without staking) and "claims" being asserted without meeting the ongoing activities required by the 3809 Regulations are an additional management challenge in the planning area.

3.2.2. Leasable Minerals – Coal

At present, there is no coal leasing in the planning area and no anticipated development of coal resources during the planning cycle. Future coal leasing and development in the planning area would require an RMP amendment.

3.2.3. Leasable Minerals – Geothermal

Geothermal resources are typically underground reservoirs of hot water or steam created by heat from the Earth. Geothermal energy is produced when this steam or heat is used to turn a turbine to create electrical energy. Geothermal steam and hot water naturally discharge at Earth's surface in the form of hot springs, geysers, mud pots, or steam vents. Geothermal resources also include subsurface areas of hot, dry rock. The Lander Field Office is responsible for supervising and managing all exploration, development, and production operations on any federal geothermal leases in the planning area.

There are two main categories of geothermal energy systems. Hydrothermal systems occur where water or steam is the primary carrier of the associated energy, and "dry" systems occur where hot, water-free rocks and magma are the energy sources. While dry environments are also the primary mechanism from which the hydrothermal environments derive their heat, existing technology used to exploit these dry environments for energy use is in the experimental phase and such extraction is usually not economically viable.

Warm water systems and normal temperature systems are hydrothermal systems typically used for site-specific and residential scale applications (direct use). Electrical grade geothermal energy comes from hydrothermal systems, which can generate electricity via geothermal fluids used to drive turbines. Electrical grade systems must have relatively high temperature fluids (liquid and/or vapor water) to efficiently drive the turbines. As technology has evolved, the temperatures required have become lower, but generally must still be more than 300 degrees Fahrenheit (°F) (Duffield and Sass 2003).

The Final Programmatic Environmental Impact Statement (PEIS) for Geothermal Leasing in the Western United States (October 2008) evaluates various alternatives for allocating lands as being closed or available for geothermal leasing and analyzes stipulations to protect sensitive resources. The Record of Decision (ROD) for the Geothermal PEIS (December 2008) amended existing land use plans to facilitate geothermal leasing on federal mineral estate in the planning area. The PEIS allocated 1,201,201 acres of BLM-administered surface as open to geothermal leasing in the planning area and 32,423 acres as closed (BLM and USFS 2008). Areas for discretionary and nondiscretionary closures as identified in the PEIS that are applicable in the planning area include:

- WSAs
- ACECs
- Areas previously closed to fluid minerals development in approved land use plans
- Lands in the BLM National Landscape Conservation System, such as National Historic and Scenic Trails

The Lander Field Office has determined that the acreage in the PEIS do not accurately reflect the components of the NLCS in the planning area. In addition, the PEIS did not provide a buffer for the excluded lands which creates planning difficulties, particularly in association with the Congressionally Designated Trails.

Geothermal Activity

There are geothermal resources in many places in the planning area, as evidenced by flowing springs with elevated groundwater temperatures. There are several areas where measured temperature gradients in groundwater wells indicate the potential for low- or medium-grade geothermal energy. These areas include north of the Gas Hills, the Diamond Springs area, Big Sand Draw, and the Copper Mountain area. Table 3.19, "Thermal Springs in the Planning Area" (p. 290) lists known thermal springs in the planning area. None of these thermal springs met the criteria to be included in the inventory of hot and warm springs included in the Geothermal PEIS (BLM and USFS 2008).

Table 3.19. Thermal Springs in the Planning Area

Thermal Spring	Location	Temperature (°C)	Flow (liters per minute)
Warm Springs Creek Springs	T 42 N, R 107 W	29	503
Little Warm Springs	T 41 N, R 107 W	25	2120
Jakey's Fork Spring	T 41 N, R 106 W	20	15
Conant Creek Springs	T 33 N, R 94 W	16	1136
Sweetwater Station Spring	T 29 N, R 95 W	32	1890
Horse Creek Springs	T 32 N, R 86 W	24	8327
Fort Washakie Hot Springs	T 1 S, R 1 W	44	568

Source: Heasler et al. 1983

°C degrees Celsius
N North
R Range
S South
T Township
W West

There are no active or pending federal leases for geothermal facilities in the planning area and no likely development of utility scale geothermal resources. There are areas in the planning area with low potential for geothermal development for direct use applications from warm water and normal temperature systems, but not for utility scale application (Map 16). These low potential areas occur around thermal springs and in areas with anomalies in the subsurface temperature gradient. Low potential areas are considered to have some potential for future exploration, but due to the expected nature of future projects (small, direct use systems) it is not likely that there would be any substantial development (BLM 2009e).

Areas with very low potential for geothermal development in the planning area are underlain by aquifer waters with temperatures in excess of approximately 120°F, and those deemed favorable for shallow, direct heat development (Map 16) (BLM 2009e). These waters, while too cool for electrical generation, might still be utilized for direct use systems, although less effectively than geothermal areas associated with thermal springs (low potential areas).

Areas with negligible geothermal potential represent the remainder of the planning area (Map 16). The entire planning area is underlain by rocks with temperatures in excess of approximately 300°F at an average depth of approximately 24,600 feet. As a result, the entire planning area might be suitable for future deep enhanced geothermal development as the technology for such systems improves. However, at present, these types of projects are not economically feasible and this type of geothermal development is the least likely to occur in the planning area.

The most likely potential for utilization of geothermal resources in the planning area is for co-generation, such as with oil and gas development. Low potential geothermal resources are more viable if a developer is already drilling to reach differentially heated material. Coupled with new low temperature equipment, electrical power to operate facilities could be generated without carbon dioxide (CO_2) or other emissions. Direct heat application could be used to warm gas lines and other facilities associated with minerals development. As clean energy initiatives increase and oil and gas operators look at ways to reduce the emissions impacts of their projects (and potentially to make projects more affordable), utilization of direct use geothermal systems on public land in the planning area might increase.

Additional information on Geothermal Resources and potential development in the planning area can be found in the *Reasonable Foreseeable Future Development Scenario for Geothermal for the Lander Field Office Planning Area* (BLM 2009e).

Management Challenges for Geothermal Development

Due to the lack of activity and absence of geothermal leasing in the planning area, no management challenges have been identified.

3.2.4. Leasable Minerals – Oil and Gas

Oil and gas occurs in the planning area in numerous geologic formations, and members of formations that range in age from the oldest producing formation (Flathead Sandstone of Cambrian age) upward to the Wind River Formation of Tertiary age. The two oil and gas basins in the planning area are the Wind River Basin and a small portion of the northern part of the Great Divide Basin. In addition, CBNG being produced in the planning area originates from coals in the Mesaverde Formation.

The Wind River Basin is a west-east trending asymmetrical intermontane basin of the Rocky Mountain Foreland, located in central Wyoming. The Wind River Basin Province is approximately 200 miles long and 100 miles wide, encompassing an area of approximately 11,700 square miles. Province boundaries are defined by fault-bounded Laramide uplifts that surround it. These include the Owl Creek Mountains to the north, Wind River Mountains to the west, Casper Arch to the east, and the Sweetwater Uplift to the south.

Two source rock and associated oil and gas reservoir systems appear to be responsible for most of the hydrocarbons found in the planning area. Permian aged Phosphoria source rocks appear to have sourced most of the pre-Cretaceous-aged reservoirs in the planning area (Kirschbaum et al. 2005). These older formations have predominately produced oil with smaller amounts of gas; the Madison Limestone, which has produced mostly gas in the Madden Field, is the exception. Tertiary and Cretaceous aged source rocks appear to have been the source of hydrocarbons in most Tertiary and Cretaceous aged reservoirs. The lower shaly member of the Cody Shale is a fair to excellent source rock for both oil and gas, and it is the most organic-rich and oil-prone of all potential hydrocarbon source rocks in Cretaceous strata in the Wind River Basin (Finn 2007). In the Tertiary and Cretaceous aged reservoirs, gas production tends to predominate, although there is usually a substantial oil component produced along with the gas.

Up until 2004, evidence for CBNG potential within the planning area has been limited to perhaps five exploration targets, generally in the Mesaverde Formation, with less than 5,000 feet of overburden (De Bruin and Jones 1990). The steeply dipping Lance and Meeteetse coalbeds

in the Waltman area of the Wind River Coal Field might present additional targets for CBNG development. The Fort Union Coals are targets for CBNG development in the Great Divide Basin portion of the planning area.

Statutory and Regulatory Authorities

The Mineral Leasing Act of 1920, as amended, provides that all public lands are open to oil and gas leasing unless a specific order has been issued to close an area. However, it is important to note that lease issuance by the Secretary of the Interior, through the BLM, is discretionary. With reasonable basis, the BLM can control the geographic location and timing of lease parcels it offers. The agency can also add lease stipulations to the standard lease terms and conditions, which can impose additional limits on the timing and methods of drilling for oil and gas.

Leasing procedures for oil, conventional natural gas, and CBNG are the same (see 43 CFR 3101). Based on the Federal Onshore Oil and Gas Leasing Reform Act of 1987, all leases must be exposed to competitive interest. Lands that do not receive competitive interest are available for noncompetitive leasing for a period not to exceed two years. Competitive sales are held at least quarterly and by oral auction.

Competitive and noncompetitive leases are issued for a primary term of 10 years. If the lessee establishes hydrocarbon production, the competitive and noncompetitive leases can be held for as long as oil or gas is produced. At the leasing stage, the Lander Field Office applies appropriate stipulations on federal oil and gas leases, including standard oil and gas stipulations (Appendix N (p. 1495)), as well as special stipulations identified in the RMP.

The federal government receives yearly rental fees on nonproducing leases. Royalty on production is received on producing leases, of which approximately one half (48 percent in 2009) is returned to the State of Wyoming.

In 2010, leasing reform was instituted. One component of the reform was to identify areas where pre-leasing management in the form of Master Leasing Plans (MLPs) would be instituted to protect identified resource values with additional management to standard stipulations. Resource protections in MLPs serve to reduce conflicts between oil and gas development and other resource values. Additional information regarding the areas proposed for management with MLP areas are identified in Chapter 2, both in the section *Alternatives Considered but Not Carried Forward for Detailed Analysis* and in the *Detailed Description of Alternatives by Resource* section. The *Oil and Gas Master Leasing Plans* subsection below discusses MLPs in more detail.

History of Oil and Gas Development in the Planning Area

Oil and gas development in the planning area has a long history that has contributed to economies at the local, state, and national levels. The first oil well in the state was drilled in the planning area in 1884. That well was the discovery well for the Dallas Field, which still produces. Later, two additional wells were drilled on the same structure producing oil from the Phosphoria Formation, with 53 additional wells in the same formation soon following (BLM 2009d). In 1930, a well was drilled producing oil from the Tensleep Sandstone, resulting in the extension of a number of previously drilled Phosphoria Formation wells into the Tensleep (BLM 2009d). Additional natural oil seeps were discovered at a number of sites northwest of the Dallas Field on WRIR lands. Oil fields were later developed on most of these sites.

Most of the fields found prior to 1947 were discovered by surface observations of oil seeps and/or surface mapping (BLM 2009d). These include the Lander, Plunkett, Sage Creek Anticline, Pilot Butte, Winkleman, Maverick Springs, Big Sand Draw, Alkali Butte, Derby, Circle Ridge, Bison Basin, Crooks Gap, Sheep Creek, Muskrat, Muskrat East, and Dubois fields. From 1938 through 1959, additional exploration methods, including mapping of surface geological structures, seismic surveys, and some subsurface mapping led to the discovery of the Beaver Creek, Steamboat Butte, Sheldon, Sand Draw South, Antelope Springs East, Longs Creek, Riverton Dome, Happy Springs, Sand Draw North, Kirby Draw, Grieve, Kirk, Sheldon Northwest, Mt. Rogers Unit, Lost Cabin, Castle Garden, Rolff Lake, Little Dome, and Dolis Hills fields in the planning area.

With increasing data obtained from drilled wells, subsurface stratigraphic mapping began to contribute to exploration for new production. In the planning area, the earliest use of subsurface stratigraphic mapping appears to have aided in the discovery of the Frenchie Draw and Dinty Moore Reservoir fields in 1961, the Bonneville Field in 1968, and the Madden Field in 1968 (Wyoming Geological Association 1989). The first producing formation in each of these fields was the Fort Union. This method was also used in combination with geophysical methods (seismic surveys) in three of the four discovery cases.

Technological Advances in Oil and Gas Development

The U.S. oil and gas industry has historically relied on continuous improvements in technology to better understand oil and gas resources and to find and extract these resources. Innovative drilling and completion techniques have enabled the industry to drill fewer dry holes and to recover more oil and gas reserves per well. Smaller accumulations once thought to be uneconomical are now being produced. Technological improvements have also allowed downspacing to occur in some cases. Increased drilling success rates have cut the number of wells drilled and dry holes (DOE 1999). The Energy Information Administration has projected the increase in percentage of wells drilled successfully will be 0.2 percent per year to 2030 (EIA 2007a).

From the early 1990s to present, oil and gas activity in the planning area has focused almost entirely on very low risk development drilling in and around known field areas, which helped to improve the overall success rate. More future exploratory drilling would be required to discover new resources in the planning area and to determine if the potential CBNG resource is economical to produce. Because the risk of failure is higher for these types of activities, success rates could decline slightly in the future.

Advances in technology have boosted exploration efficiency, and additional future advances would continue this trend. Substantial progress has been made and is expected to continue in the following:

- Computer processing capability and speed
- Remote sensing and image-processing technology
- Developments in global positioning systems
- Advances in geographical information systems
- Three-dimensional and four-dimensional time-lapse imaging technology that permits better interpretation of subsurface traps and characterization of reservoir fluid

- Improved borehole logging tools that enhance understanding of specific basins, plays, and reservoirs
- Advances in drilling that allow more cost-efficient tests of undepleted zones in mature fields, testing deeper zones in existing fields, and exploring new regions

New technologies would likely allow companies to target higher-quality prospects and improve well placement and success rates. As a result, fewer drilled wells would be needed to find a new trap, and total production per well would increase (DOE 1999). Also, drilling fewer wells would reduce surface disturbance and volumes of waste, such as drill cuttings, drilling fluids, and produced water. An added benefit of improved remote sensing technology is the ability to identify oil and gas "seeps" so that they can be cleaned up. These seeps can also help pinpoint undiscovered oil and gas resources.

There have been drilling improvements in new rotary rig types, coiled tubing, drilling fluids, and borehole condition monitoring during the drilling operation. Improvements in technology are allowing directional and horizontal drilling use in many applications. New bit types have boosted drilling productivity and efficiency. New casing designs have reduced the number of casing strings required. Environmental benefits of drilling and completion technology advances include the following:

- Smaller footprints (less surface disturbance)
- Reduced noise and visual impacts
- Less frequent maintenance and workovers of producing wells with less associated waste
- Reduced fuel use and associated emissions
- Enhanced well control for greater worker safety and protection of groundwater resources
- Less time onsite with fewer associated environmental impacts
- Lower toxicity of discharges
- Better protection of sensitive environments and habitat

Technologies such as secondary and enhanced recovery might also be used to revive old fields to a producing status. Oil remaining in existing fields could be targeted by injecting fluids such as water or CO_2 to enhance or increase recovery. For more detailed information on such technologies, see the *Reasonably Foreseeable Development Scenario for Oil and Gas* (BLM 2009d).

Geophysical Exploration

The BLM may permit geophysical operations on federal lands both on and off oil and gas leases. A geophysical operator is required to file with the BLM a Notice of Intent to Conduct Oil and Gas Exploration Operations. Geophysical surveys might include gravity surveys, geomagnetic surveys, and reflection seismic surveys, the latter being the most common method for locating subsurface structures that might contain hydrocarbons.

With reflection seismic surveys, seismic (shock wave) energy is induced into earth using one of several methods at a location called a source point or shot point. As the waves travel downward and outward, they encounter rock strata that transmit seismic energy at different velocities.

Sensing devices, called geophones, are placed on the surface to detect these reflections of energy. The end product of the seismic processing is a seismic section that presents the strata or structures below the surface. Most common is the two-dimensional survey, so called because the data yield a two-dimensional model of the subsurface being analyzed. A variation of this technique is the three-dimensional seismic profile survey. The methods of generating the seismic waves are the same as those used in conventional seismic surveys. This type of survey differs from the more common two-dimensional survey in the greater number of data points and the closer spacing of the lines. See the *Final Mineral Occurrence and Development Potential Report* for a more complete description of geophysical exploration methods (BLM 2009c).

Historically, two-dimensional seismic surveys have been conducted over large parts of the planning area. The Wind River Mountains along the western side and the Absaroka Range on the northwest side have not had recent seismic surveys. Three-dimensional surveys have been less widespread in the planning area. Recent three-dimensional surveys have been conducted in the central part of the planning area.

Oil and Gas Activity

Through the end of 2007, there were 1,566 active wells and 1,628 inactive wells in the planning area (BLM 2009d). Almost all planning area drilling activity (exploratory and development) has been occurring in the eastern Wind River Basin and eastern portions of the WRIR, with additional exploratory activity in the Great Divide Basin portion of the planning area.

New wells drilled in the last 10 years are concentrated in the northeast part of the planning area (mainly at the Madden, Frenchie Draw, Fuller Reservoir, and Beaver Creek fields) and in the southeastern part of the WRIR (at the Muddy Ridge, Pavilion, and Riverton Dome fields), with a few new oil wells drilled in the northwest and occasional new wells scattered across the south (Map 33). Of the 719 development wells completed in the last 10 years, 93.7 percent were successful.

Oil and Gas Master Leasing Plans

Subsequent to the start of the RMP revision process, the BLM issued guidance regarding MLPs to address oil and gas leasing in areas with resource values of concern; see IM 2010–117. The BLM received nominations for five areas in the planning area (either in whole or in part) for which MLPs were requested. BLM guidance requires land use plan revisions to analyze MLP proposals. The Wyoming State Office of the BLM determined that three of these areas did not meet the requirements of IM 2010–117. Of the two remaining areas, the Dubois area was also later dropped from analysis as an MLP after it was determined that the alternatives already incorporated the kinds of protections for the resource values in Dubois that would be afforded under an MLP, and as such the effect of an MLP was fully considered. These four areas are discussed in greater detail in the *Alternatives Considered but Not Carried Forward for Detailed Analysis* section in Chapter 2. The remaining area, Beaver Rim, was the only area identified for further analysis as an MLP in the RMP revision.

The citizens' nomination for the Beaver Rim area did not provide specific mapped location information. The BLM originally identified an area below Beaver Rim to the east of Highway 135 (the Sand Draw Highway) as the proposed area. On further analysis and after consultation with the nominating group, the location of the proposed Beaver Rim MLP analysis area was further refined to identify lands with resources that could be protected with an MLP. These lands were identified as being east of Sand Draw Highway and following the edge of the Rim

eastward. These lands contain Native American sacred sites and important visual resources. The topography of the area is such that surface disturbances such as oil and gas and other mineral development could be highly visible and would present a sharp contrast with the surrounding areas. The southern boundary is immediately to the north of the swath of land that makes up the visual setting for the NHTs. The importance of the visual resources in the area stems from the geologic features of the Rim (and the Native American concerns that arise because of the Rim's visual importance) and nearby setting of the NHTs. The area also lies within greater sage-grouse Core Area, as does all of the land on top of the Rim up to the Granite Mountains.

The Beaver Rim area has the only known locations of Yermo (a species listed as threatened) in the world. The two Yermo sites are managed as open to oil and gas leasing subject to no surface occupancy (NSO) stipulations. In addition, there are a number of unique plant communities including types of trees and shrubs that would not be anticipated from the type of vegetation found in the surrounding areas of sagebrush steppe. The small pockets of vegetation vary in size from a half acre to several acres and contain Douglas fir, limber pine (a BLM-sensitive species), juniper, and cottonwood.

The vast majority of the Beaver Rim has not experienced surface disturbance. However, there are current resource uses that present potential conflicts with other resource values. An existing communication site is present along with two major ROWs: a pipeline corridor running northwest to southeast and an above ground utility corridor that runs along the Jeffrey City Haul Road. There are some areas that are leased for oil and gas that contain wells that have been producing for many years. These leases are located primarily in the north western most portion of the area and extend into the most visually sensitive areas. The current level of disturbance is at a very low threshold, but the existing authorized uses raise the level of potential resource conflict.

While Beaver Rim continues as a geologic feature across the planning area, the area changes in character and values near the Haul Road (also called the Jeffrey City to Gas Hills County Road). At this point, the Rim is less prominent and although Native American sites are common, they are less important than further west. The Haul Road is the approximate western edge of the historic uranium district both above and below the Rim.

Oil and Gas Leasing

In the planning area as of June 2009, there were approximately 994,123 acres of leased federal oil and gas mineral estate and approximately 1,814,978 acres of unleased federal oil and gas mineral estate (Map 33) (BLM 2009a). Federal oil and gas leases are incorporated into 35 active unit agreements that lie within or partly within the planning area. Twenty-one companies operate the 35 units. Unique rules apply to unitized leases, which are exempt from state spacing rules. The oldest active unit is the Big Sand Draw Gas unit established in 1934 (BLM 2009d).

Areas are either open or closed to oil and gas leasing. If open, an area may be offered subject to major constraints such as NSO, moderate constraints such as timing limitations, or subject to standard lease stipulations. As indicated above, Washington Office Leasing Reform introduced the MLP concept as part of BLM oil and gas leasing. MLPs expand the tools available to the BLM to address resource conflicts prior to leasing and make a finer scale analysis on identified smaller areas than the entire RMP planning area. Although this guidance was issued late in the development of the alternatives, the MLP tool is very similar in its approach to controlling the amount and kind of surface uses that were evaluated in developing the alternatives based upon current condition and identified conflicts between resource values and leasing. See Chapter 2 for further discussion regarding MLP management.

Oil and Gas Production

The most prolific oil productive formations have been the Phosphoria Formation and Tensleep Sandstone. A substantial amount of gas production has also been associated with these two formations. Almost all of the fields producing from these two formations are within the boundaries of the WRIR, with some additional productive fields to the south and southeast of the WRIR.

The Fort Union Formation and Madison Limestone, at the Madden field have been the most prolific gas producers within the planning area. A moderate amount of oil has been produced in association with the gas in the Fort Union Formation wells, while associated oil production in the Madison Limestone has been moderate from other fields such as Beaver Creek. Most of the Fort Union Formation producing gas fields are concentrated in the northeast part of the planning area, within the Madden field (Map 33) containing more than one third of the total wells. The Fort Union Formation has been productive in 737 (23 percent) of the total productive wells in the planning area. Only 61 wells have produced from the Madison Limestone (less than 2 percent of all producing wells), with most wells located at the Circle Ridge and Beaver Creek fields. Although only eight Madison Limestone wells produce at the Madden field, that field accounts for more than 98 percent of all Madison Limestone gas production.

Table 3.20, "Producing Oil and Gas Fields and Cumulative Production in the Planning Area as of the End of 2007" (p. 297) lists producing oil and gas fields and cumulative production through 2007. The major producing gas fields in the planning area (by volume), in descending order, are Madden, Beaver Creek, Pavillion, and Big Sand Draw. The major producing oil fields, in descending order, are Winkleman, Steamboat Butte, Beaver Creek, Big Sand Draw, and Circle Ridge. At the close of 2007, there were 1,566 actively producing oil and gas wells and a cumulative oil production of approximately 502,428,297 barrels of oil and 3,885,146,697 cubic feet of gas.

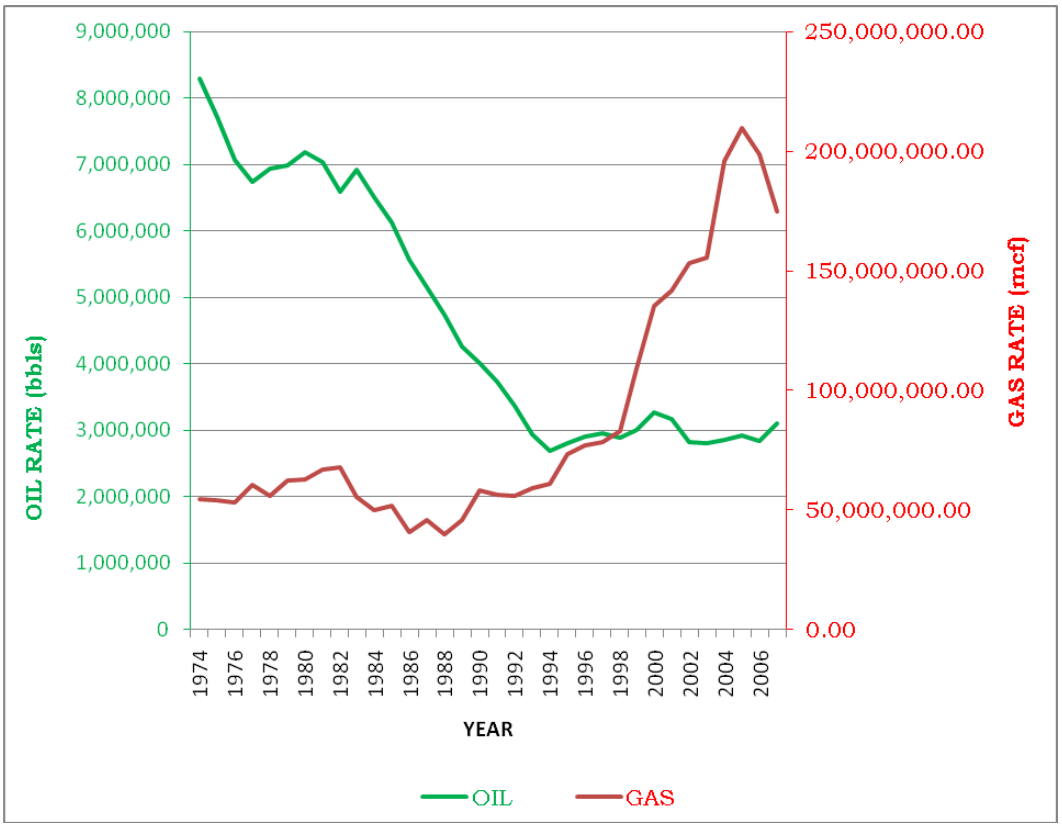
Table 3.20. Producing Oil and Gas Fields and Cumulative Production in the Planning Area as of the End of 2007

Fields	Producing Zones	Cumulative Gas (thousand cubic feet)	Cumulative Oil (barrels)	Wells	Active Wells	Inactive Wells
Alkali Butte	9	9,379,319	56,919	15	3	12
Alkali Butte North	2	1,654,720	51	2	0	2
Antelope Springs East	2	1,628,096	8,421	3	0	3
Arapahoe Creek	2	76,942	23,674	2	0	2
Austin Creek	1	1,549,402	353,233	1	1	0
Beaver Creek	17	827,049,315	59,407,755	211	110	101
Big Sand Draw	8	196,902,304	55,515,483	87	35	52
Bison Basin	2	483,160	3,40,2540	38	31	7
Bonneville	3	1,794,895	22,751	9	5	4
Boulder Dome	3	0	11,074	4	0	4
Boysen	3	50,736	630	3	0	3
Campbell Ridge	1	477,663	31,934	2	1	1
Carvner	1	5,600	5,575	1	0	1
Castle Garden	2	5,639,462	12,321	6	5	1
Cedar Gap	1	320,610	1,282	1	0	1
Circle Ridge	14	679	40,336,477	391	111	280

Fields	Producing Zones	Cumulative Gas (thousand cubic feet)	Cumulative Oil (barrels)	Wells	Active Wells	Inactive Wells
Crooks Creek	1	4,434	0	2	0	2
Crooks Gap	6	1,105,944	7,990,708	30	4	26
Dallas	5	1,021	7,199,703	109	68	41
Day Butte	2	137,468	1,589	3	1	2
Deer Creek II	2	186,243	691	2	0	2
Derby	4	0	1,559,253	48	28	20
Dubois	1	1,555	244,570	9	3	6
Frenchie Draw	3	127,064,636	3,239,555	134	126	8
Fuller Reservoir	2	25,933,280	2,315,223	73	38	35
Gates Butte	1	372,901	2,791	1	1	0
Girrard	3	311,411	0	3	0	3
Golden Goose	3	153,954	944,922	5	1	4
Grieve	2	95,649,598	26,580,521	36	3	33
Happy Springs	6	10,921,079	10,365,047	53	9	44
Haybarn	2	1,459,945	350,577	10	6	4
Hoodoo Hills	1	18,373	0	1	0	1
Howard Ranch	1	2,821,385	28,896	1	1	0
Indian Butte	1	21,203	0	1	0	1
Jade Ridge	2	1,015,632	33,090	2	0	2
Kanson Draw	2	1,209,038	4,760	5	1	4
Kirby Draw South	1	74,428	73,428	1	1	0
Kirk	1	0	3,388	1	0	1
Kohler	1	0	83,514	1	1	0
Lander	3	677	20,787,305	273	104	169
Long Butte	4	111,614,511	20	15	7	8
Longs Creek	3	3,682,290	2,031	4	2	2
Lost Cabin	3	2,822,709	508,704	15	6	9
Lost Soldier	1	976,394	483,517	1	1	0
Lysite	5	35,891,852	35,516	7	4	3
Madden	10	1,638,302,619	1,461,492	327	264	63
Maverick Springs	5	37,089	17,376,648	149	32	117
Maverick Springs SE	1	9,247	233,479	7	0	7
Meigh Ranch	1	37,722	163	3	0	3
Moneta Hills	3	1,925,468	94,537	20	10	10
Mount Rogers	1	66,288	0	1	0	1
Muddy Ridge	10	125,231,228	509,456	95	62	33
Muskrat	5	20,374,946	105,563	11	1	10
Ocean Lake	1	59,418	3,484	1	0	1
Owl Creek Valley	1	1,035,960	8,463	1	1	0
Paradise Valley	1	282,365	6,469	1	0	1
Pavillion	7	275,617,842	7,617	160	129	31
Picket Lake	2	1,751,580	17,468	7	4	3
Pilot Butte	15	8,769,616	8,683,881	65	23	42
Poison Creek	1	3,634,647	8,428	8	3	5
Popo Agie	1	0	39,322	1	1	0
Riverton	5	3,631,520	1,449,045	6	0	6
Riverton Dome	9	191,340,688	3,796,698	77	44	33

Fields	Producing Zones	Cumulative Gas (thousand cubic feet)	Cumulative Oil (barrels)	Wells	Active Wells	Inactive Wells
Riverton Dome East	9	74,444,493	218,714	36	10	26
Riverton East	1	6,751,097	22,310	1	0	1
Rolff Lake	3	1,560	1,213,079	11	5	6
Sage Creek North	1	21,011	58,781	4	0	4
Sand Draw North	3	2,294,124	678,743	5	2	3
Sand Draw South	7	9,277,024	3,202,199	32	14	18
Sand Mesa	3	4,840,068	2,093	12	4	8
Sheep Creek	1	0	329,618	10	4	6
Sheldon	11	10,067,592	5,424,313	37	16	21
Sheldon Northwest	8	349,175	2,682,841	30	7	23
Sheldon West	2	6,266	1,761	2	0	2
Shoshoni	2	235,573	342	3	0	3
Squaw Butte	3	801,570	48,333	9	5	4
Steamboat Butte	17	13,449,344	81,260,740	167	54	113
Steffen Hill	4	449,034	0	4	2	2
Unknown	1	0	0	1	0	1
Unnamed	9	3,908,395	56,715	46	25	21
Wertz	2	12,840,976	16,277,939	8	3	5
Wickersham Draw	2	53,159	0	2	0	2
Winkleman	6	2,783,129	118,520,664	212	123	89
Total		3,885,146,697	502,428,297	3,194	1,566	1,628
Source: BLM 2009d						

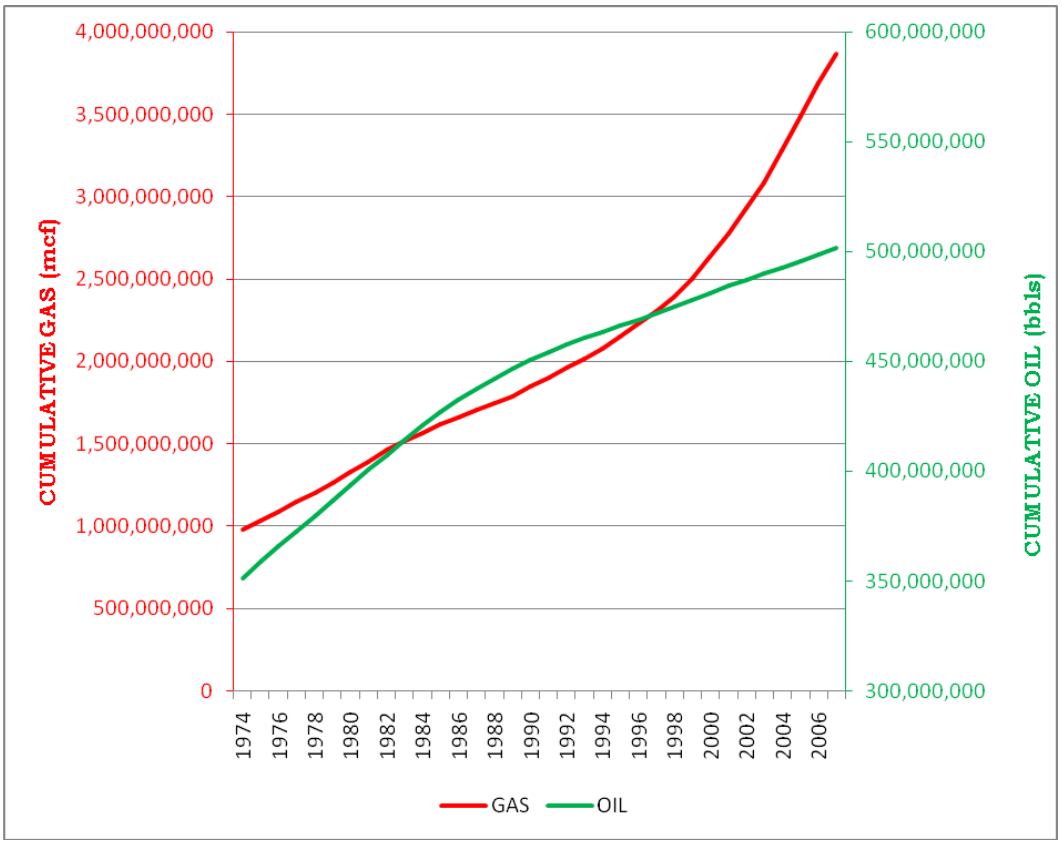
Annual (Figure 3.15, "Annual Oil and Gas Production Rates from Federal, Tribal, Private, and State Wells in the Planning Area" (p. 299)) and cumulative (Figure 3.16, "Cumulative Oil and Gas Production Rates from Federal, Tribal, Private, and State Wells in the Planning Area" (p. 300)) graphs of oil and gas production illustrate historical volume rates and cumulative volumes of oil and gas as a function of time from 1974 through 2007 (BLM 2009d). The rate of oil production declined steadily for a decade starting in 1982 and has been flat since 1993. The rate of gas production was flat up through 1994, experienced a subsequent sharp increase and then began to decline in 2006. In 2006, the Madden field was ranked tenth in the United States by gas proved reserves and twelfth by gas production (EIA 2007b). See the *Reasonably Foreseeable Development Scenario for Oil and Gas* (BLM 2009d).



Source: BLM 2009d

bbls barrels
mcf thousand cubic feet

Figure 3.15. Annual Oil and Gas Production Rates from Federal, Tribal, Private, and State Wells in the Planning Area



Source: BLM 2009d

bbls barrels
mcf thousand cubic feet

Figure 3.16. Cumulative Oil and Gas Production Rates from Federal, Tribal, Private, and State Wells in the Planning Area

Oil and Gas Resource Estimates in the Planning Area

Table 3.21, "Summary and Estimates of Oil and Gas Resources for the Planning Area" (p. 302) lists projections of the amount of oil, gas, and natural gas liquid resources in the planning area. The estimates of oil and gas resources include portions of the Wind River Basin, Southwestern Wyoming, and Bighorn Basin provinces in the planning area. It is estimated that the planning area contains a mean undiscovered volume of approximately 35.39 million barrels of oil, approximately 3.73371 trillion cubic feet of gas, and 54.55 million barrels of natural gas liquids. The planning area's oil resource could range from 9.51 to 76.12 million barrels of oil, the gas resource could range from 1.5389 to 5.49116 trillion cubic feet, and natural gas liquids resource could range from 19.55 to 93.62 million barrels of natural gas liquids (BLM 2009d). See the *Reasonably Foreseeable Development Scenario for Oil and Gas* (BLM 2009d) for a more complete summary of the assessment results.

Table 3.21. Summary and Estimates of Oil and Gas Resources for the Planning Area

	Gas (TCFG)	Oil (MMBO)	Natural Gas Liquids (MMBNGL)
Mean Undiscovered Volume[1]	3.13371	35.39	54.55
Estimated Range of Resources in the planning area[2]	1.5389 – 5.49116	9.51 – 76.12	19.55 – 93.62

Source: BLM 2009d
[1] Mean (average) undiscovered volume of all portions of assessment units lying within the planning area
[2] Assuming fractile data used has a perfect positive correlation

MMBNGL million barrels of natural gas liquids
MMBO million barrels of oil
TCFG trillion cubic feet of gas

Projected Conventional Oil and Gas Drilling Activity in the Planning Area

For a baseline unconstrained reasonably foreseeable development projection (limiting factors such as lease stipulations, or the possibility that some areas might not be administratively available for leasing, are not considered at this stage of analysis), it is estimated that during the next planning cycle as many as 2,566 wells (not including CBNG) could be drilled in the planning area (Rocky Mountain Federal Leadership Forum 2002). Seventy-five of these wells could be deep wells (more than 15,000 feet deep).

Development potential is defined as high, moderate, low, very low, and none. It is estimated that average drilling densities per township (one township is approximately 36 square miles) during the planning period will be:

- High – 100 or more wells
- Moderate – 20 to 100 wells
- Low – 2 to fewer than 20 wells
- Very low – fewer than two wells
- None – no wells

Of the 2,566 projected wells, most (2,542) are projected in areas of high, moderate, or low potential (Map 17). Drilling activity will likely be concentrated in the following areas:

- High levels of activity will be in and around the Madden and Frenchie Draw fields on the northeastern portion of the planning area and in and around the Muddy Ridge field on the WRIR. Many new wells in these townships will likely be drilled as infill or fringe wells in existing fields, or as reentries into existing wellbores. Some minor exploratory activity could occur just beyond field boundaries. Well spacing is projected to be variable, in the 160- to 20-acre range.
- Moderate levels of activity will be in the northeastern part of the planning area, in and around the Sand Mesa field, in the Beaver Creek field area, and on the southern end of the planning area. Infill field drilling, fringe wells in existing fields, or wildcat wells to discover entirely new fields are all possible. As with areas of projected high density drilling, well spacing in

areas of moderate potential is likely to be variable, depending on the characteristics of the play(s) driving development.

- In areas of projected low potential activity, future drilling will be to either improve enhanced oil production projects; to add wells in and around existing oil and gas fields that are maturely developed and have limited opportunities to develop the existing reservoirs or additional deeper reservoirs; or to explore for new oil and gas reservoirs away from existing developed areas. Well densities will remain similar to what they are at present, with isolated townships having a low potential for an increase in drilling density.

Most of the anticipated activity in the planning area will be infill drilling to increase proven recoverable reserves and as exploratory drilling to further explore the potential of continuous resources identified by the USGS in the Wind River Basin and Southwestern Wyoming provinces (USGS 2002, USGS 2005a, USGS 2005b, USGS 2008). Initial estimates of the ultimate size of new oil or gas fields are usually too low, and over time, newer estimates of the size and ultimate recovery contribute to growth in the reserve estimate (Central Region Energy Resources Team 1996). Factors that could contribute to increases in reserve growth in the planning area include:

- Physical expansion of fields by areal extensions and development of new producing intervals
- Improved recovery resulting from application of new technology and engineering methods
- Upward revisions of reserve calculations based on production experience and changing relations between price and cost

Coalbed Natural Gas Production in the Planning Area

There is little CBNG activity in the planning area. Existing CBNG producing zones are coals in the Mesaverde Formation. Three areas in the planning area have produced CBNG, two on the southeastern fringe of the WRIR and one just 4 miles south of the WRIR boundary at the Beaver Creek field.

Three CBNG units have been designated in the southern portion of the planning area; however, at present, there are no producing CBNG wells in any of these units.

Table 3.22, "Cumulative Production (through October 2008) for Coalbed Natural Gas Wells within the Planning Area" (p. 303) lists cumulative production of CBNG and produced water from all active CBNG wells since the first producing well was completed in 1990. Cumulative CBNG production in the planning area has been more than 5.026 billion cubic feet and cumulative water production has been more than 13.7 million barrels.

Table 3.22. Cumulative Production (through October 2008) for Coalbed Natural Gas Wells within the Planning Area

Year	Cumulative Oil (barrels)	Cumulative Gas (thousand cubic feet)	Cumulative Water (barrels)	Days on Production	Active Wells
1990	0	4,397	5,590	28	1
1991	0	24,520	25,057	319	1
1992	0	15,590	20,982	246	1
-	-	-	-	-	-
1999	0	39	994	8	1
2000	0	5,403	1,610,607	712	4
2001	0	8,238	1,674,494	727	4

Year	Cumulative Oil (barrels)	Cumulative Gas (thousand cubic feet)	Cumulative Water (barrels)	Days on Production	Active Wells
-	-	-	-	-	-
2005	0	364,463	428,149	2,004	9 to 16
2006	1,026	846,601	2,159,245	5,687	15 to 19
2007	417	1,826,016	2,843,328	3,911	11
2008	255	1,930,903	4,965,604	4,385	10 to 11
Total	**1,698**	**5,026,170**	**13,734,050**	**18,027**	**57 to 69**
Source: BLM 2009d					

Projected Coalbed Natural Gas Drilling Activity in the Planning Area

Development potential for CBNG ranges in the planning area between moderate, low, very low, and none. It is estimated that average drilling densities per township (one township is approximately 36 square miles) during the planning period will be:

- Moderate: 20 to 100 wells
- Low: two to fewer than 20 wells
- Very low: fewer than two wells
- None: no wells

For a baseline unconstrained reasonably foreseeable development projection for CBNG, the BLM estimates that during the next planning cycle, up to 861 CBNG wells could be drilled in the planning area (Rocky Mountain Federal Leadership Forum 2002). It is anticipated that approximately 844 of the new CBNG wells will be drilled somewhere in the areas of moderate or low potential and the remaining 17 wells will be drilled in the areas of very low potential (Table 3.23, "Estimated Coalbed Natural Gas Development Potential in the Planning Area between 2008 and 2027" (p. 304)) (Map 20). CBNG wells drilled through 2017 will likely be in areas of moderate potential where there is existing or proposed activity.

Table 3.23. Estimated Coalbed Natural Gas Development Potential in the Planning Area between 2008 and 2027

Development Potential	Area (total acres)	Number of Townships with Development Potential	Average New Wells per Township	Percent of Planning Area
High	0	0	110	0
Moderate	149,401	6.48	60	2.30
Low	1,309,236	56.82	8	20.18
Very Low	1,611,953	69.96	0.25	24.85
None	2,907,578	126.20	0	44.82
Not Assessed	508,759	22.08	0	7.84
Source: BLM 2009d				

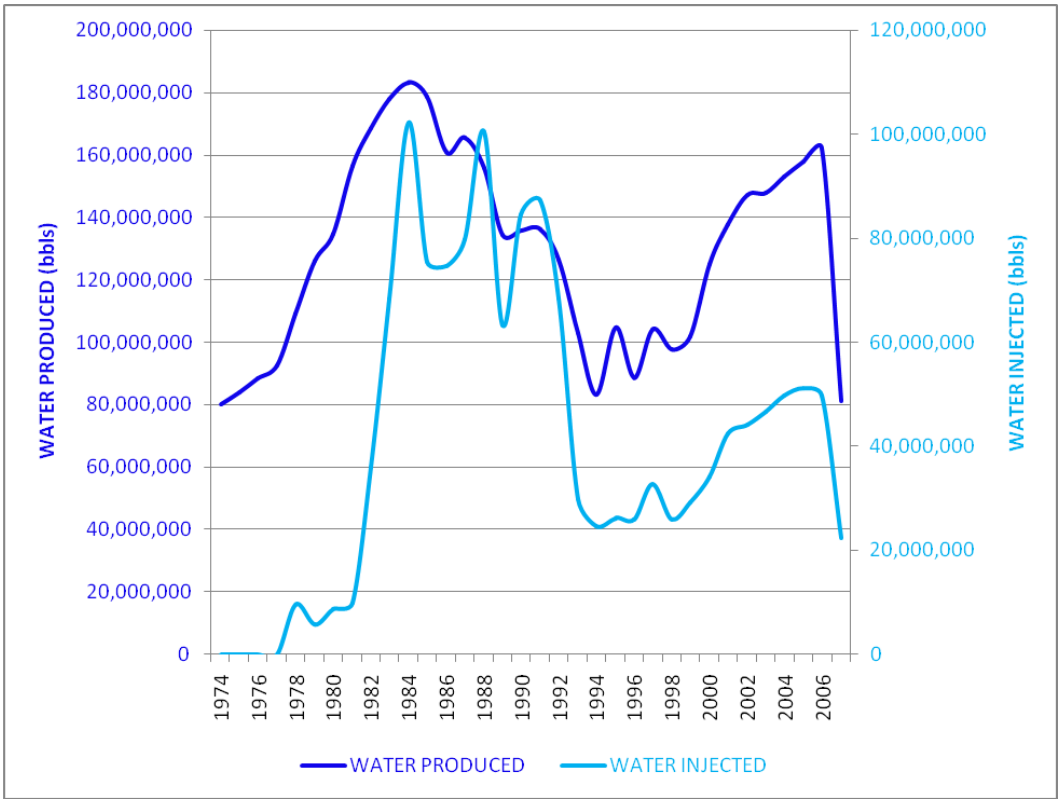
Produced Water

Water is often produced in conjunction with the production of oil and gas from most reservoirs. Water is injected into oil reservoirs as part of waterflooding projects or the water produced in conjunction with oil and gas production can be disposed of (injected) into the subsurface. Produced water that is not injected is disposed of in evaporation ponds, and in a limited number of ponds, managed by the State of Wyoming under WYPDES. Waterflooding projects also cause an increase

in associated water production. Figure 3.17, "Annual Water Injection and Water Production Rates in the Planning Area (includes the Wind River Indian Reservation)" (p. 305) shows volumes of annual water produced and annual water injection. Increases in water production in recent years are mainly tied to increased gas production (Figure 3.15, "Annual Oil and Gas Production Rates from Federal, Tribal, Private, and State Wells in the Planning Area" (p. 299)). Cumulative water produced through August 2007 was 4,389,859,424 barrels.

Water injection (mostly for waterflooding purposes) was highest from 1982 through 1992 and then dropped off for a number of years when oil prices were very low and there was little incentive to produce oil. Water injection began to increase again in 1999 and peaked in 2006, at more than 50 million barrels (BLM 2009d). With higher oil prices in recent years, there has been added incentive to bear the additional costs of waterflooding to obtain additional oil production. Since 1982, the water production curve has tended to mirror the water injection curve, but at higher rates.

Coproduction of water associated with oil and gas development is unavoidable at most locations. Wyoming allows water produced with oil and gas to be disposed of by injection in a permitted disposal or enhanced recovery well, evaporation in an approved pit, or discharge into a surface water source through an outfall permit. At present, the planning area has 26 active and two shut-in disposal wells (Wyoming Oil and Gas Conservation Commission 2008).



Source: BLM 2009d

bbls barrels

Figure 3.17. Annual Water Injection and Water Production Rates in the Planning Area (includes the Wind River Indian Reservation)

The geographic distribution of water quality samples in relation to total dissolved solids and salinity can be found in the *Reasonably Foreseeable Future Development Scenario for Oil and Gas* (BLM 2009d).

Management Challenges for Oil and Gas Development

A variety of management challenges for oil and gas exploration and development are associated with both public and internal BLM issues. Oil and gas exploration and development is a necessary, but sometimes contentious, activity with highly vested stakeholders. Oil and gas development in the planning area is associated with management challenges including impacts to resources and resource uses, produced water, mixed ownership patterns, and a variety of other issues.

Oil and gas development includes challenges for handling the disposal of produced water of variable quality, particularly total dissolved solids, while meeting management objectives for resources and resource uses. Management of produced water from oil and gas activities tends to be a disposal issue, not an impact on water quantity, because these wells do not produce from aquifers that meet the standards for U.S. drinking water.

The BLM also faces management challenges related to oil and gas development pressures and the need to conserve habitat for greater sage-grouse. In 2010, the U.S. Fish and Wildlife Service (USFWS) designated the greater sage-grouse as a candidate species for listing under provisions of the ESA (USFWS 2010). The BLM, in coordination with other federal and state agencies, local government, local working groups, and public land users, is implementing measures to conserve greater sage-grouse habitat and populations. Some areas with oil and gas development potential in the planning area lie within high-quality sage-grouse habitat; therefore, the BLM is challenged with how to manage such development while protecting greater sage-grouse habitat.

The viability of wildlife population levels is linked to a variety of factors, including habitat fragmentation. The BLM faces management challenges resulting from habitat fragmentation caused by oil and gas operations.

Oil and gas resources in the planning area might be located, in part, in areas with important visual resources, including ACECs, historic trails, and other scenic vistas. The BLM faces the challenge of managing oil and gas exploration and development while mitigating impacts to visual resources and meeting Visual Resource Management (VRM) objectives.

The land ownership pattern in the planning area consists of mixed ownership between BLM-administered lands, the WRIR, state trust lands, private lands, private surface overlying federal mineral estate, USFS lands, and lands managed by the Bureau of Reclamation. Management of oil and gas operations becomes more complex where projects are proposed in areas of mixed ownership.

Oil and gas activities, like other mineral development, fluctuate with price. The level of activity in “oil equivalents” such as natural gas increased with the international price of petroleum. As that price fell starting in the beginning of 2009, natural gas Applications for Permit to Drill (APDs) also fell. The high fluctuation in activities causes planning and staff issues for the BLM and impacts the local economy that depends on mineral activities.

Additional management challenges for oil and gas exploration and development for the BLM include:

- Processing timeframes for APDs and notices to conduct seismic exploration

- Timing restrictions on oil and gas leases, Notices of Intent to conduct geophysical exploration, and APDs
- Processing timeframes for ROW applications
- Road design requirements
- Lessee's/operator's surface use rights
- Impacts from oil and gas development and exploration activities on grazing lessees
- Impacts from oil and gas development and exploration activities on cultural resources
- Impacts from oil and gas development and exploration activities on air and water quality
- Impacts from oil and gas development and exploration activities on soils and vegetation
- Multiple-use conflicts resulting in restricted access to oil and gas resources
- Impacts from oil and gas development on levels of CO_2 in the atmosphere and on climate change
- Economic impacts on local, state, and federal government from oil and gas production in the planning area
- Split-estate issues
- Staffing and priority to complete oil and gas workload

3.2.5. Leasable Minerals – Oil Shale

At present, there is no development of oil shale in the planning area. There are low-quality oil shale deposits in the southern part of the planning area; however, there is little potential for commercial development of these resources. Based on these resource values, the existing Lander RMP was not amended for oil shale leasing under the PEIS for oil shale and tar sands resources (BLM 2008c). Oil shale development in the planning area would require an RMP amendment.

3.2.6. Leasable Minerals – Other Solid Leasable Minerals

Other solid leasable minerals (non-coal) present within the planning area include phosphate and potential tar sands (Ver Ploeg 1986). Rocks of the Permian System (299 to 251 million years BP) comprise one of the most complex and also most closely studied Paleozoic systems in the planning area. These strata are an important source of phosphate in the Intermountain West.

Studies over the years attempted to quantify the distribution and grade of phosphate-bearing sedimentary rocks in the Permian Phosphoria Formation in three general locations (BLM 2009b). The largest and most well known occurrence is on the northwest flank of the Wind River Range, particularly in the area known as the Lander Front or Lander Slope. The rock along the Lander Front can be traced south from the Dubois area to the Sweetwater River. The other occurrences of phosphate-bearing sedimentary rocks are Crooks Mountain, Lysite Mountain, and the Conant Creek Anticline southeast of Riverton (BLM 2009b).

A U.S. Bureau of Mines analysis (BLM 2009b) identified and ranked known mineral deposit areas, which are areas having past or present mineral production and/or known mineral resources. This effort mapped areas in relation to their favorability for phosphate. The classification of phosphate deposits is based on two factors: how well understood the physical extent of the deposit is (degree of geologic assurance) and how feasibly the deposit can be mined and marketed with existing technology and under current market conditions (feasibility of economic recovery). Table 3.24, "Percentage of Phosphate Lands in Moderate and High Favorability Classifications in the Planning Area" (p. 308) lists the percentage of phosphate lands in moderate and high favorability classifications in the planning area (Map 19). Crooks Mountain was not classified as having a favorability above low in this data set.

Table 3.24. Percentage of Phosphate Lands in Moderate and High Favorability Classifications in the Planning Area

Phosphate Field	Total Area (acres)	High Favorability (acres / percent)	Moderate Favorability (acres / percent)
Lander Front	400,556	3,702 (0.9%)	396,854 (99.1%)
Conant Creek	509	0	509 (100%)
Lysite Mountain	2,100	0	2,100 (100%)
Source: BLM 2009b			

Other Solid Leasable Mineral Activity

Until very recently, there had been little interest in phosphate except for one proposal in which planning area phosphate deposits were seriously considered for development during the 1960s through 1980s. During this period, a mining company extensively surveyed, mapped, drilled, trenched, and sampled phosphate deposits. Eventually, eight federal leases totaling 12,628 acres were issued and held by this company until 1985 (BLM 2009b). Although the mining company performed exploration activities under prospecting permits before it was issued leases, the company never performed mining operations under the leases.

At present, there are no phosphate lands under lease in the planning area, but in 2008 two proposals were submitted for phosphate prospecting and leasing, neither of which the BLM will consider until this RMP revision is finalized and a ROD is issued. There are currently no tar sand leases in the planning area.

Management Challenges for Other Solid Leasable Minerals

Management challenges for other solid leasable minerals reflect management challenges for other minerals in relation to impacts to resources and resource uses (especially disturbance to greater sage-grouse and associated habitat) and challenges associated with mixed land ownership patterns.

There are additional management challenges for other solid minerals associated with the location of phosphate deposits in the planning area. Phosphate deposits in the planning area are located, in part, in areas with important visual resources including ACECs, NHTs, and other scenic vistas. There are phosphate deposits on the northwest flank of the Wind River Range in the area known as the Lander Front or Lander Slope, where scenic vistas are prominent on the landscape. The BLM faces the challenge of managing phosphate exploration and development while mitigating impacts to visual resources. Managing for other resource objectives in these specially designated areas in association with phosphate development could pose additional management challenges.

3.2.7. Salable Minerals

Salable minerals, also called mineral materials, known to be present in the planning area include sand and gravel (aggregates), common-variety (non-metallurgical-grade) limestone, granite, shale and moss rock (lichen stone). Sand and gravel are the most common type of mineral materials found in the planning area (Map 18). Sand and gravel are typically used for road base, oil and gas drill pads, and various building-construction projects. Most of the limestone in the planning area is considered common variety and therefore salable. Crushed limestone can be used for rip rap or for road base in place of sand and gravel. Granite and moss rock are used for building or decorative stone. Shale has been recently used for cap material in AML reclamation projects, due to its low permeability. Refer to the *Mineral Occurrence and Development Potential Final Report* (BLM 2009c) for additional information on salable minerals.

Sand and gravel are found on old terrace benches along former and existing major drainages and pediment surfaces adjacent to range fronts. Formations for the potential exploitation of limestone resources include the Alcova Limestone member of the Chugwater Group, and the Madison Limestone. Large quantities of granitic mineral material are available at various places in the planning area, most abundantly in the Sweetwater Rocks and the Granite Mountains area. Shale is commonly obtained from exposures of Cody Shale.

Statutory and Regulatory Authority

The Materials Act of 1947 authorizes the BLM (under rules and regulations prescribed by the Secretary of the Interior) to dispose of mineral and vegetative materials through a contract or a free-use permit. The Surface Resources Act of 1955 amended the Materials Act to make common varieties of sand, stone, gravel, pumice, pumicite, and cinders salable minerals. Applicable regulations are found at 43 CFR 3600.

The BLM may dispose of mineral materials by sale or on a free-use basis to units of government and non-profit organizations. If the BLM sells such materials, it does so at not less than fair market value (see FLPMA, Sec. 102[9] and 43 CFR 3601.6). It is BLM policy to make mineral materials available unless it is detrimental to do so (see 43 CFR 3601.6). However, mineral material disposals are discretionary. The BLM may deny an applicant's request based on various considerations such as an inadequate plan, or to protect other competing resources (e.g., wildlife, scenic values, grazing, and sensitive soils) identified through National Environmental Policy Act (NEPA) analysis.

Mineral materials may also be acquired from BLM-administered lands by the State of Wyoming Department of Transportation for development of federal-aid highways, under a Title 23 Material Site ROW realty action. The authority for Title 23 actions is an Interagency Agreement between the BLM and the Federal Highway Administration AA-851-IA2-40, dated July 1982. In Wyoming, this is implemented under MOU WY920-08-07-192, among the BLM, Wyoming Department of Transportation, and the Federal Highway Administration, signed August 24, 2007.

There are two broad categories of mineral material disposals: exclusive disposals and non-exclusive disposals. Under exclusive disposals, the purchaser has an exclusive right to the materials and sole responsibility for developing and reclaiming the site or a designated portion of the site. There are three types of exclusive disposals: negotiated sales, competitive sales, and free use permits. Non-exclusive disposals are made from sites to which the general public has access and more than one party has a right to remove materials. There are two types of nonexclusive

disposal sites: the community pit and the common use area (CUA). The distinction between the two is that community pits are limited areas with extensive disturbance requiring reclamation, while CUAs are generally broader geographic areas which, after removal of the minerals, require little or no reclamation. The BLM may impose a reclamation fee on the user to cover the BLM's costs to reclaim the disturbance.

Due to its demand as a decorative building stone, several CUAs have been established for moss rock collection in the planning area. Only two CUAs, Little Popo Agie CUA and Diamond Springs CUA, remain active but are near depletion of readily available moss rock.

For exclusive disposals, the BLM is commonly approached by a private or public entity (e.g., local government agency) with a specific plan to obtain mineral materials from a certain location. The BLM must then process the request under the NEPA process and develop any necessary stipulations and mitigations required to protect other resources affected by the disposal. Typically, environmental assessments are performed for each proposal. When a contract for mineral materials amounts to less than 50,000 cubic yards or the disturbance covers an area of less than 5 acres, a categorical exclusion is commonly granted.

Once a determination is made to process a mineral material disposal, a contract is issued to describe the location of the disposal, the quantity of material authorized to be removed, and the total cost of the material. Contracts also include the terms of use (such as seasonal restrictions and access), and the required bond for reclamation. The terms of payment depend on the total cost of the material. If the cost is under $2,000, the total amount is due in full when the contract is issued. Cost of the material is determined by the most up-to-date appraisal schedule furnished by the BLM.

Non-exclusive disposals are usually accomplished "over the counter" at the field office. A customer seeking mineral materials will identify what type of material is desired and will then be directed to one of several areas developed for that purpose. The customer must sign a contract and pay in advance for the desired quantity of material. The cost of the material is determined by the most up-to-date appraisal schedule.

Mineral Materials Activity

The amount of mineral material disposals generally reflects economic conditions. Because the main uses of mineral materials are associated with construction work and oil field development, these activities highly reflect mineral material use and disposal. The increase in oil and gas activity from approximately late 2004 until the third quarter of 2008 resulted in a period of increased use of mineral materials in the planning area. Planning area infrastructure has remained static during the last planning cycle, and due to this, free use permits and material sales have decreased compared to earlier periods. In addition, most of the large AML projects in the Gas Hills and Crooks Gap Districts have been completed as of the mid-2000s; these were large contributors to disposal activity.

Aggregate disposals track the economy and AML work. Disposals experienced a higher rate during the late 1980s until mid-2000s due to the large amount of AML work. Also, demand increased due to increased oil field development in the mid-to-late 2000s. Development dropped off substantially beginning in fall of 2008.

In the late 1980s, more than 500,000 cubic yards of limestone were sold in the Gas Hills for the purpose of AML work at former uranium mining properties. This material was taken from the

Dutton Anticline where the Alcova Limestone is exposed at land surface. The permit expired in 2000, and there has since been no substantial use of these resources.

Large quantities of granite (up to 100,000 cubic yards) were sold from the so-called Black Rock quarry approximately 9 miles north of Jeffrey City over the last decade or so for the purpose of completing various AML-related projects. There has been no substantial use of these resources since.

approximately 1.5 million cubic yards of shale were removed from shale pits near the Gas Hills and more than 1 million cubic yards were removed from another pit south of Jeffrey City, both utilizing this material for AML reclamation activities during approximately the last decade. There has since been no substantial use of these resources.

Moss rock disposal in the planning area has declined possibly due to two factors. Two CUAs were substantially utilized and availability of substantial quantities of high-quality moss rock in these locations is limited. The public-at-large is less willing to obtain moss rock through individual negotiated sales due to higher costs associated with cost recovery policy and delays associated with NEPA analyses.

Sand and gravel are the only mineral materials commonly authorized for disposal under free use permits in the planning area (Table 3.25, "Authorized Mineral Material Free Use Permits in the Planning Area" (p. 311)). Sand and gravel and soil/fill materials are the only pending mineral material free-use permits in the planning area (Table 3.26, "Pending Mineral Material Free Use Permits in the Planning Area" (p. 311)).

Table 3.25. Authorized Mineral Material Free Use Permits in the Planning Area

Entity	Name or location	Case Number	Commodity	Amount
Wyoming Game and Fish Department	Bear Creek Pit, East Fork Wind River	WYW152033	Sand and gravel	3,000 CY
Fremont County Road Department	Jeffrey City Pit	WYW154885	Sand and gravel	130,000 CY
Town of Dubois	Overlook site	WYW159799	Sand and gravel	10,000 CY
Fremont County Road Department	Moneta-Lysite Hwy Project	WYW149779	Sand and gravel	40,000 CY
Fremont County Road Department	Lost Cabin Pit	WYW152039	Sand and gravel	200,000 CY
Wyoming DEQ AML	Gas Hills haul road restoration project	WYW158055	Sand and gravel	20,000 CY

Source: BLM 2009c

AML Abandoned Mine Land
CY cubic yard
DEQ Department of Environmental Quality

Table 3.26. Pending Mineral Material Free Use Permits in the Planning Area

Entity	Name or location	Case Number	Commodity	Quantity
Fremont County Road Department	Sec. 23, T. 37 N., R. 94 W. (Muskrat Crossing)	WYW135187	sand and gravel	10,000 CY
Fremont County Road Department	Sec. 6, T. 36 N., R. 93 W. (Muskrat Pit)	WYW135188	sand and gravel	15,000 CY
Fremont County Road Department	Sec. 27, T. 30 N., R. 95 W. (Sweetwater Station)	WYW147151	sand and gravel	8,072 CY

Entity	Name or location	Case Number	Commodity	Quantity
Fremont County Road Department	Sec. 1, 12, T. 38 N., R .91 W. (Lysite Gravel Pit)	WYW147157	sand and gravel	20,000 CY
Fremont County Road Department	Sec. 30, T. 39 N., R. 90 W. (Badwater Borrow)	WYW159824	sand and gravel	5000 CY
Wyoming Department of Transportation	Sec. 26, T. 35 N., R. 94 W.	WYW152035	soil/fill	10,000 CY
Wyoming Department of Transportation	Sec. 9, T. 34 N., R. 92 W.	WYW152036	soil/fill	10,000 CY
Wyoming Department of Transportation	Sec. 32, T. 35 N., R. 93 W.	WYW152037	soil/fill	10,000 CY
Wyoming Department of Transportation	Sec. 31, 32, T. 35 N., R. 92W.	WYW152038	soil/fill	10,000 CY
Source: BLM 2009c CY cubic yard N North R Range Sec. Section T Township W West				

The planning area currently has authorized sales of mineral materials for sand and gravel, decorative stone and moss rock. The planning area has pending sales of mineral materials for sand and gravel, shale, limestone, moss rock, and decorative stone (Table 3.27, "Current and Pending Authorized Sales of Mineral Materials" (p. 312)).

Table 3.27. Current and Pending Authorized Sales of Mineral Materials

Status	Commodity	Quantity
Current	Sand and gravel	50,000 cubic yards
Current	Decorative stone	100 tons
Current	Moss rock	10 tons
Pending	Sand and gravel	18,000 cubic yards + undetermined amount
Pending	Shale	100,000 tons
Pending	Limestone	Undetermined amount
Pending	Moss rock	650 tons
Pending	Decorative stone	15 tons
Source: BLM 2009c		

Management Challenges for Salable Mineral Development

Management challenges associated with disposal of mineral materials result from adverse impacts to resources and resource uses from mining activities and the demand for mineral materials. The need to conserve greater sage-grouse habitat can conflict with the development of mineral material resources. Some salable mineral resources in the planning area might lie in or near habitat for the greater sage-grouse. Although salable mineral disposals are discretionary, the BLM faces challenges in meeting demands for these minerals while protecting greater sage-grouse habitat.

Areas of mixed land ownership pose additional management challenges for mineral material disposal. Management of salable mineral operations becomes more complex where projects are proposed in areas of mixed ownership. In particular, salable mineral operations on land surface patented under the Stock Raising Homestead Act can present management challenges related to

coordinating the concerns of the surface owner with the mineral operations. The 1983 *Watt v. Western Nuclear* U.S. Supreme Court decision, which established that gravel on Stock Raising Homestead Act lands belonged to the federal government, was a case originating in the planning area near Jeffrey City.

Due to the relatively high cost of transportation to the site of end use compared to value in place, salable minerals tend to serve local markets. These minerals help meet the demand for community growth. The BLM faces management challenges in meeting the demand for mineral materials to meet local needs while mitigating potential impacts to other resource values.

3.3. Fire and Fuels Management

Fire is an integral part of the ecological process of many plant communities in the planning area. Several vegetation types in the planning area have developed under a regime of intermittent fires and have adapted to the impacts of fires in some way. For each vegetation type, fire behavior varies based on many factors, including topography and site productivity. Highly productive sites, such as north slopes, generally have more biomass and therefore can carry fires better than less productive sites characterized by less fuel.

The 2001 Review and Update of the 1995 Federal Wildland Fire Management Policy is the primary interagency wildland fire policy document. In February 2009, a joint effort between the BLM, USFS, Bureau of Indian Affairs, USFWS, and the National Park Service resulted in updated guidance for implementation of the Federal Wildland Fire Management Policy (DOI and USDA 2009). This guidance provides for consistent federal implementation of the Federal Wildland Fire Management Policy.

According to the implementation guidance for the fire policy the following terms are used to describe the different types of fire:

- Prescribed fire – Any fire ignited by management actions to meet specific objectives. A written, approved prescribed fire plan must exist, and NEPA requirements (where applicable) must be met, prior to ignition.

- Wildland fire – A general term describing any non-structure fire that occurs in the vegetation and/or natural fuels.

- Wildfire – An unplanned ignition caused by lightning, volcanoes, unauthorized, and accidental human-caused actions and escaped prescribed fires.

The BLM fire management program focuses on two categories of fires: unplanned/wildfires and planned/prescribed fires. The objectives of prescribed fires include reduction of fuels, maintenance or improvement of wildlife habitat or range conditions, control of invasive species, and maintenance of the historic fire return interval. Firefighter and public safety are the highest priority in every fire management activity.

For much of the last century throughout the United States, fire management has focused on the suppression of wildfires with minimal use of prescribed fires to achieve management objectives. As a result, there has been a buildup of vegetative fuels and biomass, exacerbated by the impacts of disease and drought.

Both wildfires and prescribed fires could be utilized as management tools to achieve predetermined objectives established through the land use planning process. The fire management program utilizes a full suite of fire suppression tactics in containing and controlling wildfires throughout the planning area, with the highest likelihood for use of full suppression tactics occurring in areas with high resource and/or human values and in areas with intermingled land ownership patterns, while also utilizing prescribed fire and other fuel treatments to help meet the objectives of other resource management programs.

The BLM response to wildland fires is based on values to be protected from and/or enhanced by wildland fires. The response to wildland fires also considers the ecological, social, and legal consequences of fires. The circumstances under which a fire occurs, and the likely consequences to firefighter and public safety and welfare, natural and cultural resources, and values to be protected, dictate the appropriate response to the fire. The response to wildland fires considers all resource values and concerns and is coordinated across jurisdictional boundaries. Although fire terminology changes over time, the approach to suppression actions remains relatively consistent.

The Southern Zone has interagency cooperative agreements with the Shoshone National Forest, WRIR, Wyoming State Forestry, Fremont County Rural Fire Associations, Hot Springs County, Natrona County, Sweetwater County, Carbon County, city of Riverton, city of Lander, all local fire battalions, local volunteers, and all Firewise communities. Fire suppression operations are coordinated with the Southern Wyoming Interagency Dispatch Center.

3.3.1. Unplanned/Wildfire

Wildfires are unplanned ignitions caused by natural events (e.g., lightning) or by human acts. There have been numerous large fires in the planning area from 1988 to 2008 at a scale and quantity that exceeds the annual average acreage burned in the previous 13-year period from 1974–1987.(Table 3.28, “Selected Large Wildfire Occurrences in the Planning Area, 1988-2008” (p. 315)). Whether this trend is part of the natural fire cycle or representative of flammable conditions because of past fire and vegetation management is not precisely understood. Regardless, it appears that the planning area is within an undetermined period of more frequent, larger fire occurrence. Much of the forest, shrublands, and grasslands are vulnerable to wildfires, but under existing conditions the areas that have the greatest potential for large wildfires are within the 15- to 19-inch and 20-inch precipitation zones where natural fuel loading is greater (Map 44). Almost all of the fires larger than 100 acres within the planning area have been within these precipitation zones. Figure 3.18, “Acres Burned and Number of Wildfires Per Year within the Lander Field Office, 1974-2008” (p. 316) depicts the number of wildfires and the number of acres burned by wildfires each year from 1974 to 2008.

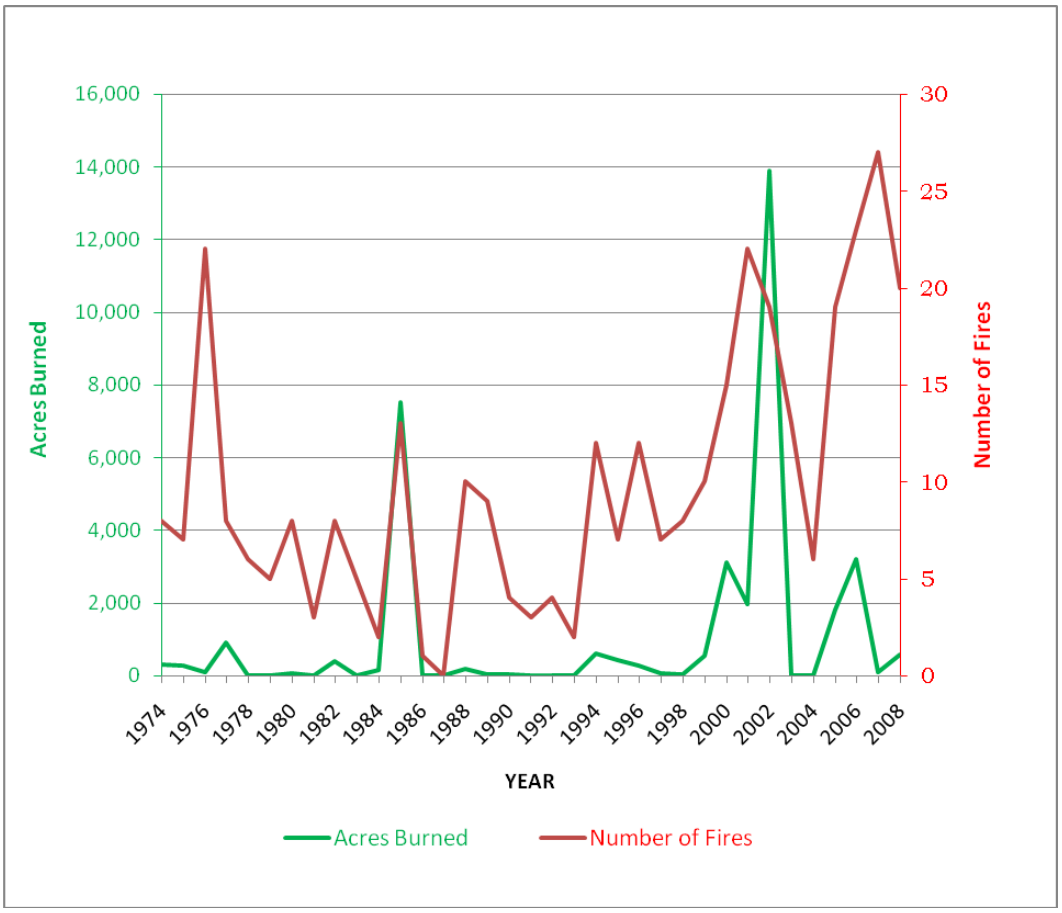
Table 3.28. Selected Large Wildfire Occurrences in the Planning Area, 1988-2008

Name	Year	Jurisdiction	Cause	Acres	Precipitation Zone (inches)	Fuel Type
North Fork	1988	BIA	Lightning	25,000 (approximate)	10-14 and 15-19	Wyoming sagebrush/ grass, mountain shrub/grass, juniper/limber pine
Kates Basin	2000	BIA	Lightning	137,069	10-14, 15-19, and 20+	Wyoming sagebrush/ grass, mountain shrub/grass, juniper/limber pine, lodgepole pine
Murphy Draw	2000	BLM	Human Caused	1,365	15-19	Wyoming sagebrush/ grass, mountain shrub/grass, juniper/limber pine
Red Canyon	2000	BLM	Lightning	1,312	15-19	Wyoming sagebrush/ grass, mountain shrub/grass, juniper/limber pine
Bighorn Flat Unit 3	2000	BIA	Escaped Prescribed Fire	751	10-14	Wyoming sagebrush/ grass
Beaver Rim	2001	BLM	Lightning	1,927	15-19	Wyoming sagebrush/ grass, mountain shrub/grass, juniper/limber pine
Bighorn Flat Unit 1	2001	BIA	Escaped Prescribed Fire	655	10-14	Wyoming sagebrush/ grass
Pass Creek	2002	BLM and USFS	Lightning	13,433	15-19 and 20+	Wyoming Sagebrush/ grass, mountain shrub/grass, juniper/limber pine, lodgepole pine

Name	Year	Jurisdiction	Cause	Acres	Precipitation Zone (inches)	Fuel Type
South Fork 2	2002	BIA	Lightning	13,978	15-19 and 20+	Wyoming sagebrush/ grass, mountain shrub/grass, lodgepole pine
Sagehen	2005	BLM	Lightning	1,271	15-19	Wyoming sagebrush/ grass, mountain shrub/grass, juniper/limber pine
Wise Flat	2006	BIA	Lightning	1,044	15-19	grass, juniper/ limber pine
Bull Ridge	2006	BIA	Lightning	837	15-19	grass, juniper/ limber pine
Washakie Park	2006	BIA	Lightning	1,240	15-19	Wyoming sagebrush/ grass, mountain shrub/grass
Poison Spider	2006	BLM	Lightning	3,166	15-19	Wyoming sagebrush/ grass, mountain shrub/grass, juniper/limber pine
Total Acres				**203,048**		

Source: BLM 2009b

BIA Bureau of Indian Affairs
BLM Bureau of Land Management
USFS United States Forest Service



Source: BLM 2010b

Figure 3.18. Acres Burned and Number of Wildfires Per Year within the Lander Field Office, 1974-2008

Public Safety and Resource Protection

Title 1 of the Healthy Forest Restoration Act requires identification and mapping of the fire regimes and fire regime condition classes on BLM-administered lands at risk of wildfire and insect or disease epidemics. BLM policy requires that existing and desired resource conditions related to fire management be described in terms of three condition classes and five fire regimes. The Fire Regime Condition Class (FRCC) system classifies existing ecosystem conditions to determine priority areas for treatment. This system provides a measure of the existing vegetation community's degree of departure from a reference condition. Departure from the reference condition can indicate changes to key ecosystem components such as vegetation characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances, such as insect- or disease-related mortality. FRCC involves two pieces of information: the historic fire regime and the condition class. Fire regime is the inferred historic fire return interval and severity on a given landscape (Table 3.29, "Fire Regime Groups and Descriptions" (p. 318)), while condition class is the departure of the given area from the historic fire interval.

Fire regime is an indicator of the role wildfires play in an ecosystem. A natural fire regime is a general classification of the role fire would play across a landscape in the absence of modern human mechanical intervention, but including the possible influence of aboriginal fire use

(National Wildfire Coordinating Group 2003). The BLM utilizes five historic fire regimes based on the average number of years between fires (fire frequency) combined with the severity (amount of replacement) of the fire on the dominant overstory vegetation.

Table 3.29. Fire Regime Groups and Descriptions

Group	Frequency	Severity	Severity Description
I	0 to 35 years	Low/mixed	Generally low-severity fires replacing less than 75 percent of the dominant overstory vegetation; could include mixed-severity fires that replace up to 75 percent of the overstory.
II	0 to 35 years	Replacement	High-severity fires replacing more than 75 percent of the dominant overstory vegetation.
III	35 to 200 years	Mixed/low	Generally mixed-severity; could also include low-severity fires.
IV	35 to 200 years	Replacement	High-severity fires.
V	More than 200 years	Replacement/any severity	Generally replacement-severity; could include any severity type in this frequency range.
Source: DOI and The Nature Conservancy 2008			

Historically, wildfires in the planning area have generally been group III or IV, meaning that wildfires occurred every 35 to 200 years. The amount of overstory replacement was highly variable.

FRCC describes the degree of departure from the historic natural fire regime in terms of either fire frequency or stand replacement (Hann and Bunnell 2001). Extreme departure from the historic fire regimes results in changes to one or more of the following ecological components: vegetation characteristics (species composition, structural stages, stand age, canopy closure, and mosaic pattern); fuel composition; fire frequency, severity, and pattern; and other associated disturbances such as livestock grazing and drought. The majority of the planning area is composed of FRCC 2 and 3 (Map 42). FRCC describes ecosystem health, as follows:

- **Condition Class 1.** For the most part, fire regimes in this fire condition class are within historical ranges. Vegetation composition and structure are intact. Therefore, the risk of losing key ecosystem components from the occurrence of fire remains relatively low.

- **Condition Class 2.** Fire regimes on these lands have been moderately altered from their historical range by either increased or decreased fire frequency. A moderate risk of losing key ecosystem components has been identified on these lands.

- **Condition Class 3.** Fire regimes on these lands have been substantially altered from their historical return interval. The risk of losing key ecosystem components from fire is high. Fire frequencies have departed from historical ranges by multiple return intervals. Vegetation composition, structure, and diversity have been substantially altered. Consequently, these lands verge on the greatest risk of ecological collapse.

The planning area is divided into six Fire Management Units (FMUs) (Table 3.30, "FRCC Ratings and Management Prescriptions by Fire Management Unit" (p. 319)) (Map 43). An FMU is a geographic area with similar plant communities and resource and fire management objectives. The fire program identifies a full suite of responses to all wildland fires, with responses ranging from monitor to full suppression. The response to wildland fires also includes wildfire use for resource benefit. The BLM tailors responses to wildland fires to meet management objectives. In establishing a response to wildland fires, the BLM considers the impacts of both fire suppression and unsuppressed fire on wildlife, viewshed, invasive species, and loss of forest products, particularly when cumulative impacts are considered. Appendix O (p. 1499) lists the suppression objectives, fire use and prescribed burn objectives, planned fuels treatment by vegetative type, non-fire fuel treatment objectives, community protection and assistance, prescribed fire and non-fire treatments, and restoration and rehabilitation objectives by FMU.

The Wyoming BLM Forest and Woodland Management Action Plan concluded that the information regarding condition class within forest and woodland communities was based on the foresters' professional opinions in the absence of up-to-date inventory data (BLM 2005c). Moreover, these criteria were not the same as the FRCC definitions. In the future, the goal is to complete a vegetation fuels inventory that more accurately identifies fire regimes and condition classes across the landscape using up-to-date definitions and determination methods as identified in the *Interagency FRCC Guidebook* (DOI and The Nature Conservancy 2008).

The locations of human-caused fires have been widespread in the planning area, with heavier concentrations of ignitions in the Green Mountain, Lander Slope, and Sweetwater Valley FMUs. Historically, wildfires have occurred in camping and woodcutting areas from accidental ignition caused by fireworks, campfires, and machinery. Wildfires not caused by humans have been widespread, with natural fires occurring in areas of intense lightning activity in the Lander Slope and Rattlesnake Hills FMUs. Table 3.30, "FRCC Ratings and Management Prescriptions by Fire Management Unit" (p. 319) lists information regarding condition and class for the six FMUs in the planning area.

Table 3.30. FRCC Ratings and Management Prescriptions by Fire Management Unit

Fire Management Unit	Total Acres (BLM-administered surface acres)	Fire Regime Group	Fire Regime Condition Class	Treatments
Green/Crooks Mountain	262,485 (220,114) WUI present	IV – lodgepole pine, limber pine, juniper, mountain shrub, big shrub	2-3 – timbered communities and 2 – shrubland communities	Prescribed fire and non-fire treatments (mechanical, chemical, biological) ongoing
Sweetwater Valley	2,267, 001 (1,745,060) WUI present	IV – big sagebrush V – juniper, limber pine, aspen	2	Prescribed fire and non-fire treatments (mechanical, chemical, biological) ongoing
Rattlesnake Hills	191,576 (128,729) WUI present	IV – big sagebrush V – juniper, limber pine, aspen	2	Treatment allowed, but not ongoing
Lander Slope	269,997 (128,675) Substantial WUI issues	IV – mountain shrub, limber pine, lodgepole pine, Douglas fir	2	Prescribed fire treatments ongoing and planned

Fire Management Unit	Total Acres (BLM-administered surface acres)	Fire Regime Group	Fire Regime Condition Class	Treatments
Copper Mountain	194,390 (127,153) WUI present	IV – big sagebrush V – juniper, limber pine	2	Prescribed fire and non-fire treatments (mechanical, chemical, biological) ongoing
Dubois (USFS has initial suppression management)	161,232 (42,736) WUI present	IV – mountain shrub, limber pine V – lodgepole pine, Douglas fir	2 1 – the badlands	Prescribed fire and non-fire treatments (mechanical, chemical, biological) ongoing
Sources: BLM 2004b; National Fire Plan 2009 BLM Bureau of Land Management FRCC Fire Regime Condition Class USFS United States Forest Service WUI Wildland Urban Interface				

Fuel Loading

Table 3.30, "FRCC Ratings and Management Prescriptions by Fire Management Unit" (p. 319) provides a coarse scale landscape level assessment of condition class of the Lander Field Office FMUs based on University of Wyoming GAP Analysis Program Data (University of Wyoming 1994), ground truthing, and inputs from experts. There is no other inventory available to determine vegetation ecological condition and fuels build up. For example, the mountain pine beetle epidemic is present in the Dubois FMU, but the extent of the beetle epidemic is only loosely identified in the Lander Slope, South Pass, and Green Mountain FMUs.

In forested areas, mountain pine beetle outbreaks create a buildup of dead and dry fuels that are particularly susceptible to fire. Fuel loading caused by the pine beetle create a problem that traditional forest management practices are not designed to address. In the absence of a local market for beetle kill timber and lack of available funding to remove or treat beetle kill areas, fuel loading increases the potential for wildfire spread and occurrence.

The growing Wildland Urban Interface (WUI) brings more people in closer contact with forests and woodlands, making the public more invested as stakeholders and more concerned about the health and appearance of forests. Many treatments are designed to reduce the risk of landscape-level fire while maintaining the aesthetic qualities of the landscape. For example, juniper woodlands adjacent to the Red Canyon Subdivision were thinned to approximately 30-foot spacing, with a residual woodland stand representing a diversity of age classes. The finished treatment has maintained the qualities of juniper woodlands that landowners value, while reducing fuel loading.

The WUI could become more of an influence on fire suppression and fuel management activities in the future. Urban development and use of public land could increase as the population grows and the desire to live close to wildlands remains desirable. The fire and fuels treatment program is affected by the cost of suppressing wildfires, which has increased, particularly in the WUI. The WUI is a key aspect of wildfire management. Table 3.31, "Wildland Urban Interface Treatment Areas in the Planning Area" (p. 321) lists WUI areas that have been treated for fuels reduction.

Table 3.31. Wildland Urban Interface Treatment Areas in the Planning Area

Name	Adjacent Lands Jurisdiction	Fuels Reduction Treatment Type	Fuels Reduction Project Time	Natural Fuels Type
Union Pass	BLM and USFS	Forest fuels mechanical	10 years	Lodgepole pine
Red Canyon Subdivision	BLM	Woodland and sagebrush mechanical	5 years	Juniper/limber pine and sagebrush
Dubois Area	BLM, USFS, and state lands	Forest fuels mechanical	15 years	Lodgepole pine and mountain shrub
South Pass Atlantic City	BLM and USFS	Forest fuels, woodland, and sagebrush mechanical	15 years	Lodgepole pine, mountain shrub, Wyoming sagebrush
Homestead Park	BLM and USFS	Forest fuels, woodland, and sagebrush mechanical and prescribed fire	10 years	Lodgepole pine and mountain shrub

Source: BLM 2009b

BLM Bureau of Land Management
USFS United States Forest Service
WUI Wildland Urban Interface

Management Challenges for Unplanned/Wildfires

Over the last century, the focus on suppressing wildfires has created a management challenge because fuels have built up and created the potential for larger wildfires. Likewise, the impacts of disease (pine beetle and other infestations) and recent drought have created similar management challenges. Fire and fuels management challenges have increased due to limited vegetation treatments that reduce fuel loading, such as vegetative thinning and forest product sales.

Encroaching development and urbanization create challenges for managing wildfires in WUI areas because the BLM needs to consider the potential impacts of fuels treatments and suppression tactics to certain adjacent areas that still contain a natural aesthetic. As the WUI increases with expanding development, the cost and personnel required to manage wildfires in these areas creates additional management challenges.

3.3.2. Planned/Prescribed Fires and Other Fuels Treatments

Prescribed fires and other methods of fuels reduction including mechanical, hand cutting and chemical treatments, have become increasingly important as tools to manage natural fuels buildup and to achieve habitat and rangeland health management objectives. There are many factors that affect the success of prescribed fire and other vegetation treatment methods. With the use of prescribed fire, these include fire behavior and characteristics including fire size, fire intensity, fire severity and weather conditions, as well as vegetation community condition prior to burning and the short-term and long-term management of a treatment area. Prescribed fires can also become uncontrolled due to a number of factors, including unanticipated weather changes. The success of non-fire fuels treatments is similar in that it is dependent upon short-term and long-term management of the project area post-treatment, the condition of the vegetation community prior to treatment, and the appropriate treatment location and extent to strategically reduce fuel loading in the event of a wildfire.

The goal of all fuels reduction and vegetation management treatments is to reduce the accumulation of hazardous fuel, diversify vegetation age class structures, or rejuvenate areas

where woody vegetation has become decadent. For example, various areas of sagebrush and mountain shrub habitat in the Mexican Creek drainage were successfully prescribed burned between 2002 and 2005, rejuvenating wildlife habitat and reducing conifer encroachment. A similar prescribed burn project is being implemented near Lysite Mountain. Examples of mechanical treatments that have been implemented within the last several years include the reduction of timber fuels loading in the Dubois area from 2003 through the present time, mastication of juniper in the Lander area from 2005 through 2010, and mowing of sagebrush in the Sweetwater Valley FMU from 2005–2010.

Prescribed fire can be used to open the timber canopy so that more grasses and forbs are available and areas are open to wildlife use. Fire also can provide a mechanism for controlling plant diseases and insect infestations. Succession processes, such as aspen gradually succeeding to lodgepole pine and other conifers in the absence of fire, could be influenced by fire management. However, landscape scale changes such as is now being experienced because of the pine beetle infestation are likely to be considerable contributors to aspen succession. The success of fire as a management tool is a function of precipitation timing and amounts following the fire as well as post-fire vegetation treatments including livestock grazing.

The locations of prescribed fires are primarily selected so that fire improves rangeland health and wildlife habitat as well as targeting areas of hazardous fuel loadings. Project area boundaries are established to enable appropriate containment and control of the prescribed fire.

There are locations and fuels situations that are not appropriate for fire treatment, such as areas with high potential for erosion or invasive plant infestation or areas where fire would adversely impact visual resources. Subsequent chemical treatment could reduce the adverse impacts of invasive species following the otherwise beneficial fire treatment. In locations with Wyoming big sagebrush, the use of prescribed fires must be considered carefully. Wyoming sagebrush ecological sites in the planning area are in Fire Regime Group III, with the return to mature sagebrush dominated sites not occurring for at least 35 years after burning, but more likely not occurring for closer to 100 years. The FMU analysis needs to consider both beneficial and potentially adverse impacts from prescribed fires and wildlife habitat requirements (Davies et al. 2008, Davies et al. 2009a).

From 1985 to 2008, prescribed fires were used to treat 6,162 acres (BLM 2009b). Results included improved herbaceous production, rejuvenated crown sprouting, and robust seed production among shrub species such as true mountain mahogany, antelope bitterbrush, snowberry, and mountain sagebrush. In a few cases, portions of the treated areas were revegetated by invasive species such as cheatgrass, with a corresponding adverse impact to wildlife habitat and overall ecological health.

Vegetation treatment is addressed on a case-by-case basis because fire, mechanical, hand-cutting, and chemical treatments might not be appropriate for conditions on the ground. For example, studies indicate that burning of certain sagebrush steppe communities should be undertaken with caution because of the threat of invasive plant species and the importance of intact sagebrush steppe to many sagebrush-obligate wildlife species. Though non-fire fuels management methods can be viewed as “safer” treatment options on the landscape, many of the same issues exist for these options, such as threats of increasing the percent composition of invasive plant species within treated areas as well as conflicts with other resource disciplines whose goals may include maintaining current habitat conditions.

Large-scale prescribed burn, mechanical, and chemical fuels project areas are being identified, but to successfully achieve these landscape-level projects, planning at the allotment level needs to include fuels treatments where vegetation types are appropriate for the use of fire or other fuels treatment options and include the required post-fire change in livestock grazing management.

Cheatgrass is a substantial component in many areas in the Sweetwater Valley, Lander Slope, and Copper Mountain FMUs, and it responds favorably to the reduction of shrub canopy from burning, mechanical and chemical treatment methods, negating the beneficial impacts of fuels treatment on the vegetative community (Zouhar et al. 2008, Blumenthal et al. 2006). There are several areas in these FMUs that would benefit from prescribed burning, mechanical treatment such as sagebrush mowing, and thinning of sagebrush with tebuthiuron, but these treatment methods would not be utilized due to the expected spread of cheatgrass unless followed by application of herbicides.

The Lander Field Office has identified prescribed fire/non-fire treatment objectives, planned fuels treatment by vegetative type, and non-fire fuel treatment objectives. At present, prescribed burning is a tool identified for each of the five FMUs that fall under the administration of the Lander Field Office. There are approximately 44,000 acres identified as suitable for treatment in the next 10 years either by prescribed burning and/or by mechanical, manual, chemical, or biological methods. Areas that are of primary interest for the use of prescribed fire are:

- Vegetation communities within the 15- to 19-inch precipitation zones, especially large-scale prescribed fire treatments in the Rattlesnake Hills and Green Mountain FMUs and smaller prescribed burn treatments in the Dubois, Lander Slope, Sweetwater Valley, and Copper Mountain FMUs (Map 43).
- Areas that have shown a beneficial response from such treatments are those dominated by mountain shrub/grass and juniper/limber pine woodlands.
- Areas that are identified within Condition Class 2 or 3 and Fire Regime Group IV.

All fuels management treatment options can also be used as tools to counter the damage from climate change by removing decadent vegetation and rejuvenating the carbon sequestration potential of vegetation. Fuels reduction is even more important as the climate warms and results in fluctuating precipitation patterns. Refer to the *Climate Change* section at the end of this chapter for more information regarding climate change.

Management Challenges for Planned/Prescribed Fires and Other Fuels Treatments

Management challenges for prescribed fire include the successful collaboration with adjacent landowners and stakeholders in conducting prescribed fires. The success of fire treatments depends on collaboration with affected stakeholders, including adjoining landowners or livestock permittees, surrounding municipalities, and regulatory agencies that monitor air quality. Planned and prescribed fires are usually successful only if BLM partners and cooperators agree with the approach. Another substantial challenge to implementing prescribed burns is conflicts with objectives from other resource disciplines within the BLM and other resource management agencies. For example, wildlife habitat management can limit the timing, extent or even the use of prescribed fire within key habitat areas.

Challenges to non-fire fuels treatments include long-term management of the area treated, public perception of the treatment, and conflicts with management objectives with other BLM programs. Similar to the challenges that may restrict the use of prescribed fire within the planning area,

wildlife habitat management can also restrict the use and extent of mechanical and chemical vegetation treatments.

3.3.3. Stabilization and Rehabilitation

The Burned Area Emergency Stabilization and Rehabilitation (ES&R) Plan is an interdisciplinary response to protecting natural resources and threats to human health and safety. The guidelines for development of this plan are outlined in BLM Handbook H-1742-1, *Burned Area Emergency Stabilization and Rehabilitation*.

Fires throughout the West have become much larger, have threatened the natural integrity of the burnt ecosystem, and have become a threat to human health and safety. The recovery of burned landscapes, especially from large, landscape-level fires, sometimes requires actions to maintain the integrity of the natural resources and the safety of adjacent communities. The need to stabilize and rehabilitate burnt areas has become increasingly important. Some areas do not successfully recover with native vegetation and become dominated by invasive plant species. Many communities adjacent to wildfires are threatened by erosion of bare soil, loss of public infrastructure, and contamination of water resources.

All wildfires are analyzed for the need to implement an ES&R Plan after the fire is contained. Indicators of the need for an ES&R Plan for a burn are areas of high-severity burns, steep terrain, high probability of proliferation of invasive plant species after the burn, and threats to human health and safety or loss of infrastructure. Relatively few fires in the planning area require a plan.

Table 3.32, "Emergency Stabilization and Rehabilitation Plans and Treatments in the Planning Area between 2000 and 2007" (p. 324) lists ES&R Plans developed for the planning area between 2000 and 2007. ES&R Plans were developed for wildfires such as the Pass Creek Fire (2002), the Arapahoe Fire (2002), and five other wildfires over the past 10 years. The plans for the Pass Creek and Purdy fires (USFS) were complex and addressed multiple threatened resources and values. Most of the plans are of relatively low complexity and have not required substantial funding to implement. Increased need for ES&R Plans has corresponded with the increase in larger fires. ES&R Plans have been developed and successfully implemented in the planning area to rehabilitate areas infested with cheatgrass, such as in the Twin Creek watershed.

Table 3.32. Emergency Stabilization and Rehabilitation Plans and Treatments in the Planning Area between 2000 and 2007

Fire name	Treatment Name	Treatment Category	Funding Source	Treatment	Fiscal Year
Poison Spider	Fence Repair	Fence Repair	Emergency Stabilization	2 miles	2007
	Rehabilitation-Road Signing	Protection	Emergency Stabilization	25 signs	2007

Fire name	Treatment Name	Treatment Category	Funding Source	Treatment	Fiscal Year
Arapahoe	Jeep Trail Closure	Erosion/ Sedimentation	Suppression Activity Damage	20 acres	2003
	Rehabilitation-Road Signing	Roads	Rehabilitation	1 sign	2003
	Erosion Control Structures	Erosion/ Sedimentation	Emergency Stabilization	75 acres	2003
	Temporary Fence	Erosion/ Sedimentation	Rehabilitation	320 acres	2003
	Monitoring	Invasive Weeds	Rehabilitation	356 acres	2003
	Seeding	Erosion/ Sedimentation	Emergency Stabilization	30 acres	2003
Pass Creek	Monitoring Weeds	Invasive Plants	Rehabilitation	4,725 acres	2003
	Monitoring Vegetation	Erosion/ Sedimentation	Rehabilitation	4,725 acres	2003
	Rehabilitation-Road Signing	Roads	Rehabilitation	44 signs	2003
	Seeding	Erosion/ Sedimentation	Emergency Stabilization	250 acres	2003
	Temporary Fence	Erosion/ Sedimentation	Rehabilitation	600 acres	2003
Murphy Draw	Temporary Fence	Erosion/ Sedimentation	Rehabilitation	5.75 miles	2001
	Monitoring Weeds	Invasive Plants	Rehabilitation	30 acres	2001
	Monitoring Vegetation	Erosion/ Sedimentation	Rehabilitation	1,365 acres	2001
	Rehabilitation-Monitoring Weeds	Invasive Plants	Rehabilitation	30 acres	2001
	Seeding	Erosion/ Sedimentation	Emergency Stabilization	200 acres	2001
	Rehabilitation-Road Signing	Protection	Emergency Stabilization	28 signs	2001
Cottonwood	Temporary Fence	Erosion/ Sedimentation	Rehabilitation	1.6 miles	2000
	Rehabilitation-Monitoring Weeds	Invasive Plants	Rehabilitation	155 acres	2000
	Monitoring Vegetation	Erosion/ Sedimentation	Rehabilitation	155 acres	2000
	Rehabilitation-Monitoring Weeds	–	–	30 acres	2000
	Seeding	–	–	155 acres	2000
	Rehabilitation-Road Signing	Protection	Emergency Stabilization	28 signs	2000
	Erosion Control Structures	Erosion/ Sedimentation	Emergency Stabilization	10 waterbars	2000

Source: BLM 2009b

ES&R Emergency Stabilization and Rehabilitation

Management Challenges for Stabilization and Rehabilitation

Fluctuations in precipitation patterns create management challenges for stabilization and rehabilitation. The affect of continual years of drought intermixed with years of average or slightly above average precipitation influences the need to develop ES&R plans following a wildfire. Additionally, increased drought, disease, and large wildfires create management

challenges related to rehabilitation. The need for stabilization and rehabilitation in the planning area is predicted to increase as wildfires become increasingly larger and include more expansive high severity burned areas.

Impacts to water, soil, vegetation, and forests from larger wildfires increase the need for and importance of stabilization and rehabilitation. Areas with burned vegetation are vulnerable to erosion, especially due to fluctuations in precipitation patterns and the potential for severe storms associated with climate change.

3.4. Biological Resources

This section describes the biological resources in the planning area including vegetation, invasive species and pest management, fish, wildlife, special status species, and wild horses. Due to the complexity of biological resources and the size of the planning area, this section does not attempt to provide an encyclopedic description of all vegetation, fish, wildlife, and special status species in the planning area. Common names for species are used throughout this section and the rest of this document. A complete list of scientific names for species referenced in this document can be found in Appendix P (p. 1505).

Acreage reported for biological resources in the planning area in this section does not include the WRIR and USFS lands as the BLM does not manage these lands. However, these areas are depicted on the referenced maps in this document to provide a visual and geographic context for biological resources in the planning area. Important ecosystem components of biological resources include biological diversity and habitat fragmentation which are discussed below.

Biological Diversity

The Keystone Center (Keystone Center 1991) defines four elements of biological diversity relating to scale:

1. Genetic diversity
2. Species diversity
3. Community or ecosystem diversity
4. Landscape or regional diversity

Biological diversity is complex, and makes the measurement of existing conditions difficult. Species diversity is the most recognizable and easily understood element of biological diversity and in this document is defined as the variety of species found in the planning area. In other words, species diversity includes the numbers and distribution of all species in the planning area. This includes species (e.g., mule deer, elk, and pronghorn) that are common and plentiful, and other species (e.g., burrowing owl, mountain plover, and bald eagle) that are less common or are rare. Classifying rare species as sensitive, threatened, or endangered is one way of conserving biological diversity because these classifications heighten awareness for conservation of rare species.

Spatial and temporal scales are also important considerations for conserving biological diversity. For example, nonmigratory populations of mammals are sometimes temporarily diminished following a harsh winter and limited food supply. In addition, migratory birds might return to breeding grounds with diminished populations due to the stresses associated with migration. In these cases, the lower number of individuals of wildlife populations does not necessarily equate to a reduction in biological diversity in the planning area because the number of individuals

ultimately (all else being equal) return to pre-winter levels. For the purposes of this document, permanent reductions in the four elements of diversity listed above are considered adverse impacts to biological diversity.

Counting the number and relative frequency of species occupying an area over time is one means of identifying reductions in species diversity; however, this approach can be overly simplistic and does not necessarily address the other three elements of diversity. There is no single commonly accepted scientific protocol for measuring biological diversity. Nevertheless, it is generally accepted that "…reducing the number of biological entities in a system or making some of them less abundant reduces diversity" (Langner and Flather 1994).

Climatic factors (e.g., drought), disease, fire regime, predation, competition, and population cycles all have contributed to the existing natural variability in number and relative frequency of individuals, species, and communities of plants and animals in the planning area. Other factors include surface-disturbing activities (e.g., road and well pad construction), the physical and chemical environment (e.g., soil nutrients and water), adjacent area vegetation (e.g., croplands), historic vegetation, invasive species, herbivory (e.g., native ungulates and livestock), and existing vegetation in the planning area.

Existing conditions for biological diversity in the planning area is a function of physical factors (e.g., soils, geology, air, water, geography, and elevation), natural factors (e.g., fire, drought, disease, evolution), and human actions. In the context of these physical and natural factors, biological diversity evolved over time to produce the diversity in the planning area prior to European American settlement. Human actions during the subsequent 150 years changed the pattern, composition, structure, and function of plant and animal communities in the planning area, thus affecting the pre-European American biologically diverse settlement. Management challenges for biological diversity include competing resources and resource uses. Management actions to address these challenges are incorporated in the alternatives for physical and biological resources and for fire and fuels management in Chapter 2.

Habitat Fragmentation

As large contiguous blocks of habitat are bisected into smaller blocks, they become isolated from one another by dissimilar habitats and land uses. For example, a contiguous 100,000-acre block of sagebrush habitat is considered fragmented when a road or other development is constructed through the habitat, thereby bisecting the block. If, in this example, the road bisects the 100,000-acre block in half, the result of this fragmentation is two 50,000-acre blocks of sagebrush habitat bisected by a road. As blocks of habitat are repeatedly bisected into smaller blocks, there can be adverse impacts, including isolation, to individual plant and animal species and communities occupying the habitat. The impacts to biological resources from habitat fragmentation can occur on multiple scales.

Actions that result in habitat loss are exacerbated when fragmentation reduces the size and/or isolates remaining habitat patches below size thresholds necessary to support particular species. Some species are area-sensitive and habitat loss and fragmentation that reduces or isolates their area thresholds likely affects their distribution and abundance in the planning area.

The planning area habitat is fragmented by linear features, including roads, trails, irrigation systems, and ROWs. A network of state highways, county roads, and local roads on private and public lands cross portions of the planning area. Fences can also block migration routes for wildlife species such as pronghorn, consequently fragmenting their habitats. The conversion

of large areas of sagebrush to predominately grassland communities can fragment habitat for sagebrush-dependent species such as the greater sage-grouse.

Habitat fragmentation in the planning area is most prevalent along the linear features identified in the previous discussion; however, fragmentation also occurs at population centers, reservoirs, and other developments where humans live, recreate, and work. For example, the development of private parcels bordering BLM-administered lands has, in some instances, contributed to habitat fragmentation by the conversion to subdivisions or smaller ranchettes. This type of land conversion and habitat fragmentation primarily occurs near population centers and the WUI. Buildings, roads, fences, and utility corridors associated with residential and commercial developments have all contributed to habitat fragmentation in the planning area.

In addition to the linear features and other types of development, conditions on BLM-administered land continue to be influenced by the management of resources and resource uses, including mineral resources; fire and fuels management; forests, woodlands, and aspen communities; and land resources. Refer to the appropriate sections in this chapter for additional details regarding existing conditions for these resources and resource uses.

In general, development and the associated construction and maintenance of roads, railroads, well pads, pipelines, and powerlines has fragmented habitat in the planning area. In addition, wildland fires have sometimes contributed to temporary habitat fragmentation. Intense and large area burns can temporarily isolate individual species and communities of plants and less mobile species of animals. A frequent fire return interval often associated with invasive species can effectively fragment habitat over the long term. Similar to fire, mechanical vegetative treatments have generally been temporary. Motorized vehicle use also can contribute to habitat fragmentation through the transportation of invasive species seeds.

Vegetation

There are three major types of vegetative communities in the planning area: forest and woodland communities, grassland and shrubland communities, and riparian-wetland communities. These communities are identified on Map 45.

Precipitation patterns and zones play an important role in the functions and types of vegetative communities (Map 44).

- The Wind River Basin is in the 5- to 9-inch precipitation zone, with some inclusions in and around the town of Shoshoni where precipitation might be less than 5 inches annually.
- Most of the area of increasing elevation up Beaver Rim into the Sweetwater Valley is in the 10- to 14-inch High Plains East precipitation zone.
- Areas in the higher elevation portions of the Green Mountain physiographic feature, the Rattlesnake Mountain Range, and the Copper Mountain/Bridger Mountain area receive more than 15 inches of precipitation annually. These areas are unique oases of the intermountain cold desert shrublands that dominate the area.
- The Lander Slope and Twin Creek areas are characterized by both the 10- to 14-inch and the 15-inch+ precipitation zones, with ecological sites that portray those areas.
- The Dubois area is mostly in a rain shadow, but all precipitation zones found in the planning area are within a very short distance. As elevation increases, precipitation changes

dramatically from a desert environment in and around Dubois to a spruce/fir/aspen community in the Ramshorn Peak area near the headwaters of Tappan Creek.

Table 3.33, "Acreage of Vegetative Communities in the Planning Area" (p. 329) lists the acreage for plant communities in the planning area based on Wyoming GAP Analysis data (BLM 2009a).

Table 3.33. Acreage of Vegetative Communities in the Planning Area

Vegetative Type	Total Acreage	BLM-Administered surface acreage	Percent BLM-administered surface acreage
Grasslands	276,142	177,156	7.4
Sagebrush	2,396,517	1,770,153	73.9
Conifer (ponderosa/ lodgepole pine forests)	34,232	19,058	0.8
Desert shrubs and saltbush-greasewood flats	301,833	231,746	9.7
Juniper/limber pine, and aspen (woodlands)	67,268	42,803	1.8
Mountain shrubs	94,410	70,518	2.9
Riparian-wetland	131,684	54,292	2.3
Other (rockland, disturbed Area, water, unclassified)	45,120	25,416	1.1
Totals	**3,347,206**	**2,391,142**	**-**

Source: BLM 2009a

Note: Percentages might not sum to 100 due to rounding; totals for acreage columns do not equal total planning area and total BLM-administered land in the planning area due to differences in source files for boundary and for vegetation.

BLM Bureau of Land Management

The USDA NRCS developed Major Land Resource Areas (MLRAs) as a way to classify geographic areas with similar elevation, topography, geology, climate, water, soils, biological resources, and land use (USDA 2006). The planning area lies within three MLRAs (Map 45), as described below:

1. MLRA 32 – Northern Intermountain Desertic Basins (5- to 9-inch and 10- to 14-inch precipitation zones) – MLRA 32 occupies the lowest elevations and includes salt desert environments and soils that support sagebrush but not large contiguous stands. This MLRA has the longest growing season in the planning area, but is also the driest.

2. MLRA 34A – Cool Central Desertic Basins and Plateaus (7- to 9-inch and 10- to 14-inch precipitation zones) – While many MLRAs in Wyoming support sagebrush, MLRA 34A forms the core of sagebrush habitat in Wyoming. This is the most intact tract of sagebrush remaining in the world. Virtually everywhere else the sagebrush biome is fragmented and threatened. Green Mountain, and to a lesser extent Crooks Mountain, have the alpine characteristics associated with MLRA 43B, but the region is too small to map separately on the scale appropriate for MLRAs.

3. MLRA 43B – Central Rocky Mountains (15- to 19-inch and 20-inch+ precipitation zones) – MLRA 43B is an alpine environment. It has the shortest growing season and the highest precipitation in the planning area. It includes the Wind River Front and the south slopes of the Owl Creek and Copper Mountains. Much of this MLRA is forest or mountain shrub vegetation types.

Each MLRA contains a set of "Ecological Sites," which describes the land capability and function based on precipitation zones, soil factor differences that determine plant production and composition, site hydrology, functioning of the ecological processes of the water cycle, nutrient cycles, and energy flow. Different ecological sites exhibit differences in the number and relative proportion of species and total annual vegetation production.

Ecological site descriptions are used as the initial basis for determining the existing and potential range of conditions for each site. State and transition models are used to develop objectives and guide management actions necessary to meet the Wyoming Standards for Healthy Rangelands (Appendix J (p. 1437)). State and transition models describe the anticipated vegetation changes on a given site over time in response to various types of disturbances and environmental factors (NRCS 2003).

Vegetative Conditions

Appendix Q (p. 1511) provides a general discussion of vegetative conditions in the planning area. The appendix provides an estimate of vegetation conditions based on data from existing vegetation, fire regime groups, FRCC from regional LANDFIRE data, and estimates from ground level conditions. The coarse scale, landscape level assessment of the condition classes for vegetation types in the planning area was conducted in 2001 for the purpose of describing the Fire Regime Group and the Landscape Level FRCC, and to provide the only planning area wide inventory available for determining the ecological condition of vegetation communities. The LANDFIRE database description of the ecological condition of vegetation communities was used because the Lander Field Office has not completed a forest and woodlands inventory, and there has not been an Ecological Site Inventory of grassland and shrubland conditions in more than 35 years. This assessment technique does not provide useful information for riparian-wetlands, as the scale is too broad.

While the information provided in Appendix Q (p. 1511) provides broad information that can be informative at the RMP level of analysis, up-to-date inventories are still needed. Refer to the *Fire and Fuels Management* section for additional information on the FRCC system.

3.4.1. Vegetation – Forests, Woodlands, and Aspen Communities

Approximately 61,861 acres, or 2.6 percent, of BLM-administered surface in the planning area consists of forest and woodland communities (including juniper/limber pine and aspen woodlands and conifer forests) (Map 45). Overall, forest and woodland health throughout the West is declining. Drought conditions, hotter summers and fewer deep winter freezes have stressed forest and woodland communities and made them more susceptible to insect and disease outbreaks. Related to changing climatic conditions, 100 years of fire suppression has altered the ecology of the existing landscape. Evidence of the combination of these factors include juniper encroachment, conifer stands decimated by pest infestation, and the decline of aspen stands. Loss of aspen stands have been reported throughout the west, with the highest mortality occurring in areas where aspen is a mid-seral species (Bartos and Campbell 1998).

Age-class distribution, diversity, fire return intervals, as well as pine beetle and other infestations, are key indicators of forest and woodland health. Aspen, because of its importance as a vegetative resource for wildlife habitat, serves as an overall indicator species for forest and woodland health.

Forest Communities

Forest communities comprise approximately 19,058 acres of BLM-administered surface, or less than 1 percent of the planning area. Forest communities in the planning area are dominated by lodgepole pine with some confined Douglas fir and Englemann spruce stands, and are primarily found north of Dubois and Lander, and in the South Pass and Green Mountain areas. The importance of these forest stands is a function of their distribution, relatively long rotation age (number of years to maturity), and the diversity of plants and animals they support. Age-class distribution of forested lands is tending toward mature, heavily stocked stands with younger age-class stands in smaller areas that have burned over the past 30 years or have had some logging activity over the past 40 years. Portions of these older and more mature stands remain healthy, but many are declining in tree vigor and productivity. The advanced age and density of these stands, combined with the lack of vegetative treatments and altered fire regime, have contributed to the decline in overall forest stand health. Vegetative treatment includes methods to manage natural processes, insects and diseases, structure, density, species composition, age-class distribution, and site quality of forest stands.

The age-class distribution of lodgepole pine stands is largely a result of past logging activities and, to a lesser extent, the influence of wildland fires and wind throw. Except where there has been recent (within approximately the last 50 years) disturbance, lodgepole pine is primarily even-aged stands between 100 and 200 years old with size classes of pole (5- to 9-inch diameter breast height) and medium saw timber (9- to 21-inch diameter breast height). Old-growth characteristics are generally not applied to lodgepole pine.

Lodgepole pine is stressed by mountain pine beetle and dwarf mistletoe infestations in scattered patches throughout the planning area. Forested lands adjoining the planning area exhibit more pest damage than in the planning area itself. The mountain pine beetle has most heavily affected the Dubois area, but there are signs of disease on Green Mountain and Lander Slope. Funding levels provide little scope for management response to the spread of the mountain pine beetle. The BLM works with the Shoshone National Forest and the community of Dubois to control pine beetle infestations.

Douglas fir and Englemann spruce are minor components of forested areas. Douglas fir stands are found in the South Pass, Lander Slope, and Dubois areas and are restricted to limestone derived calcareous soils of the Wind River Slope. Some of the Douglas fir stands in the Mexican Creek area of Lander Slope display old growth characteristics with basal bark scarring from past fires and age classes in excess of 300 years. Engelmann spruce is limited to forested drainage bottoms. Small stands are found on Green Mountain, Lander Slope, South Pass, and in the Dubois area. Neither Douglas fir nor Englemann spruce display the degree of infestation and mortality that is affecting lodgepole pine and limber pine.

Woodland Communities

Woodland communities comprise approximately 42,803 acres, or 1.8 percent of BLM-administered surface in the planning area. Woodlands include limber pine, Rocky Mountain and Utah juniper stands, aspen stands, and cottonwood galleries along waterways. In general, distribution of aspen has decreased, while limber pine and juniper stands have increased.

Identified woodland areas are on the Lander Slope, Green Mountain, Copper Mountain-Lysite Mountain area, the Beaver Creek-Twin Creek area, the Sweetwater Rocks, the Dubois/Wind River area, and portions of the Rattlesnake Range. Juniper/limber pine woodlands occur in the Beaver Creek and Twin Creek areas. Limber pine has been more acutely impacted by disease than other woodland species in the planning area. There is no whitebark pine in the planning area, and

as such management does not address this BLM sensitive species; see the Wyoming sensitive species list for locations of other sensitive species (NRCS No Date). Extensive herbivory has adversely impacted aspen stands in numerous areas, including on Green Mountain and Beaver Rim. The long-term lack of fire necessary to regenerate aspen stands has also been detrimental.

Aspen is scattered throughout the planning area, although most stands are maturing and distributions are declining. Most of the aspen occurs within forest and woodland sites in mid-seral communities that naturally transition into conifer stands before a disturbance, such as fire, returns the stands to early- and mid-seral aspen dominated woodland communities. Aspen stands typically exhibit a diversity of understory vegetation, are used by wildlife and livestock, can serve as natural fire breaks, and often occur as part of important riparian-wetland components in the forest system. Older aspen stands are showing signs of increased cankers, conks, and decay in the boles, and generally have little clone regeneration due to competition from conifers and herbivory from wildlife and livestock. The healthiest aspen stands are on Lander Slope and in the Dubois area, probably due to the extensiveness of the forested landscape and the lack of concentrated browsing pressure; the largest acreage of this community occurs in the Green Mountain area.

Much of the aspen at middle to high elevations is declining as succession to conifer dominance proceeds. In the absence of treatment or re-generation through fire or other landscape-wide event, this trend would continue. The loss of deciduous forestland affects watershed and riparian-wetland function and the diversity of habitat. Slowing the landscape level loss of aspen is a high management priority and is being addressed by aspen regeneration projects using the most recent aspen inventory data.

Forest Products

Forest product sales in the planning area are minimal with total receipts of $4,209 in 2005, $4,956 in 2006, $5,513 in 2007, and $5,478 in 2008 (fiscal years). These receipts were mainly from sales of fuel wood permits, Christmas tree permits, and post and pole permits.

Management of Forests, Woodlands, and Aspen Communities

Forest Communities

Forestlands in the Lander Slope-Red Canyon, South Pass, Whiskey Mountain, and East Fork areas are under restricted management for forest products due to access and topographical limitations (steep slopes) associated with forest management in these areas. The BLM manages stands in the WUI to reduce hazardous fuel loading. Refer to the *Fire and Fuels Management* section for information on planned/prescribed fire and non-fire treatments by FMU in the Southern Zone FMP (BLM 2004b) (Appendix O (p. 1499)).

The BLM has attempted to increase forest sales in recent years to address fuel loading and beetle kill. There is an opportunity to combine the BLM harvest with other state, private, and federal agency harvests where jurisdictional boundaries cut through larger sale areas. The Healthy Forest Initiative of 2002 and the subsequent Healthy Forest Restoration Act of 2003 promotes expediting fuels reduction and forest restoration and entering into stewardship contracts under which contractors would harvest wood products and complete service work such as thinning trees and removing dead wood (BLM 2009b). In the planning area, however, there is a weak demand for the forest products that could be garnered through these stewardship contracts (with the exception of the Dubois area, where there is currently a demand for all types of forest products).

The demand for minor wood products such as firewood, posts and poles, and Christmas trees is likely to continue and could be a tool to manage areas, such as Green Mountain, that would benefit from thinning. However, the cost in time and fuel to drive to Green Mountain makes this area much less desirable to those interested in forest products from the Lander area than closer areas in the Lander Slope and South Pass areas.

Woodland Communities

The BLM manages 42,803 acres of woodlands in the planning area to enhance other resources. Management includes enhancement of aspen stands through the removal of encroaching limber pine and juniper from mountain shrubland habitat. Future site-specific inventories would identify additional acres of these vegetative types because of woodland encroachment on shrublands.

The Green Mountain area has the largest acreage of aspen within the planning area, with over 6,000 acres. Treatment has averaged approximately 50 acres annually since 2006. This level of treatment is not sufficient to maintain and enhance the health of this community type, but with proper funding and staffing to issue larger aspen health contracts and utilize tools (e.g., the Stewardship Contracting Authority and service contracts), greater benefits to aspen communities could be achieved. Barring any major surface disturbance, conifers would eventually replace most of the aspen stands, impacting overall forest health, wildlife habitat requirements, and visual resources (Wyoming State Forestry Division 2001). Major disturbance to woodland communities include wildland fires, and mountain pine beetle or other insect infestations; which can result in massive losses of woodlands.

Management Challenges for Forests, Woodlands, and Aspen Communities

Management challenges for forests, woodlands, and aspen communities include the lack of a natural fire regime, limited fuels management, fragmented and isolated stands, encroachment of woodland species, lack of an up-to-date inventory, a weak local and regional demand for sawlogs, declining or over-mature stands, and management of disease, insects, pathogens, and invasive species. Fragmented vegetative communities generally suffer from these declining conditions more than other vegetative communities.

Mountain pine beetle infestations can result in management challenges for forests, woodlands, and aspen communities as conifers have very little defense against infestation and entire groves can be destroyed by a single brood of pine beetles. Mountain pine beetles infestations result in substantial changes in species composition and an altered fuels complex. Early pine beetle infestations result in an increase in the amount of fine surface fuels compared to endemic stands. In post infestation stands, large, dead, wood fuels, and live surface fuels dominate. Infestations of pine beetles can increase the occurrence, rate of spread, and intensity of fires that affect forests, woodlands, and aspen communities.

The impacts of climate change might also be contributing to management challenges associated with disease, drought, infestation, habitat fragmentation, and other issues. Refer to the *Climate Change* section at the end of this chapter for additional information on the potential impacts of climate change in the planning area.

3.4.2. Vegetation – Grassland and Shrubland Communities

The sagebrush biome, which consists of grassland, sagebrush, mountain shrub, and desert shrub and saltbush-greasewood flats vegetative types (Table 3.33, “Acreage of Vegetative

Communities in the Planning Area" (p. 329)) comprises 2,249,573 acres, or 94 percent of the BLM-administered surface in the planning area. The sagebrush biome has become increasingly important as it is lost throughout the western United States to development, urbanization, and fragmentation. For decades, the objective was to convert sagebrush steppe, whenever it could be done in a cost-effective manner, to crops or grassland. In the Great Basin, altered fire regimes from cheatgrass infestation have removed approximately half of the sagebrush in the last few decades. The importance of sagebrush is especially important in relation to greater sage-grouse, which is declining in population and distribution across much of its range. Sagebrush in the planning area remains largely intact and the Lander Field Office is positioned to ensure the proper functioning of the biome (Map 45).

Standard 3 of the Wyoming Standards for Healthy Rangelands states that upland vegetation on each ecological site should consist of plant communities appropriate to the site which are resilient, diverse, and able to recover from natural and human disturbance (Appendix J (p. 1437)). Indicators used to assess upland vegetation health include vegetative cover, plant composition and diversity, bare ground and litter, erosion, water infiltration rates, and invasive species. Refer to the *Livestock Grazing Management* section of this chapter for additional information on the Wyoming Standards for Healthy Rangelands.

Most vegetative communities have been influenced by surface-disturbing activities, livestock grazing, and fire or fire suppression. As mineral developments and pipeline projects increase, sagebrush and grassland conditions are increasingly affected.

Existing management practices for upland grass and shrub communities are addressed primarily through monitoring livestock grazing, evaluating terms and conditions of individual grazing permits, and the development and implementation of Allotment Management Plans (AMPs). As discussed in the *Livestock Grazing Management* section, the impacts of drought, climate change, and mineral development on grass and shrub communities have been historically overlooked. Moreover, short-term indicators, such as stubble height of vegetation in riparian-wetland areas and utilization on uplands, are only useful for determining whether livestock grazing may continue in a given season, unless they are correlated to long-term trend data establishing a cause and effect relationship. Long-term indicators, such as upland condition and trend studies are in place for some high priority "Improve" category grazing allotments, but are lacking in other allotments. Standards assessments of vegetative condition need to be completed to evaluate health and trends.

Grasslands

Grasslands comprise 177,156 acres, or 7.4 percent of BLM-administered surface in the planning area and include lowland, foothill, mountain, and alpine types. Most of the grassland areas are in valley bottoms, uppermost south facing slopes, and scattered patches on windswept ridges, such as the bighorn sheep habitat on Whiskey Mountain in Dubois.

The average composition of the grass vegetative type is 48 to 80 percent grass species, 10 percent forbs, and 10 to 42 percent shrubs. Grasses comprise only 7.4 percent of BLM-administered surface in the planning area, but are important to wildlife, livestock, and wild horses and contribute to the diversity of the area. Open grasslands are important components in bighorn sheep habitat. The standard habitat types included in this vegetative type are highland short grass, sagebrush mixed grass, lowland short grass, and sagebrush mixed shrub.

Shrublands

Sagebrush (1,770,153 acres, or 74 percent of BLM-administered surface) is the most common vegetative type of the shrubland communities. The average species composition varies widely across the sagebrush landscape, depending on soil classification and average annual precipitation. An estimate for most mid-seral sagebrush communities within the 10- to 14-inch precipitation zone is 50 to 65 percent grass, 5 to 10 percent forbs, and 15 to 35 percent shrubs.

There are multiple sagebrush species in the planning area. Great Basin sagebrush and silver sage are discussed in the *Riparian-Wetland Resources* section. Bud sagebrush is identified in the discussion of saline upland sites. Threetip sagebrush is present on clay soils and is common along Lander Slope, although uncommon elsewhere. Low and black sagebrush are found on shallow soils. Big sagebrush is the most widely recognized sagebrush.

Big sagebrush includes two subspecies of similar appearance, including mountain big sagebrush and Wyoming big sagebrush. Only Wyoming big sagebrush occurs in the 5- to 9-inch precipitation zone. Both subspecies occur in the 10- to 14-inch precipitation zone, and only mountain big sagebrush occurs in the 15- to 19-inch precipitation zone.

Big sagebrush is a biome level plant that supports a variety of obligate species such as greater sage-grouse, pygmy rabbits, and vesper sparrows. Many species, such as mule deer, pronghorn, and ferruginous hawk, are not sagebrush obligates, but occupy ranges closely correlated with sagebrush. Domestic sheep graze sagebrush, especially on winter ranges.

Almost all big sagebrush communities can support an understory of cool season bunchgrasses. Needle and thread is the key grass species on sandy soils; bluebunch wheatgrass is more prevalent on loamy sites. These large cool season bunchgrasses occur in conjunction with a mix of smaller grasses such as thickspike wheatgrass, Sandberg bluegrass, and prairie junegrass. Cool season bunchgrasses complete over 90 percent of their growth in a relatively short period, primarily in May. When subjected to repeated heavy grazing use during that short growth period, the preferred cool season bunchgrasses tend to decline as a part of the plant community, after which more grazing adaptive species such as Sandberg bluegrass and threadleaf sedge become the predominant component of the herbaceous community (Cagney et al. 2010).

Depending on location and soil type, blue grama or upland (needle leaf or threadleaf) sedges usually prevail instead of smaller grasses. Blue grama is a warm season grass that produces a minimum amount of forage and ground cover. Sagebrush communities are increasingly vulnerable to cheatgrass infestations, especially in MLRA 32. Cheatgrass appears to be expanding its range in the planning area. While cheatgrass is relatively uncommon in MLRA 43A, no area occupied by sagebrush in the planning area is outside of its reach.

Plant succession in big sagebrush communities is complex, and cool season bunchgrasses, if lost from a given site, do not readily reemerge on sites unless niches are opened through sagebrush treatments. Because greater sage-grouse habitat is a prime concern, sagebrush treatments might or might not be appropriate, and prescribed fire should be used only with great care.

Mountain shrub communities (70,518 acres, or 2.9 percent of BLM-administered surface) occur primarily in the 15- to 19-inch precipitation zone. Mountain big sagebrush, bitterbrush, and snow berry are the key species. Mountain mahogany sometimes occurs, mostly in conjunction with Utah juniper on rocky outcrops in lower-precipitation zones. The grass component includes needle grasses, mountain brome, and Idaho fescue. Arrowleaf balsamroot is a key forb. Mountain shrub areas provide forage for livestock and wildlife, particularly mule deer.

Salt desert habitats (231,746 acres, or 9.7 percent of BLM-administered surface) consisting of desert shrubs and saltbush-greasewood flats are found in two basic forms, saline upland and saline lowland. Saline upland sites are found along the base of Beaver Rim and in the northeast portion of the planning area. These sites are dominated by Gardner's saltbush, often with bud sagebrush. If the salt content is not too severe, these sites have a herbaceous component that includes thickspike wheatgrass and Indian ricegrass. On the edge between a saline upland site and a loamy site, Wyoming big sagebrush and bottlebrush squirreltail can intermingle with the salt tolerant species. They offer high levels of protein in the fall and winter making these sites winter range for livestock and wildlife, particularly domestic sheep and pronghorn. When saline soils are disturbed, reclamation efforts are difficult.

When saline upland sites are subject to improperly managed grazing, the herbaceous component declines and pure stands of Gardener's saltbush develop. The higher the salt content in the soil, the more vulnerable these sites are to this transition. Saline upland sites are also vulnerable to the invasive plant species halogeton. In most circumstances, halogeton is an opportunistic species that occupies disturbed sites. However, halogeton does have the ability to advance onto undisturbed saline upland sites. Saline lowland sites are dominated by greasewood, with variable amounts of basin big sagebrush that decline with increasing salinity as the amount of greasewood increases.

Rockland

This "vegetative" type covers approximately 10,828 acres, or less than 1 percent of the BLM-administered surface in the planning area. Sites include areas of unharvestable trees or brush and rocky or barren areas with little or no potential for agricultural activities due to inaccessibility or a lack of forage production. Typical rockland sites are Sweetwater Rocks, Copper Mountain, and Green Mountain. These areas are used by wildlife for escape and thermal cover and by recreationists.

Management Challenges for Grassland and Shrubland Communities

Management challenges for grassland and shrubland communities include addressing impacts associated with surface-disturbing activities, livestock grazing, and fire or fire suppression. As mineral developments and pipeline projects increase, sagebrush and grassland conditions are adversely impacted. Additional factors such as drought and climate change have been historically overlooked. Moreover, short-term indicators such as stubble height of vegetation in riparian-wetland areas or utilization on uplands are only useful for determining whether livestock grazing may continue in a given season, unless they are correlated to long-term trend data establishing a cause and effect relationship. Long-term indicators, such as upland condition and trend studies that would provide long-term information are in place to "Improve" category grazing allotments, but are lacking in other allotments.

Shifting precipitation patterns and potential climate change cause additional management challenges in grassland and shrubland communities. Cool season bunchgrasses do not resume growth if their spring growing season is aborted due to drought, even if ideal climate conditions for growth return. In the absence of any climate change, Wyoming undergoes climatic shifts in precipitation, which requires monitoring, observation, and timely inventories of rangelands to ensure proper responses to changes are implemented. Refer to the *Climate Change* section at the end of this chapter for additional information on climate change in the planning area.

Increased surface disturbance from human actions, drought, and erosion have lead to the establishment and spread of invasive species in grassland and shrubland communities, resulting in

additional management challenges. The mostly arid climate of the planning area affords little reserve moisture during times of prolonged drought. Although native plant communities adapted to cope with natural shifts in precipitation from wet to dry, human intervention and climate change are altering that relationship. The loss of soil through wind and water erosion can remove nutrients and organic matter from the ecosystem and affect grassland and shrubland communities potentially impacting the health and viability of existing plant communities

Management challenges for grassland and shrubland communities also result from grazing. Historic overuse of the rangeland and concentration on riparian-wetland areas by season long livestock grazing have led to plant communities that are not meeting the potential for the site, and possibly resulting failure to meet the Wyoming Standards for Healthy Rangelands. In some areas, range site vegetation has crossed a threshold and moved to a different transitional state. It might not be possible to restore these areas through rest and/or management and they might require mechanical intervention. Refer to the *Livestock Grazing Management* section of this chapter for additional information.

Increased mineral development is affecting range conditions. Invasive plant species such as halogeton have slowly made their way into these areas. Once established, halogeton tends to spread, displacing desirable species. In the past, there was little monitoring and enforcement of reclamation activities and some mines were abandoned without reclamation. Historic mining areas are slowly being reclaimed with mixed success under a variety of programs.

3.4.3. Invasive Species and Pest Management

Invasive species is defined as "a species that is nonnative to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental health or harm to human health" (NISC 2008). State of Wyoming Designated noxious weeds are those plants that are considered detrimental or poisonous and have been placed on the Wyoming designated noxious weed list by the procedure provided for in the Wyoming Weed and Pest Control Act of 1973. Typically, these weeds are perennial or biennial, difficult to control, and usually interfere with agriculture. The State of Wyoming designates six animal species and 25 plant species as pests and noxious weeds. This list is dynamic and additions to it are made as necessary by the Wyoming Board of Agriculture and the Wyoming Weed and pest Council. Declaring a plant, insect, or rodent to be an invasive weed or pest allows for joint funding for control and assistance through the established state statute. Most of the weeds found on this list are capable of producing monotypic stands as they may process a competitive advantage in establishing on disturbed soils; also, some are allelopathic, producing or accumulating toxins to keep the seeds of other species from germinating. There are 30 additional plant species listed by adjoining states as noxious weeds, bringing the total list to 55 plants that are weedy in Wyoming or bordering states. A number of other species are of concern for the community. The result is a list of approximately 75 species of interest. Table 3.34, "Wyoming Weed and Pest Control Act Designated List" (p. 338) lists the Wyoming Weed and Pest Control Act designated invasive plant and pest species.

In 2007, invasive vegetation and invasive plant species were determined to be the dominant vegetation on an estimated 35 million acres of public lands in the western United States (BLM 2007c). In 1996, the spread of invasive plants on all western public lands was estimated to be 2,300 acres per day (BLM 1996). It is difficult to estimate the damage invasive species cause; however, as early as 1992, invasive species were determined to result in $2 to $3 billion in crop losses alone (NISC 2008). West Nile virus (WNV) is an invasive pathogen which, from 1999

to 2008, had caused 1,134 deaths in the U.S. (Lindsey et al. 2010). WNV is further discussed in the *Health and Safety* section. Executive Order 13112, established the Invasive Species Advisory Committee to represent diverse constituencies around the nation in the development of an invasive species plan. Completed in 2001, the plan has subsequently been updated with a five-step approach to addressing invasive species: prevention, early detection and rapid response, control and management, restoration, and collaboration (BLM 2009b).

Table 3.34. Wyoming Weed and Pest Control Act Designated List

Wyoming Invasive and Noxious Weeds		
Canada thistle	Houndstongue	Russian knapweed
Common burdock	Leafy spurge	Russian olive
Common St. Johnswort	Musk thistle	Scotch thistle
Common tansy	Ox-eye daisy	Skeletonleaf bursage
Dalmatian toadflax	Perennial pepperweed	Spotted knapweed
Diffuse knapweed	Perennial sowthistle	Tamarisk
Dyers woad	Plumeless thistle	Yellow toadflax
Field bindweed	Purple loosestrife	–
Hoary cress (whitetop)	Quackgrass	–
Designated Pests		
Beet leafhopper	Ground squirrel	Mountain pine beetle
Grasshopper	Mormon cricket	Prairie dog
Source: Wyoming Board of Agriculture and the Wyoming Weed and Pest Council 2010		

Other invasive plant species, such as black henbane, larkspur, and locoweeds, are of special concern because they are poisonous. Under state law, local weed and pest districts can declare additional species to be a weed or pest in their district. Table 3.35, "Declared List of Weeds and Pests by Counties in the Planning Area" (p. 338) identifies the secondary declared weeds as of 2010 by county weed and pest district.

Table 3.35. Declared List of Weeds and Pests by Counties in the Planning Area

Species	Fremont County	Carbon County	Natrona County	Sweetwater County
Army cutworm	No	No	No	Yes
Black henbane	No	No	Yes	Yes
Buffalobur	No	No	Yes	No
Cheatgrass	No	No	Yes	No
Curlycup gumweed	No	No	Yes	No
Foxtail barley	No	No	Yes	Yes
Halogeton	No	Yes	Yes	No
Lady's bedstraw	No	No	No	Yes
Mosquito	Yes	Yes	Yes	Yes
Mountain thermopsis	No	No	No	Yes
Plains larkspur, Geyer larkspur	No	Yes	No	No
Plains prickly pear	No	Yes	No	No
Poplar bud-gall mite	No	No	No	Yes
Puncturevine	No	No	Yes	No
Russian olive	Yes	No	No	No
Showy milkweed	No	No	Yes	No
Swainsonpea	Yes	No	No	No
Wild licorice	No	No	Yes	Yes
Wyeth lupine	No	Yes	No	No
Source: Wyoming Department of Agriculture 2010				

As of 2007, there were 11,547 acres of BLM-administered surface in Fremont County identified as infested with invasive plant species (BLM 2009b). These infestations were found to include black henbane and Swaisonpea. The primary location of leafy spurge infestation in the planning area is on the Lander Slope. Natrona County has approximately 500 acres of infestations, primarily leafy spurge. Other invasive plants like common burdock, perennial pepperweed, bull thistle, and sulfur cinquefoil are found in the planning area, but rarely, if ever, on BLM-administered public lands. There are also biennial thistles in the Forest oil field area. Map 46 shows the locations of identified invasive species in the planning area. Additional information is available through the Fremont County Weed and Pest District (Fremont County Weed and Pest District 2009).

Sweetwater County does have some problems with invasive species; black henbane is present on roads and pipeline ROWs and is the major concern in this area. This part of the Great Divide Basin contains primarily annual invasive plants on disturbed ground such as cheatgrass, halogeton, and Russian thistle. There are also biennial thistles in the Forest oil field area. Black henbane is the invasive plant of concern that appears to be spreading with the increasing oil and gas related surface-disturbing activities in Sweetwater County.

The Lander Field Office controls invasive species on the public lands through cooperative agreements with the Fremont and Natrona Weed and Pest Control Districts. In addition to the county weed and pest control districts, the Lander Field Office works in cooperation with the Wyoming Game and Fish Department (WGFD), State Lands Division, State Parks, local NRCS offices, and private landowners. Invasive species are an increasing problem in the planning area and are affecting water and other resources.

The BLM invasive species program has treated between 136 and 800 acres annually over the past decade. Energy companies treat approximately 70 to 200 acres annually for invasive plant species in addition to general vegetation treatments for fire hazards (BLM 2009b). On average, the BLM annually treats 700 acres in Fremont County and 70 acres in Natrona County with herbicides (BLM 2009b).

There is a linear relationship with surface-disturbing activities and invasive species. Proper land rehabilitation practices can allow native vegetation to establish and out compete annual invasive plants in times of normal precipitation and if seedlings are protected from concentrated herbivory, which can otherwise lead to seedling mortality.

At present, WSAs, study exclosures, and most ACECs are almost free of invasive species. Roads and watercourses are the typical routes of invasive species invasion. The most invasive plant infested area is the Lander Slope ACEC and, secondarily, the riparian-wetland area of Beaver Creek. With well-established stands of leafy spurge, Russian knapweed, and hoary cress, the strategy is to contain these invasive plants at the perimeter of the infestation, typically through herbicides, and to introduce insect vectors in the infested areas. Gradually, since the early 1990s, the bulk of the introduced insects have been able to adapt or travel to suitable sites where they can survive, multiply, and diffuse to other infested areas. Some of the insects need a bit of help still and they are collected and placed where they are needed.

Before the 1990s, leafy spurge was largely a problem confined to the Lander Slope. Leafy spurge has since spread to ephemeral drainages to the Government Draw area and Beaver Creek. It can also be found sporadically along the Sweetwater River and in the Sweetwater Rocks in the Split Rock area. Horse Creek and Keester Basin in Natrona County have some isolated patches of leafy spurge, but they do not appear to be expanding. The introduction of Aphthona flea beetles has helped control some areas heavily infested by leafy spurge.

Russian knapweed has expanded its range in the planning area. This species occurs along Twin and Beaver Creeks and the wide floodplain of Badwater Creek and its tributaries in the northeastern part of Fremont County. It is also found in the ephemeral drainages between Poison Creek, by Moneta, to Lysite, Wyoming.

Spotted and diffuse knapweed are becoming more common along highways and in campgrounds. There is an infestation on the eastern part of Green Mountain in the Cooper Creek drainage that appears to be related to previous surface-disturbing activities.

Tamarisk, or salt cedar, has expanded its range in the past two decades to several small drainages north of Beaver Rim, including Big Sand Draw, and a dozen or more small reservoirs. There is also a tamarisk infestation at Carmody Lake, atop Beaver Rim.

One formerly prevalent invasive species of the Lander Slope was musk thistle. With the successful introduction of Rhinocyllus conicus and Trichosirocalus horridus weevils, this invasive species is no longer found in the dense thickets that used to exist roughly 25 years ago.

Cooperative Management for Invasive Plant Species

The Lander Field Office manages invasive plant species in accordance with the goals described in Partners Against Weeds, An Action Plan for the Bureau of Land Management (BLM 1996).

In 2007, the BLM established national priorities to be used in conjunction with local priorities for meeting restoration goals; these priorities are expected to improve efforts to prevent the spread of invasive species. The BLM established the following treatment priorities to promote integrated efforts across resource programs that manage vegetation.

- WUI protection treatments designed to reduce risk of wildland fire to the community and/or its infrastructure, developed collaboratively.
- Treatments to restore or maintain healthy, diverse, resilient, and productive native plant communities.
- Special status species habitat improvement projects designed to improve or protect special status fish, wildlife, and plant habitat.
- Treatments that are planned, implemented, and/or monitored using funding from multiple sources, both internal and external.
- Landscape treatments (more than 1,000 acres for mechanical and more than 4,500 acres for prescribed fires), coordinated across boundaries, to improve treatment effectiveness.
- The Federal Noxious Weed Act requires that the BLM enter into cooperative agreements with state agencies or local agencies to coordinate the management of invasive plant species or undesirable plants on BLM-administered lands. The BLM has agreements with Fremont County and the weed management areas.

In accordance with the above mentioned 2007 national priorities, development strategy to manage invasive plant species is set at the local level and aligned with land use planning objectives. Close cooperation with local community groups is a critical component of any effective strategy. Part of the analysis of proposed invasive species treatments includes determining what post-treatment management prescriptions need to be applied.

Vegetation treatment priorities identified in the Vegetation Treatment on BLM-Administered Lands in Thirteen Western States Environmental Impact Statement (EIS) (BLM 2007c) still apply to invasive plant species. More specific control priorities for current management include:

- Prevent infestation by use of certified weed-free hay, straw, seed, and reclamation material, along with vehicle washing and weed survey of areas proposed for surface-disturbing activities. Prevention is the first line of defense and the most cost-effective approach.

- Collaboration with other stakeholders is crucial. The BLM has been a cost-sharing sponsor of Fremont County Weed and Pest District coordinated efforts, such as periodic newspaper supplements about local weed control efforts and the printing of weed identification booklets distributed to the public. The Fremont County Weed and Pest District has also given presentations to the Lander Field Office personnel to increase weed knowledge and awareness.

Weed management areas, which are formed around areas with similar geography, weed infestations, climate, and human-use patterns, are tools to facilitate cooperation among all land managers and owners. The goal of weed management areas is to prevent the reproduction and spread of weeds into and within weed management areas. The formation of a weed management area replaces jurisdictional boundaries, which can be barriers to weed management programs, with natural boundaries that facilitate cooperation, coordination, and implementation of an integrated weed management program. One agency or landowner's weed management success is likely determined by the cooperative efforts of other landowners in the area.

At present, the Lander Field Office participates in the Popo Agie Weed Management Area and the Dubois-Crowheart Weed Management Area, and will soon be a cooperator in the newly formed Lower Wind River Weed Management Area. The Dubois area experiences extensive recreation use and is a scenic area on a thoroughfare for Grand Teton and Yellowstone National Parks. The Dubois-Crowheart Weed Management Area was created to prevent new infestations of invasive species, educate the public about invasive species and the problems they cause, and to combat invasive species in this area.

The Fremont County Weed and Pest District plans, funds, and staffs a systematic invasive plant and pest inventory with the goal of examining all invasive plant susceptible lands at least every five years. Thus, about 20 percent of the land surface each year is searched for new infestations of plants and animals that are recognized as being injurious or damaging.

Cooperative Management for Pest Control

In February 2003, the USDA Animal and Plant Health Inspection Service (APHIS) and the BLM signed a memorandum of understanding (MOU) detailing cooperative efforts between the two entities on suppression of grasshoppers and Mormon crickets on BLM-administered lands (Appendix A (p. 1343)). This MOU clarifies that APHIS would prepare and issue to the public site-specific environmental documents that evaluate potential impacts associated with proposed measures to suppress economically damaging grasshopper and Mormon cricket populations. The MOU also states that these documents would be prepared under the APHIS NEPA implementing procedures with cooperation and input from the BLM. The MOU further states that the responsible BLM official would request in writing the inclusion of appropriate lands in the APHIS suppression project when treatment on BLM-administered lands is necessary. The BLM must also approve a Pesticide Use Proposal (Form FS-2100-2) for APHIS to treat

infestations. According to the provisions of the MOU, APHIS could begin treatments after appropriate decision documents are issued and the BLM approves the Pesticide Use Proposal.

Wyoming designated pests (Table 3.34, "Wyoming Weed and Pest Control Act Designated List" (p. 338)) include grasshoppers, Mormon crickets, mountain pine beetle, beet leafhopper, prairie dogs, and ground squirrels. The preferred method for treating grasshoppers and Mormon crickets is by Reduced Agent Area Treatments (RAATs). RAATs is a grasshopper suppression method in which the rate of insecticide is reduced from conventional levels and treated swaths are alternated with swaths that are not directly treated. The RAATs strategy relies on the impacts of an insecticide to suppress grasshoppers in treated swaths while conserving grasshopper predators and parasites in swaths not directly treated.

Grasshoppers and Mormon crickets have not reached a level needing control for more than a decade. The local weed and pest districts and APHIS surveys determine the need for insect control. Because other agencies make decisions about how insects will be controlled on BLM-administered lands, this document does not further discuss invasive insect species.

Four aquatic pest species of concern in the planning area are the quagga mussel, zebra mussel, New Zealand mud snail, and didymo. The New Zealand mud snail has been found in the Bighorn Basin, an adjacent planning area. At present, the quagga mussel and zebra mussel are not found in the State of Wyoming, but they have been found in Colorado and Utah. Didymo algae is present in the planning area, but appears to be confined to a few streams, such as the Middle Fork of the Popo Agie River. Didymo algae could form massive blooms that could smother streambeds, affecting invertebrate species and ultimately fish populations.

Management Challenges for Invasive Species and Pest Management

Areas of disturbed soils and those subject to accelerated erosion are at an increased risk of invasive species establishment. These areas include sites with oil and gas activity such as pipeline construction in the Badwater Creek drainage, and AML projects such as large mine rehabilitation in the Gas Hills and Green Mountain areas. The Lower Wind River Weed Management Area was formed to combat the spread of invasive species due to mineral development activity in the Badwater Creek and Gas Hills areas.

Wildfires and the use of prescribed fire present challenges in managing invasive plant species. Some invasive plant species, such as cheatgrass, often spread and become established in burned areas. Managing burned areas to reduce the spread and establishment of invasive plants species requires BLM personnel and resources to develop and implement ES&R plans and perform monitoring and treatments.

The use of insects to manage invasive species presents a management challenge. Insects are often effective at treating invasive species; however, it is difficult to monitor their natural dispersal and effectiveness, especially when chemical, mechanical, or cultural (grazing) methods might also be occurring on the same site.

Confronting potential impacts of climate change is a management challenge for invasive species and pest management. Increasing levels of CO_2 and changing temperature and precipitation patterns could favor invasive species. Management of invasive species and pest management in response to climate change aids in addressing management challenges associated with changing science. Increased surface-disturbing activities and changing weather patterns, which could

disproportionately favor invasive species, could present management challenges for invasive species. Refer to the *Climate Change* section at the end of this chapter for additional information.

3.4.4. Riparian-Wetland Resources

Riparian-wetland areas are the transition zones between terrestrial and aquatic ecosystems and are often the key sites in arid and semi-arid environments. These communities are found in areas along perennial or intermittent drainages, seeps, and springs, and make up a relatively small, but productive portion of the landscape. Wetlands are comprised of aquatic vegetation with unique soil characteristics that have developed under the influence of perennial water.

The BLM defines wetlands as areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that normally supports, a prevalence of vegetation typically adapted for life in saturated soil conditions.

Riparian-wetland areas include marshes, shallow swamps, lakeshores, bogs, and wet meadows, along with lands adjacent to or contiguous with perennial and intermittent flowing rivers and streams, lakes, and reservoirs with stable water levels. Ephemeral streams that do not exhibit the presence of vegetation that depends on free water in the soil are usually not considered riparian-wetland areas.

Healthy riparian-wetland areas enhance water quality, control erosion, diminish the impact of floods, and act as a stabilizing force during drought. These areas provide biological diversity; stable banks and shorelines; floodplain maintenance; clean and stable water supplies; aquifer recharge; flood energy dissipation and moderation; fish and wildlife habitat; livestock forage; opportunities for recreation; carbon sequestration; and scenery.

Riparian-wetland communities also support a number of BLM sensitive species. In addition, Ute ladies'-tresses is an endangered plant species only found in riparian-wetland areas.

The importance of greater sage-grouse, both as a BLM sensitive species and as identified by the Governor's Task Force, is receiving national attention. Riparian-wetland areas are a component of brood-rearing habitat for greater sage-grouse because they provide needed forbs and insects necessary for chick survival.

The BLM riparian-wetland initiative for the 1990s set goals for public land riparian-wetland areas. These included restoring and maintaining riparian-wetland areas so that at least 75 percent are in PFC by 1997; protecting riparian-wetland areas and associated uplands through proper land management; and by avoiding or mitigating adverse impacts.

Riparian-wetland communities make up less than 3 percent of the BLM-administered surface in the planning area, but their value is inversely proportional to their physical extent. Some rangeland studies have found that even though riparian-wetland meadows and stream corridors cover only 1 to 2 percent of a given pasture, they often supply 20 percent of the forage produced; in steeply sloping pastures they can account for more than 80 percent of the herbaceous forage removed by cattle. These areas also benefit wildlife; some have called riparian-wetland stream corridors the single most productive type of habitat on the land (Kauffman et al. 1984). The influence of riparian-wetland ecosystems to wildlife is not limited to animal species restricted in distribution to streamside habitat, but also is important to elk, mule deer, pronghorn, greater sage-grouse, blue and ruffed grouse, nongame species, and insects.

Riparian-wetland areas are important to wildlife migrants and to a diverse population of seasonal residents. Most terrestrial animal and insect life depends on riparian-wetlands or wetland areas as sources of water, forage, and cover. It is estimated that 70 to 85 percent of Wyoming's wildlife uses riparian-wetland areas for at least a portion of their life-cycles (BLM 2009b).

There are a number of indicators to evaluate the condition of riparian-wetland areas, including plant composition and diversity; bank stability; channel morphology and floodplain function; erosion and water infiltration rates; groundcover; and the chemical, physical, and biological characteristics of the water. To meet Standard 2 of the Wyoming Standards for Healthy Rangelands, riparian-wetland communities should have structural, age, and species diversity characteristic of the stage of channel succession and be resilient and capable of recovering from natural and human disturbance in order to provide forage and cover, capture sediment, dissipate energy, and provide for groundwater recharge. Indicators used to assess Standard 2 include erosion and deposition rate, channel morphology and floodplain function, channel succession and erosion cycle, vegetative cover, plant composition and diversity, bank stability, woody debris and in stream cover, and bare ground and litter. Refer to the *Livestock Grazing Management* section of this chapter for additional information on the Wyoming Standards for Healthy Rangelands.

Riparian-wetland Communities

Forest Dominated Riparian-Wetlands

Cottonwood is the most common riparian-wetlands tree species, but aspen, boxelder, and a variety of conifer species are also present in the planning area (BLM 2009b). Cottonwood regeneration depends on the presence of bare, moist soil for seedling germination, so stands tend to occur on ephemeral systems or perennial systems where the channel is braided. Cottonwood stands are invariably the product of systems that feature highly variable streamflows that periodically scour potential germination sites, and move the stream channel laterally across the floodplain. The introduced species of salt cedar (tamarisk) is starting to show up in many riparian-wetland zones that formerly featured willows and cottonwoods.

Shrub Dominated Riparian-Wetlands

Systems with persistent water availability and moderate gradients generally form shrub dominated riparian-wetland areas. Several species of willow are the main shrub component of riparian-wetland zones, but other species such as water birch and alder are common.

Herbaceous Dominated Riparian-Wetlands

Herbaceous dominated communities represent the largest percent of riparian-wetland areas in the planning area. Wetlands and riparian-wetland areas with low gradients are typically dominated by grasses, sedges, rushes, bulrushes, and forbs. Herbaceous dominated riparian-wetland areas typically do not include woody species, but are dominated by herbaceous wet meadow complexes that are grazed by wildlife. The presence of wet meadow areas within this community can result in hummocking which may be interpreted as an indication of riparian-wetland degradation.

Proper Functioning Condition Assessment

Proper Functioning Condition (PFC) is the assessment tool used to determine the relative health of stream hydrology, riparian-wetlands vegetation, and the aquatic fauna and flora of riparian

habitats. A wetland system that exhibits high integrity and proper function has a mosaic of well-connected, high-quality water and habitats that support a wide assemblage of native species and the genetic diversity necessary for long-term persistence and adaptation in a variable environment. The BLM utilizes PFC as a tool to measure riparian-wetlands as required by Standard 2 of the Wyoming Standards for Healthy Rangelands.

Most lotic (moving water) and lentic (standing water) riparian-wetland habitats (Map 48) were assessed for PFC between 1994 and 2002 (BLM 1993b). PFC assessments still need to be completed on approximately 91 acres and 51 miles of riparian-wetland habitats. Table 3.36, "Results of Proper Functioning Condition Assessment Ratings" (p. 345) lists the PFC assessment ratings for lotic and lentic areas on BLM-administered surface in the planning area.

Table 3.36. Results of Proper Functioning Condition Assessment Ratings

Condition	Lotic Miles	Lentic Acres
Proper Functioning Condition	104	1,259
Functional at-Risk Upward Trend	37	109
Functional at-Risk Not Apparent Trend	96	202
Functional at-Risk Downward Trend	96	1,298
Non-Functional	33	195
Unknown	51	91
Total	**417**	**3,154**
Source: BLM 2009b		

PFC is the minimum acceptable condition for public land riparian-wetlands, and approximately 25 percent of assessed lotic miles and 40 percent of lentic acres met this standard at the time of the evaluations. Most of these areas have not been formally reassessed to determine the impacts of the multi-year drought, although site visits and monitoring have shown a continued declining trend on some riparian-wetland areas.

The presence or absence of wetland, sub-irrigated, and lowland sites in their proper place in the landscape is often an indicator and product of riparian-wetland health. When a riparian-wetland area is in a downward trend, the water table drops and the site dries out. Vegetation common to a lowland site would encroach on the adjacent sub-irrigated site. Poor road design, water diversions, and herbivory have been identified as factors affecting the condition of riparian-wetland areas.

Livestock prefer riparian-wetland zones during the hot summer season which can lead to increased concentration and heavy, repeated, utilization if improperly managed. Such grazing results in a shift from deep rooted sedges that armor stream banks to shallow rooted bluegrasses that do not armor stream banks is an issue. This shift pre-stages a change in stream channel morphology, where wider or deeper watercourses that drain the watershed are created.

When riparian-wetland areas that feature cottonwood stands are not functional, adult trees persist, but reproduction tends to fail. Cottonwood seedlings are not usually palatable, but tend to be browsed because of their position in the landscape. Cottonwood galleries become remnant galleries, and eventually the stand is lost as the existing trees die out.

On shrub dominated systems, upland species such as big sagebrush encroach on the lowland site. Herbaceous species on the sub-irrigated site shift from preferred species such as sedges and tufted hairgrass to a less valuable, but grazing resistant mix dominated by bluegrasses, dandelion, cinquefoil, and pussytoes. Older willows take on a mushroomed appearance and reproduction is

unsuccessful. The wetland site narrows, and eventually the grazing-resistant mix that formed on the sub-irrigated site replaces the sedges.

On herbaceous dominated sites, the progression is much the same as described for shrub dominated sites, except no shrubs are involved in the transition. The wetland site also tends to undergo hummocking as it transitions to the lowland site.

Hummocked areas feature an uneven soil surface where steep sided mounds approximately 1 square foot in size dominate the site. Hummocked areas tend to be in low gradient lentic sites not armored by bedrock, although it is not uncommon to find them in streamside riparian-wetland zones. Some dispute the origin of hummocks, but their presence is correlated with repeated concentration of cattle in the summer (BLM 2009b). The creation of hummocks leads to a shift in plant composition; the top of the hummocks is drier than the interspaces. Wetland plants are replaced with upland species on the tops of hummocks. Capillary action from seasonal wetting brings salts to the surface, which has lead to the formation of alkali deposits, or soil salinization, in some areas. Soil compaction and root shearing, caused by hoof action in the interspaces between hummocks, accelerates erosion. As wetlands dry, they are more vulnerable to erosion by wind and water. Wetlands with severe hummock formation do not produce riparian-wetland values commensurate with their potential.

Lowland sites dominated by basin big sagebrush and great basin wild rye are generally not evaluated in a PFC format because they make limited contributions to riparian-wetland features. However, when these sites are not functional the herbaceous component is primarily annual mustards. In recent years, cheatgrass has become a concern in these locations.

The primary reasons certain riparian-wetland areas were not assessed to be in PFC include vegetation shifts from riparian-wetland plants to upland species; poor vegetative composition and diversity; wide and shallow channels; headcuts and excessive erosion; unstable banks; narrowing of floodplains; and excessive hummocking.

Some streams that historically supported beaver populations have no existing beaver activity due to a loss of adequate amounts of woody plants and appropriate dam building material, and erosion caused by surface-disturbing activities. Beaver were crucial to maintaining the dam and pond complexes on small streams throughout the planning area; however, they are largely absent from these former habitats. Without beaver to maintain them, the old dams have washed out, water tables have dropped, and streams have become entrenched. These degraded ecosystems function as drainage ditches rather than wetlands and associated riparian-wetland zones that formerly stored water and served to spread and dissipate the energy of floods.

The PFC assessments indicate that many riparian-wetlands (23 percent of lotic miles and 41 percent of lentic acres) are in a downward trend. This downward trend has been impacted by the drought the planning area has experienced since 2000. Drought has affected vegetation production and water availability in riparian-wetland areas. Springs that depend on rainfall to recharge their aquifers have experienced decreased flows in recent years. Stream reaches in some areas have become dry or almost dry during late summer and fall due to lack of snow runoff and below-average precipitation.

A variety of methods have been implemented to improve conditions, including the implementation of grazing systems, installation of additional range improvement projects, stubble height monitoring, the repair of roads and stream crossings, and vegetative treatments.

Management Challenges for Riparian-Wetland Resources

Livestock grazing in riparian-wetland areas creates management challenges. Intensive use of riparian-wetland areas by livestock, as well as wildlife and wild horses, can degrade the condition of riparian-wetland areas and prevent areas from meeting the rangeland health standards. As management moves toward meeting the Wyoming Standards for Healthy Rangelands (Appendix J (p. 1437)) and improving the reclamation success of surface-disturbing activities, the upward trend established in some intensely managed grazing allotments could be extended. Rangeland health assessments completed thus far indicate that allotments not meeting health standards often fail due to the condition of riparian-wetland habitats (Standard 2).

In general, riparian-wetland areas where intensive management of livestock grazing has been implemented are improving. Intensive management typically includes changing the time of year for livestock use, reducing the amount of time the areas are used, creating fenced riparian-wetland pastures and exclosures, and developing range improvements such as offsite water and forage through vegetative treatments.

Fencing riparian-wetland areas into exclosures and eliminating grazing or having very limited grazing use has improved riparian-wetland conditions, although fencing can result in adverse impacts to wildlife, wild horses, recreation, and visual resources. The success of exclosure fencing on riparian-wetland health suggests that the number of riparian-wetland exclosures and pastures could increase to address certain management challenges. Riparian-wetland pastures have been successful in improving conditions, but the speed of improvement appears to depend on the length of time grazing is allowed within the pasture. Management is complicated by the fact that the BLM often controls only small segments along stream courses, with most of the stream under other ownership.

Development in the planning area has the potential to degrade riparian-wetland areas and create management challenges. Mineral extraction requires new roads and other surface disturbance, all of which have the potential to affect riparian-wetland areas. Although surface disturbance must be kept 500 feet away from riparian-wetland areas, erosion from the disturbed soil still could degrade them. The increase in surface disturbance from these permitted activities, and the potential for additional mineral development and major ROW activities, continues to adversely impact riparian-wetland areas throughout the planning area.

Motorized vehicle use in the planning area has also affected riparian-wetland conditions. When use occurs off existing trails, it creates new surface disturbances and the resulting erosion causes silt infiltration of riparian-wetlands. Motorized cross-country users can create large disturbance areas trying to avoid muddy areas. This outcome has been observed in a number of places during the wet spring period or where motorized hunting occurs after snowfall. motorized vehicle use on stream banks can result in banks breaking down and additional sediment being added to the drainage

Fish and Wildlife Resources

The BLM is responsible for managing fish and wildlife habitat on BLM-administered land in the planning area. Management of fish and wildlife species is overseen by state and federal wildlife management agencies. The WGFD manages resident wildlife populations in the planning area. The USFWS provides regulatory oversight for all species listed, proposed for listing, or candidates for listing under the ESA. The USFWS also administers the Migratory Bird Treaty Act (MBTA), which protects migratory bird species whether they are hunted (waterfowl) or not

(songbirds). For a description of special status species, see the *Special Status Species – Fish* and *Special Status Species – Wildlife* sections.

3.4.5. Fish and Wildlife Resources – Fish

Fish habitats are managed according to laws, regulations, BLM policies, and principles of fish management within the BLM multiple-use mandate. Aquatic species, to the extent that they are directly managed, are overseen by state and federal game management agencies. The WGFD is responsible for regulating the sport and commercial take of all fish in the planning area. The USFWS has oversight over federally threatened or endangered species. However, the BLM directly manages the habitat that supports both game and nongame fish species where they are found on BLM-administered lands. See the *Special Status Species – Fish* section for a discussion of threatened, endangered, and BLM-designated sensitive fish species such as the Yellowstone cutthroat trout.

Fish species known to occur in the planning area are adapted to a variety of stream habitats, from cold, rapid waters at higher elevations to slow, turbid waters of the high desert. Most fish populations occur in the larger rivers and their tributaries, although the WGFD stocks several waterbodies. Fish are typically classified as game or nongame and native or nonnative species. Table 3.37, "Fish Species Known to Occur in the Planning Area" (p. 348) identifies fish species known to occur in the planning area.

Table 3.37. Fish Species Known to Occur in the Planning Area

Common Name	
Burbot	Longnose Dace
Brook Trout	Longnose Sucker
Black Bullhead	Mottled Sculpin
Black Crappie	Mountain Sucker
Bluegill	Mountain Whitefish
Brown Trout	Shorthead Redhorse
Bonneville Cutthroat Trout	Plains Killifish
Channel Catfish	Rainbow Trout
Creek Chub	River Carpsucker
Carp	Sauger
Emerald Shiner	Sand Shiner
Flathead Chub	Splake
Fathead Minnow	Snake River Cutthroat Trout
Green Sunfish - Bluegill Hybrid	Stonecat
Golden Shiner	Spottail Shiner
Iowa Darter	Walleye
Johnny Darter	White Crappie
Lake Trout	White Sucker
Lake Chub	Yellow Perch
Largemouth Bass	Yellowstone Cutthroat Trout
Source: BLM 2009b	

The Big Horn and North Platte watersheds are the two major drainages in the planning area (Map 4). Fish habitat includes perennial and intermittent streams, lakes, and reservoirs that support fish through at least part of the year (Map 49). The condition of fish habitat is related to the hydrologic conditions of the upland and riparian-wetland areas associated with or contributing to a specific stream or waterbody. Aquatic habitat quality varies by location and orientation to geographic landforms and vegetation. Stream habitat conditions are closely tied

to riparian-wetland conditions and water quality. Riparian-wetland vegetation moderates water temperatures, increases bank stability, supports insects used as important food sources, filters sediment, provides in stream habitat for fish, and provides organic material for aquatic insects (see the *Riparian-Wetland Resources* section). Point source discharge, which is managed by the State of Wyoming, also has implications to fish and aquatic life. The listing of a waterbody as impaired under the Clean Water Act raises concerns for potential impacts to fish and aquatic life. Refer to the *Water* section in this chapter for information regarding water quality.

The WGFD estimates that approximately 367 miles of the 775 miles of streams that occur on BLM-administered lands support fish. The remaining stream miles either are unsuitable for fish or only support fish seasonally when conditions are suitable. The WGFD manages most of these streams for brook, brown, cutthroat, and rainbow trout species. However, there is some focus on managing several streams for native species.

Cold-water sport fisheries are dominated by trout; cool-water sport fisheries contain burbot, sauger, and walleye. The WGFD classifies cold-water sport fisheries into ribbon categories based on estimated pounds of sport fish per mile. These categories, ranging from high to low, are blue, red, yellow, or green for streams containing cold-water sport fisheries and orange for streams containing populations of cool/warm sport fish species. Of the BLM-administered stream miles that support cold-water populations, less than 1 mile in the planning area is categorized as blue ribbon; 6 miles are red ribbon; 54 miles are yellow ribbon; and 138 miles are green ribbon.

In general, cold- and cool-water sport fisheries are in decline and populations of nongame fish range from stable to declining. The Sweetwater River in Sweetwater Canyon is the highest quality fishery in the planning area. This stretch of river supports a cold-water fishery that includes brown, rainbow, brook, and cutthroat trout species and has approximately 10 miles of contiguous habitat on public land; such a stretch is rare in the planning area. This area provides excellent fishing opportunities and is a popular destination for recreationists. This stream section also has an in streamflow protection for fish and a Wyoming DEQ Class 1 water designation; such a designation is uncommon outside wilderness areas.

The Sweetwater River and its tributaries provide spawning habitat for native and nonnative fish. Most identified spawning areas are for trout species because they are the easiest to detect. Spawning areas for native nongame fish communities are largely undetermined. There are very few streams with contiguous miles of fisheries on public lands; most stream miles are on private lands, with segments on BLM-administered lands. The premier stream sections on public lands are in the Sweetwater Canyon stretch of the Sweetwater River.

There are three segments of rivers that have in streamflow protections for fish. These include 10.2 miles on the Sweetwater River below Wilson Bar, 5.2 miles on the Wind River below its confluence with Jakey's Fork, and 1.4 miles below the canyon on the Little Popo Agie River. The Wind River and Little Popo Agie River segments do not cross BLM-administered lands; however, approximately 9.8 miles of the Sweetwater River segment is on BLM-administered lands.

There are several reservoirs on BLM-administered lands capable of supporting a fishery; the WGFD stocks many of these reservoirs with game fish. Some reservoirs have been dry for a number of years and many have low and fluctuating water levels.

The WGFD stocks and manages Silver Creek and Western Nuclear Reservoirs for rainbow and brook trout and Antelope Springs and Jensen Reservoirs for rainbow trout. The WGFD has stocked Picket Lake with several species of fish in an attempt to find one that would thrive; at

present the WGFD manages Picket Lake for yellow perch. Carmody Lake is a playa that relies on snowmelt and has been dry for several years. When there is enough water to sustain a population for a year, the WGFD stocks Carmody Lake with rainbow trout. Historically, the WGFD has stocked and managed Snyder Creek Reservoir for rainbow trout; however, due to drought and the abandonment of the irrigation ditch that fed the reservoir, it has ceased to function as a fishery. The WGFD manages Spring Creek Reservoir for rainbow and brook trout, but due to low water, this reservoir has not been stocked in recent years. The WGFD used to manage Rocky Draw Reservoir for brook trout, but the reservoir has not had water in it for approximately 15 years. These reservoir fisheries do not have specific management prescriptions other than the 500-foot setback from riparian-wetland areas for permitted surface-disturbing activities.

Sauger and burbot are WGFD species of concern and are found in the planning area. Actions affecting water quality and quantity for waters in which these species occur and upstream tributaries could adversely impact spawning success and the survival of early life stages for these species. Early life stages are sensitive to environmental conditions and decreasing turbidity during spring could lead to increased predation of larval fish. These species are discussed in the *Special Status Species-Fish* section of this document.

Management Challenges for Fish

Management challenges for fish include sediment loading, drought conditions, water depletions, isolated systems, aquatic invasive species, and activities that degrade riparian-wetland areas. In addition, the BLM manages relatively little fish habitat and very few streams have contiguous miles of fish habitat on public lands in the planning area. Surface-disturbing activities can contribute sediment to spawning areas and can alter stream hydrology and degrade the stream or its water quality, which could adversely impact fish habitat, reproduction, and survival. Changes in weather patterns (e.g., drought) could contribute to changes in stream systems such as flow, temperature, and turbidity. Due to drought conditions and increased demands for water on private lands, sections of secondary streams and tributaries of primary rivers can become almost dry during late summer and early fall; which directly affects river fisheries habitat. Aquatic invasive species (e.g., zebra mussels) degrade fish habitat (see the *Invasive Species and Pest Management* section) and create management challenges to control their spread and establishment. Continuation of activities that degrade riparian-wetland areas could result in further declines in fish communities and shift streams from cold-water to cool- and warm-water fish communities dominated by nongame fish species. Irregular land ownership patterns and the inability to influence water diversions and in-streamflows limit opportunities for fish habitat improvements on BLM-administered lands.

3.4.6. Fish and Wildlife Resources – Wildlife

Wildlife resources include big game, trophy game, furbearers, predators, small game, game birds, migratory game birds, and nongame species (raptors, mammals, neotropical migrant birds, reptiles, and amphibians), and their habitats. The BLM is responsible for managing wildlife habitats, whereas management of wildlife species is overseen by state and federal wildlife management agencies. This section includes a description of the existing conditions and management challenges for habitat types and statutory wildlife groups in the planning area. See the *Special Status Species – Wildlife* section for a discussion of threatened, endangered, and BLM-designated sensitive wildlife species.

The health and viability of different types of wildlife and their habitats are connected. Though each category of wildlife is described independently in this section, these species and groups of wildlife are inherently linked by the habitat they share and the synergistic connections in ecosystem function. As a result, management that affects one species may also result in unanticipated impacts to other species.

Wildlife populations require healthy and connected habitats. Some wildlife species migrate seasonally, some species use large territories to hunt, and other species travel great distances to maintain genetic diversity in their populations. Habitat connectivity is important for wildlife to obtain food, water, and cover, for migration, and for reproduction. Each habitat type supports an assemblage of species. Wildlife species have unique inter-relationships, which link assemblages on a landscape to one another and to specific habitats within the landscape.

The wildlife section is not intended to be an encyclopedic description of all wildlife species that occur in the planning area, instead it focuses on the habitat types that occur in the planning area and the wildlife species that are typically associated with those habitat types. Some of the species may use other habitats during certain portions of year or during their life-cycles. In addition, the descriptions of the habitats for one species may apply to other species not identified. Emphasis is placed on species that are of particular interest to the public for hunting, watching, or photography, as well as species or groups of species that serve as indicators of ecosystem health or management activities.

Wildlife and Habitats in the Planning Area

There are diverse wildlife habitats in the planning area, primarily because of its location in the Southern Rocky Mountain and the Intermountain Semidesert ecoregions (Bailey 1995). Elevation in the planning area ranges from 4,750 feet to 10,400 feet, which supports a variety of habitats including coniferous forests, juniper woodlands, aspen stands, mountain shrublands, canyons and rim rock, badlands, sagebrush-steppe shrublands, grasslands, and riparian-wetland areas. This variety of habitats possesses the biological and physical attributes important for breeding, birthing, foraging, wintering, and migrating wildlife species. The habitats and wildlife in the planning area represent the Great Basin flora and fauna. For more detailed information on vegetation in the planning area, please refer to the *Vegetation – Forests, Woodlands, and Aspen Communities*, *Vegetation – Grassland and Shrubland Communities*, and *Riparian-Wetland Resources* sections of this chapter.

Grasslands, sagebrush, and mountain shrub vegetative types dominate the planning area (Table 3.33, “Acreage of Vegetative Communities in the Planning Area” (p. 329)). The open grassland, sagebrush, and shrubland vegetative types are home to many raptor species, including the Swainson’s hawk, northern harrier, and prairie falcon. These vegetative types support many other wildlife species, including small game, upland game birds, and numerous rodent species upon which raptors prey. Sagebrush provides crucial winter range for big game and habitat necessary for greater sage-grouse and other sagebrush obligate species such as the Brewer’s sparrow, sage sparrow, and sage thrasher.

Riparian-wetland communities make up less than 3 percent of the BLM-administered lands in the planning area, but these areas support the greatest diversity of plant and animal life of all habitat types. Riparian-wetland communities provide forage and cover for moose, furbearers, neotropical migrants, and amphibians, as well as corridors for wildlife migration and travel.

In the planning area, forests and woodlands are limited and are dominated by lodgepole pine, Douglas fir, limber pine, Rocky Mountain and Utah juniper, aspen, and cottonwood. Although these areas are less abundant than grasslands and shrublands, they add structural and biological diversity to the landscape. Forests and woodlands provide cover for big game and are habitats for mountain lion, black bear, blue grouse, marten, and northern goshawks.

The condition of wildlife habitat is related to management that impacts vegetation and habitat connectivity. Habitat quality varies in the planning area, with areas that do not meet PFC or the Wyoming Standards for Healthy Rangelands (Appendix J (p. 1437)) generally being less supportive of wildlife. Management that has occurred in the planning area to maintain or improve habitat for wildlife includes vegetation treatments, restrictions on surface-disturbing activities, application of mitigation measures and BMPs, fire and fuels management, limitations on motorized vehicle use, and management of livestock grazing.

There are several important features and areas in the planning area that provide habitat and survival of wildlife, including birthing and winter range habitats for big game, riparian-wetland habitats, and the Whiskey Mountain bighorn sheep area. In addition, habitat integrity, unfragmented habitat, and migration routes are important to wildlife in the planning area. Birthing and winter range habitats are typically used each year and are usually limited in size and availability. The East Fork elk winter range north of Dubois supports as many as 6,000 to 7,000 elk without the need for supplemental feeding. The Lander Slope and Red Canyon areas provide the necessary winter forage for elk and mule deer that is not available on adjacent areas due to deep snows. Green and Crooks Mountains provide year-round habitat for a predominantly non-migratory elk herd. Elk primarily summer on top and on the south slopes, and are fairly restricted to the north slopes during winter months because of snow depths. There are designated calving areas on top of Green Mountain.

Many species of wildlife depend on healthy riparian-wetland habitats to provide for their necessary forage and cover requirements. The year-round availability of clean water is essential for maintaining wildlife and fish populations. Compared to all other habitats, these areas support the greatest diversity of wildlife and plant species. Many species of birds, amphibians, reptiles, and mammals are found only in riparian-wetland habitats. Riparian-wetland areas in the South Pass, Upper Beaver Creek, and Sweetwater River Valley are important moose habitat.

The Whiskey Mountain bighorn sheep area near Dubois supports one of the largest and most visible bighorn sheep herds in North America. BLM-administered lands provide crucial winter range for bighorn sheep in this area (Map 50). The only active habitat management plan in the planning area, *A Comprehensive Bighorn Sheep Management Plan* (Bighorn Sheep Technical Committee 2006), guides the management responsibilities for the Whiskey Mountain Bighorn Sheep Winter Range to perpetuate and emphasize bighorn sheep and their habitat (Map 55).

The WGFD developed a conservation strategy, *A Comprehensive Wildlife Conservation Strategy for Wyoming* (WGFD 2005), to provide a long-range conservation plan to conserve Wyoming's Species of Greatest Conservation Need and meet the requirements of the Congressionally authorized State Wildlife Grants Program. The BLM was a partner in this effort. The species and habitats identified in the conservation strategy, along with the associated challenges and conservation actions, define the focus of cooperative efforts to conserve and manage Wyoming's wildlife.

Terrestrial vertebrate wildlife species in the planning area represent all major vertebrate classes: mammals, birds, reptiles, and amphibians. Terrestrial wildlife species are described below

under the WGFD statutory wildlife categories of big game, trophy game, furbearing animals, predatory animals, small game, game birds, migratory game birds, and nongame species (raptors, neotropical migrants, mammals, and reptiles, and amphibians). Refer to the *Special Status Species – Wildlife* section for information on wildlife species of special concern (threatened, endangered, and sensitive species).

Big Game

Big game species include pronghorn, mule deer, white-tailed deer, elk, moose, and bighorn sheep. Much of the planning area is big game habitat and because the BLM manages much of this habitat, the BLM regularly consults with the WGFD, which manages the populations. The WGFD big game herd management objectives are based on herd units. Boundaries of the herd unit areas are established to encompass all of the seasonal ranges and habitats or special life function areas (such as calving and lambing) utilized by a more or less discreet population or herd. Table 3.38, "Big Game Herd Units, Acreage, and Population Estimates in the Planning Area" (p. 353) provides information on the herd units and big game populations in the planning area.

Table 3.38. Big Game Herd Units, Acreage, and Population Estimates in the Planning Area

Herd Unit Name	Total Herd Unit Acres	Herd Unit Acres in Lander Field Office	Percent of Herd Unit in Lander Field Office	Herd Unit acres on BLM-administered Land	Percent of Herd Unit on BLM-administered Land	Herd Unit Population Objective	Herd Unit Population 2005	Herd Unit Population 2007
Pronghorn								
Badwater	648,299	407,181	63	269,915	42	3,000	3,900	3,645
Beaver Rim	2,618,700	2,422,184	92	1,590,126	61	25,000	25,900	24,504
Copper Mountain	1,458,546	14,155	1	5,419	1	4,800	5,000	5,152
North Ferris	328,978	21,968	7	10,478	3	5,000	4,800	5,200
Project	1,949,591	1,949,292	100	258	< 1	400	308	288
Rattlesnake	630,441	37,149	6	21,504	3	12,000	Unknown	Unknown
Red Desert	2,181,405	469,685	22	411,393	19	15,000	12,400	13,200
Sublette	6,850,689	87,467	1	29,080	1	48,000	49,100	62,200
Wind River	796,952	790,994	99	36,781	5	400	Unknown	627
Total		**6,200,075**		**2,374,954**				
Mule Deer								
Beaver Rim	831,894	712,714	86	547,696	66	2,600	900	1,150
Chain Lakes	699,791	22,731	3	22,089	3	500	500	480
Dubois	1,232,962	791,750	64	36,833	3	10,000	7,900	7,085
Ferris	783,489	21,965	3	10,479	1	5,000	2,700	3,288
Project	1,953,011	1,952,714	100	81	< 1	500	402	480
Rattlesnake	825,740	152,671	18	107,716	13	5,500	4,700	4,540
Southwest Bighorns	1,953,173	420,324	22	275,320	14	28,000	25,900	26,455
South Wind River	1,238,837	1,085,162	88	575,338	46	13,000	10,200	10,267
Steamboat	2,562,699	29,234	1	27,714	1	4,000	4,000	4,520*
Sublette	3,901,897	27,281	1	0	0	32,000	28,900	31,241
Sweetwater	1,015,088	987,151	97	771,693	76	6,000	5,800	5,643
Total		**6,203,697**		**2,374,959**				
White-tailed Deer								
Bighorn Basin	8,177,677	277,852	3	5,516	0	No Objective	Unknown	Unknown

Herd Unit Name	Total Herd Unit Acres	Herd Unit Acres in Lander Field Office	Percent of Herd Unit in Lander Field Office	Herd Unit acres on BLM-administered Land	Percent of Herd Unit on BLM-administered Land	Herd Unit Population Objective	Herd Unit Population 2005	Herd Unit Population 2007
Central	9,230,982	152,671	2	107,716	1	No Objective	Unknown	Unknown
Total		**430,523**		**113,232**				
Elk								
Ferris	797,724	21,991	3	10,489	1	350	500	510
Green Mountain	1,774,154	1,627,184	92	1,252,837	71	500	1,300*	Unknown
Jackson	1,119,001	24,148	2	0	0	11,000	12,500	12,881
Rattlesnake	810,866	152,564	19	107,660	13	200	Unknown	Unknown
Shamrock	699,943	22,762	3	22,119	3	75	130	120
South Bighorn	3,251,163	406,015	12	273,021	8	2,900	3,300	5,450
South Wind River	1,519,564	985,502	65	484,405	32	3,300	4,000	3,696
Steamboat	2,529,713	201,885	8	185,251	7	1,200	1,250	1,300
Green River	530,153	3,055	1	0	0	2,500	2,300	2,452
Wiggins Fork	2,771,646	2,765,470	100	36,924	1	6,000	6,000*	5,974
Total		**6,210,576**		**2,372,706**				
Moose								
Dubois	798,105	792,204	99	36,832	5	400	Unknown	Unknown
Jackson	962,708	23,975	2	0	0	3,600	1,500	1,691
Lander	2,712,810	2,095,132	77	1,367,605	50	450	327	315
Sublette	3,717,236	3,239	0	0	0	5,500	4,000	4,629
Total		**2,914,550**		**1,404,437**				
Bighorn Sheep								
Franc's Peak	1,797,318	494,160	27	17,003	1	1,360	1,400	1,386
Jackson	1,065,568	23,940	2	0	0	500	400	406
Temple Peak	770,471	511,807	66	40,040	5	250		40
Whiskey Mountain	898,151	347,238	39	8,290	1	1,350	650	681
Yount's Peak	849,174	172,297	20	53	0	900	900	923
Total		**1,549,442**		**65,386**				

Source: BLM 2009b; BLM 2009a
Note: Acreage totals may be different than other totals depicted throughout the document as a slightly different ownership layer was used to calculate the acreage.

BLM Bureau of Land Management

The planning area contains 1,055,702 acres of crucial winter range for big game, of which 605,898 acres are on BLM-administered surface. Winter is a stressful time for wild ungulates; therefore, crucial winter range is often the focus of management for big game populations. During winter months, snow depths, forage availability, and cold temperatures stress big game populations. Snow depths can impede the movement of big game and forage is limited and may be lacking nutritional elements needed by these species. These elements plus the cold temperatures cause winter to be stressful for big game and can lead to starvation. Winter ranges typically provide more food and cover during the winter months. In addition to crucial winter range, the planning area provides summer ranges and parturition areas for big game. Summer ranges provide thermal and visual cover and adequate forage, particularly for females with young. Parturition areas are important for reproductive success and this habitat is limited in the planning

area. Table 3.39, "Acres of Big Game Seasonal Habitats on BLM-administered Surface in the Planning Area" (p. 355) identifies big game seasonal habitats in the planning area. Maps 55–59 and Map 61 identify the WGFD herd units for pronghorn, mule deer, white-tailed deer, elk, moose, and bighorn sheep, respectively.

Table 3.39. Acres of Big Game Seasonal Habitats on BLM-administered Surface in the Planning Area

Seasonal Range	Pronghorn	Mule Deer	White-tailed Deer	Elk	Moose	Bighorn Sheep
Spring/ Summer/Fall	560,593	236,489	-	62,663	101,739	22,176
Yearlong	496,348	545,944	-	92,384	11,270	-
Winter/ Yearlong	906,318	427,070	-	102,541	13,200	5,704
Winter	-	843	-	48,196	17,759	-
Crucial Winter/ Yearlong	351,178	200,407		38,355	38,100	9,151
Crucial Winter	-	-	-	28,570	5,429	-
OUT[1]	59,699	963,372	114,413	1,986,068	1,214,563	38,235
Severe Winter Relief	-	-	-	13,092	-	-
No Herd Unit	-	-	2,259,725	2,262	972,072	2,298,866
Parturition Areas[2]	-	-	-	22,708	-	4,803
	-	-	-	-	-	-
Total BLM Acres	**2,374,136**	**2,374,125**	**2,374,138**	**2,374,131**	**2,374,132**	**2,374,132**

Sources: BLM 2009b; BLM 2009a

[1] These areas do not contain enough animals to be important or the habitats are of limited importance to the species.
[2] Parturition areas overlap other seasonal ranges.
Note: Acreage totals may be different than other totals depicted throughout the document as a slightly different ownership layer was used to calculate the acreage.

Several diseases, including chronic wasting disease, epizootic hemorrhagic disease, and pneumonia, are known to affect big game species, although none of these diseases is prevalent in the planning area. Chronic wasting disease is a contagious neurological disease affecting deer, elk, and moose. It causes a degeneration of the brain of the infected animal and results in emaciation, abnormal behavior, loss of bodily functions, and death. Epizootic hemorrhagic disease causes spontaneous hemorrhaging in the muscles and organs and results in death. Pneumonia, a respiratory disease, can be transmitted between domestic sheep and bighorn sheep. At present, no animals in the planning area suffer from chronic wasting disease, but the disease is spreading toward the area. Disease can impact big game populations and lead to long-term reduction in survival and recruitment resulting in stagnant or declining populations over many years.

Management challenges for big game species include poor habitat conditions, fire management, drought, increased development and urbanization, habitat fragmentation, motorized travel, disease, and the impacts of grazing on the frequency, quality, and composition of key forage species. The BLM and the WGFD continually coordinate and evaluate actions affecting herd units and habitat conditions to determine appropriate management direction.

Pronghorn

Pronghorn are a unique animal of the western plains and are the only living species in their taxonomic family (Antilocapridae). Wyoming is the center of the pronghorn's range. Pronghorn inhabit a variety of open rangeland habitat types throughout the planning area and forage primarily on shrubs, especially on sage species. Common year-round throughout the planning area, pronghorn populations are generally below levels in the mid-1980s, but have been increasing slowly over the past decade and are currently at or above objectives throughout most of the planning area.

Mule Deer

Mule deer are common year-round throughout the planning area. Mule deer use woody riparian-wetland, shrubland, juniper woodland, and aspen woodland habitat types during spring, summer, and fall. During winter, mule deer can be found in juniper and limber pine woodlands, big sagebrush/rabbitbrush, sagebrush steppe, and riparian-wetland habitat types. Mule deer populations are generally below herd unit objectives, but several herds have experienced population increases in recent years. Many factors can contribute to lower populations, including drought, historic heavy forage utilization by livestock, and habitat fragmentation. An increase in juniper establishment in many key mule deer habitats increases cover but decreases desirable browse in these areas. Declines in overall habitat quality have affected the reproduction and survival rates, resulting in less recruitment of young.

White-tailed Deer

White-tailed deer use woody riparian-wetland habitats (willow and cottonwood) along the major creeks and rivers for both forage and cover. The status of white-tailed deer is unknown, but populations are likely increasing in riparian-wetland habitats and associated agricultural fields.

Elk

Elk are common year-round throughout the planning area. In summer, elk use aspen and conifer woodlands for security and thermal cover, ranging out into upland meadows, sagebrush/mixed grass, and mountain shrub habitat types to forage. In winter, elk move to lower elevations, foraging especially in sagebrush/mixed grass and mountain shrub habitat types, especially in windswept areas where snow depth is less. Elk generally have stable to increasing populations and are at or above objective numbers for all herd units in the planning area. Elk forage on grasses, which have had fewer impacts from drought conditions than woody plants. Drought conditions have least affected elk herds that migrate from high elevation summer habitats to lower elevation winter habitats.

Moose

Moose are found primarily in the riparian-wetland habitats along the Sweetwater River, Wind River, and Popo Agie River corridors. Moose populations are stable to declining and well below historic levels and herd objective numbers. Contributing to the population decline is the poor condition of many riparian-wetland areas because of drought and historic heavy forage utilization by grazing animals. Reduced aspen, cottonwood, and willow health in riparian-wetlands and uplands also adversely impact moose. Other contributors to lower moose populations include diseases and parasites and increased mortality from vehicles, fences, and predators.

Bighorn Sheep

Bighorn sheep are present predominantly in the Whiskey Mountain and East Fork areas near Dubois, although there are small populations in the Sinks and North Fork Canyons near Lander and on Green Mountain. Bighorn sheep populations are stable and are at or near population objectives for most herd units. The Whiskey Mountain herd unit is below the population objective, but appears to be increasing. Bighorn sheep typically occur in steep, high mountain terrain. Ridges and slopes, which are normally free of snow, provide forage, while steep rims, and canyon walls provide escape cover (Bighorn Sheep Technical Committee 2006). They prefer herbaceous forage and typically use alpine slopes and meadows and mountain shrub habitat types, primarily foraging on forbs and grasses and converting to browsing on shrubs when snow depths dictate.

Trophy Game

Mountain lion and black bear are classified as trophy game animals in the planning area. Mountain lions are present in habitats with dense cover and rocky, rugged terrain habitats where deer, their primary prey, are present. Mountain lions have been observed throughout the planning area, but are mainly observed along the Wind River front, in the Dubois area, and the Bridger, Rattlesnake, and Green Mountains. Black bear are present in coniferous forests, aspen, and riparian-wetland shrub habitats, and in mountain grasslands. The planning area supports limited black bear habitat. The species is typically found along the Wind River front and in the Dubois area. Mountain lion and black bear populations are relatively stable. It is difficult to estimate the population sizes of these two species due to their secretive nature. Management challenges for trophy game include loss or alteration of habitat from surface-disturbing activities.

Furbearing Animals

Furbearing animals in the planning area include badger, beaver, bobcat, mink, muskrat, marten, and weasel. These species can be found in a variety of habitats throughout the planning area. Population estimates are available on a statewide basis. Trapping seasons have been established for most furbearers, with badgers being taken year-round; other species (e.g., bobcat, muskrat, mink, and weasel) are typically trapped in winter. Trapping dates vary for beaver and marten. Muskrat and mink are usually associated with streams, lakes, and riparian-wetland habitats. Martens inhabit coniferous forests and badgers are common throughout sagebrush/grass habitats. Beaver are common in perennial waters where willows and aspen are plentiful and can be found associated with streams of the Upper Sweetwater, Beaver Creek, and Twin Creek drainages, streams on Lander Slope (including the Popo Agie River drainages), and streams on Green Mountain. Beaver depend on aspen, willow, and cottonwood trees to build and maintain their dams and lodges.

Data on distribution of mink and muskrat populations are not available, but their populations have likely decreased due to a loss of water in some riparian-wetland systems. It is expected that beaver, mink, and muskrat populations are declining due to degraded riparian-wetland conditions and drought. Water volumes have decreased in many riparian-wetland systems from a loss of water storage capability and from a lack of precipitation. Beaver are no longer present in some streams that historically supported colonies and many beaver dams are not being maintained. Due to a drop in the water table and drier conditions at some riparian-wetland areas, conifers have invaded some riparian-wetland areas adjacent to streams. Conifers take up available water and space, both surface and subsurface, choking out aspen, willow, and cottonwood communities. The reduction in beaver populations has had an impact on the health of the riparian-wetland communities this species formerly occupied.

Drought conditions and loss and degradation of habitats, especially riparian-wetland areas, for furbearing animals present management challenges for these species.

Predatory Animals

According to Wyoming statute, predatory animals include jackrabbit, porcupine, coyote, red fox, raccoon, and skunk. These predator species are found throughout the planning area in a variety of habitats. Populations tend to fluctuate with the availability of prey species and no population estimates exist. Although classified as predators, jackrabbits typically consume grasses, sedges, forbs, and shrubs, and porcupines consume the inner bark of trees, evergreen needles and buds, leaves, small twigs, and herbs. Coyote populations are typically consistent with prey cycles. When rabbit and ground squirrel populations are high, coyote populations also tend to be high. Red fox populations appear to be expanding into new areas. Red fox typically feed on mice, insects, and plant matter in the summer and rabbits in the winter. Raccoons are omnivorous, feeding on a variety of plants and animals, particularly aquatic animals and insects. Skunks feed primarily on grasshoppers, beetles, crickets, butterfly larvae, deer mice, voles, bird eggs, berries, and fruit. It is expected that populations of skunk, raccoon, and porcupine are static to increasing. Predators are not protected by seasons or bag limits; consequently, any number of animals can be hunted or trapped at any time. USDA APHIS-Wildlife Services performs predator control on public lands with little input from the BLM. There are no specific management challenges for predatory animals in the planning area.

Small Game

Common small game species in the planning area include cottontail rabbit, snowshoe hare, and red squirrels. Cottontail rabbits and red squirrels are found throughout the planning area and snowshoe hare are found in the transition area between mountain shrub habitats and coniferous forests. These species are hunted during fall and winter. There are no estimates of population size, mortality, or natality rates for these species. Rabbit and squirrel populations are cyclic, so trends are difficult to determine. Populations generally appear to be stable. Due to the wide distribution of small game species, there are no management challenges in the planning area.

Game Birds

The *Upland Game Bird Habitat Management Plan* (BLM 1992a) provides game bird management direction for the BLM. All game bird species in Wyoming are managed for recreational use (e.g., hunting, bird watching, etc.). Upland game birds include greater sage-grouse, blue grouse, chukar partridge, gray partridge, pheasant, sandhill crane, and mourning dove. See the *Special Status Species – Wildlife* section for a discussion of greater sage-grouse. Blue grouse are found in preferred habitats on Green Mountain and on the east end of Crooks Mountain. The forest-woodland edges near South Pass, Lander Slope, and the upper Wind River Valley (Dubois) also support stands of preferred habitat and limited populations of blue and ruffed grouse. Chukar and gray partridges are found most abundantly among the rolling breaks and sparse grasslands near Lander. The highest quality habitat is in the Sheep Mountain area along Twin Creek, in and adjacent to the canyons in the Lander Slope and Red Canyon areas, and along the south slopes and drainages of the Lysite and Copper Mountains. Pheasants are limited primarily to areas near agricultural fields in the Riverton, Lander, and Shoshoni areas.

Blue and ruffed grouse habitat conditions vary from poor to excellent in different sites. In areas with established populations, chukar populations appear to fluctuate primarily with the

severity of winter conditions and weather conditions during spring nesting. There are no specific management challenges for game birds in the planning area.

Migratory Game Birds

There are many waterfowl species in the planning area, including ducks, geese, coots, snipe, and rails. The entire planning area is part of the Central Flyway (one of four major north-south routes for migratory birds, generally avoiding mountain ranges or areas with limited food availability). Natural lakes, streams, and human-made reservoirs are important resting areas for a variety of ducks, geese, and shorebirds. The abundance of waterfowl varies from year to year depending on the availability of water. Generally, waterfowl populations are stable on large waterbodies that have consistent water. All species of geese have had increasing population trends over the last 10 years (BLM 2009b). Drought has affected the availability of water in ponds, small reservoirs, and streams historically used to support broods, thereby reducing the availability of habitat.

Nongame

Nongame species include raptors, neotropical migrants, non-migratory songbirds, mammals, and reptiles and amphibians. Such species are numerous and diverse, especially given the diversity of habitats present in the planning area.

Raptors

Raptor species in the planning area include turkey vultures, osprey, red-tailed hawk, Swainson's hawk, northern harrier, Cooper's hawk, sharp-shinned hawk, rough-legged hawk, golden eagle, merlin, American kestrel, prairie falcon, and numerous owls, including great-horned, long-eared, short-eared, great gray, barn, western screech, northern pygmy, boreal, and northern saw-whet. These species are found in a variety of habitats throughout the planning area. Raptors are sensitive to environmental disturbance and occupy an ecological position at the top of the food chain; thus, they act as biological indicators of environmental quality. *Raptor Habitat Management on Public Lands* (BLM 1992b) guides management of these species. Refer to the *Special Status Species – Wildlife* section of this document for information regarding special status raptor species (e.g., bald eagle, ferruginous hawk, northern goshawk, peregrine falcon, and burrowing owl).

The nesting season is considered the most critical period in the raptor life-cycle because it determines population productivity, short-term diversity, and long-term trends. Most species have specific nest site requirements that are key factors in nest site selection and in reproductive success. These include nesting strata, available prey base, and nest site disturbance. Raptors build nests in a myriad of habitats, including steep cliffs and rock ledges, trees, and on the ground. Raptors also use human-made structures such as barns, utility poles, and tanks as nesting habitat. Golden eagles and prairie falcons usually build their nests on steep cliffs and rock ledges, but other species, such as red-tailed hawks and great-horned owls, often build on these sites. Turkey vultures will nest on cliffs, but may also use caves or hollow stumps. Golden eagle populations have increased.

Several species of raptors typically nest in trees and most known raptor nests in the planning area are located in cottonwood trees. Swainson's hawks, red-tailed hawks, American kestrels, great horned owls, and screech owls prefer the more open plains and usually nest in trees along drainages. Cooper's hawks, sharp-shinned hawks, long-eared owls, and northern saw-whet owls usually nest in lodgepole pine stands, mixed conifer forests, or aspen woodlands. Because of the

dense canopy cover, these nests are difficult to find. Consequently, intensive inventories of these species have been limited to areas targeted for habitat alteration.

Several species of raptors are ground nesters. Short-eared owls typically nest in tall grasslands with sparse sagebrush or shrubland cover. Northern harriers generally nest on the ground in riparian-wetland or marsh habitats.

Management challenges for raptors include habitat degradation and loss. Habitat management has been limited to maintaining upland range sites in satisfactory ecological condition. Range management practices that maintain ranges in good condition will provide an adequate prey base for raptor species. Raptors prey on a variety of species including small mammals, fish, and other birds; the turkey vulture feeds primarily on carrion.

Neotropical Migrants

Neotropical migrants include shorebirds, water birds, and songbirds found throughout the planning area. Every vegetative community type supports various bird species, with riparian-wetland communities having the most diverse array of species. There are no population estimates for many of these species; however, the WGFD has been conducting breeding bird surveys that provide limited information. The *Nongame Migratory Bird Habitat Conservation Plan* (BLM 1992c) and the *Wyoming Partners in Flight Wyoming Bird Conservation Plan* (Cerovski et al. 2001) guide management of neotropical migrants in the planning area.

Audubon Wyoming established four Important Bird Areas (IBAs) in the planning area. These areas provide essential habitat for one or more bird species. The areas include Ninemile Draw, Red Canyon Ranch, Red Desert, and the Sweetwater River Project. The Ninemile Draw and Red Desert IBAs identify habitats for sagebrush-obligate species and the Red Canyon Ranch and Sweetwater River Project IBAs focus on habitats for riparian-wetland migrants.

Species that depend on woody plant communities are generally declining in numbers due to declines in habitat quality and quantity. Species that require herbaceous plants for forage and cover have stable to increasing populations. Due to the declining condition of many riparian-wetland areas, species that depend on these areas for all or part of their life-cycle likely have been impacted. Populations of sagebrush obligate species are declining. Juniper obligate species have generally seen stable to upward trends based on the increase in amount of juniper present throughout the planning area. Management challenges include maintaining the habitat types upon which these species depend.

Mammals

Nongame mammals include species such as mice, rats, voles, ground squirrels, shrews, bats, and prairie dogs, which are found in a variety of habitats throughout the planning area. Bat surveys have been conducted in suitable caves and mines. There are several known maternity roosts and hibernacula identified in the planning area, primarily the historic mines in South Pass and the Copper Mountains. No estimates of population size are available for any of these nongame mammal species. Refer to the *Atlas of Birds, Mammals, Amphibians, and Reptiles in Wyoming* (Cerovski et al. 2004) for complete habitat descriptions and distribution of nongame mammals.

Nongame mammals play an important role as prey species for many other wildlife. Large carnivores, raptors, and other predatory animals rely on nongame mammals as a food source. As

nongame mammal populations fluctuate, so may the populations of the predators that prey on them.

Nongame mammal species that depend on woody plant communities are generally declining in numbers due to declines in habitat quality and quantity. Species that require herbaceous plants for forage and cover have stable to increasing populations. There is no or very little population data for many of these species, so trends cannot be determined. Management challenges include the lack of population data for these species, and maintaining or enhancing the presence of these species and the habitats upon which they depend.

Reptiles/Amphibians

Reptile species in the planning area include greater short-horned lizard, northern sagebrush lizard, eastern yellow-bellied racer, bullsnake, intermountain wandering garter snake, and prairie rattlesnake. These species are found throughout the planning area, but typically occur in the more arid shrub-steppe and grassland habitats. The lizard species feed on ants, beetles, grasshoppers, and other insects. The snake species feed on insects, small mammals, frogs, and fish. The greater short-horned lizard, intermountain wandering gartersnake, and prairie rattlesnake bear live young, while the other reptiles listed lay eggs. There are no estimates of population size for any of these species. However, it is likely that populations trend downward due to the overall increase in habitat alteration and loss.

Amphibian species in the planning area include tiger salamander, plains spadefoot toad, and boreal chorus frog. These species are typically found in riparian-wetland areas. Tiger salamanders occur in most habitats with non-flowing water nearby and overwinter in suitable moist habitat including rodent burrows and cellars. The plains spadefoot toad occurs in grassland and shrubland areas and excavates a deep burrow in winter. The boreal chorus frog occurs in marshes, ponds, and small lakes. Amphibians deposit eggs in lakes, reservoirs, marshes, bogs, rain pools, and flooded areas. Tiger salamander newts remain in water for two months to two years before metamorphosis occurs. Plains spadefoot tadpoles complete metamorphosis in 36 to 40 days, while boreal chorus frogs complete metamorphosis in approximately 60 days. There are no estimates of population size for any of these species. The declining condition of many riparian-wetland areas, combined with drought, has adversely impacted amphibian populations and populations are likely on a downward trend. Management challenges include maintaining a variety of habitat types and components in proximity to provide for the requirements of reptiles and amphibians.

Special Status Species – Introduction

Several policies and agreements guide management of special status species and their habitats in the planning area. In March 1990, the WGFD and the BLM signed an MOU with the purpose of strengthening the cooperative approach to the management of wildlife and wildlife habitat on public land between the two agencies and to encourage them to work together to develop, enhance, maintain, and manage wildlife resources, including planning and sharing data concerning biological resources.

The BLM prepares the Wyoming Sensitive Species Policy and List (BLM 2010c) to focus species management efforts toward maintaining habitats for these species. The goals of this policy include:

- Maintaining vulnerable species and habitat components in functional BLM ecosystems

- Ensuring special status species are considered in land management decisions
- Preventing a need for species listing under the ESA
- Prioritizing needed conservation work with an emphasis on habitat

BLM Manual 6840, Special Status Species Management, establishes policy for management of species listed or proposed for listing pursuant to the ESA and BLM sensitive species on BLM-administered lands. The goals and objectives of this policy are to (1) conserve listed species and the ecosystems on which they depend and (2) ensure that actions requiring BLM authorization or approval are consistent with the conservation needs of special status species and do not contribute to the need to list special status species either under the provisions of the ESA or BLM Manual 6840. In addition, management actions for federally listed species are often derived through the consultation process (Section 7 of the ESA).

The USFWS provides regulatory oversight for all species that are listed, proposed for listing, or are candidates for listing under the ESA. The USFWS also administers designation of critical habitat for listed species and the MBTA, which protects migratory bird species whether they are hunted (e.g., waterfowl) or not (e.g., songbirds). In accordance with the ESA, the USFWS oversees the management of federally listed species and the designation of critical habitats. Any action a federal agency proposes that (1) could adversely impact a federally listed species or (2) will result in jeopardy or adverse modification of critical habitats requires formal consultation. Any action a federal agency proposes that (1) could affect – not likely to adversely affect or (2) could affect – could have beneficial impacts to a federally listed species requires informal consultation.

The BLM is responsible for managing habitat; state and federal wildlife management agencies oversee the management of special status wildlife and fish species. The WGFD has developed a list of species of greatest conservation need for Wyoming. Information regarding these species can be found on the WGFD website (http://gf.state.wy.us/index.asp).

The Wyoming BLM mitigation guidelines for surface-disturbing and disruptive activities include wildlife mitigation guidelines (Appendix M (p. 1489)). These guidelines identify seasonal restrictions on surface disturbance that have the potential to affect special status species habitat, such as greater sage-grouse habitat.

Standard 4 of the Wyoming Standards for Healthy Rangelands ensures that habitats that support or could support threatened, endangered, and BLM-designated special status species will be maintained or enhanced. Indicators that are used to assess standard 4 include the presence of invasive plant species, species diversity, age class distribution, population trends, habitat fragmentation, and other indicators associated with upland and riparian-wetland standards (Appendix J (p. 1437)).

In the planning area, the BLM determines the presence of special status species on a case-by-case basis. In addition, the BLM relies on the Wyoming Natural Diversity Database inventory and modeling to determine the presence of special status species. The Wyoming Natural Diversity Database maintains a list of Wyoming species of special concern and provides information on global and state abundance, legal status, and state distribution. Species in Wyoming are considered to be of special concern if (1) the species is vulnerable to extinction at the global or state level due to inherent rarity, (2) the species has experienced a substantial loss of habitat, or (3) the species is sensitive to human-caused mortality or habitat disturbances.

Special status plants, fish, and wildlife species considered in this analysis are those listed as threatened or endangered under the ESA, those proposed for listing or are candidates for listing under the provisions of the ESA, or those designated by the BLM State Director or the State of Wyoming as sensitive (BLM sensitive species).

3.4.7. Special Status Species – Plants

The BLM is responsible for managing habitat for special status plant species. The planning area contains potential habitat for 14 special status plant species. One species is listed as endangered, two species are listed as threatened, and 11 species are on the BLM sensitive species list. Table 3.40, "Special Status Plants in the Planning Area" (p. 363) identifies these special status plant species. There is designated critical habitat for one species (desert yellowhead) in the planning area.

Table 3.40. Special Status Plants in the Planning Area

Common Name	Status
Blowout penstemon	Endangered
Desert yellowhead[1]	Threatened
Ute ladies'-tresses	Threatened
Barneby's clover	BLM Sensitive
Beaver Rim phlox	BLM Sensitive
Cedar Rim thistle	BLM Sensitive
Dubois milkvetch	BLM Sensitive
Fremont bladderpod	BLM Sensitive
Limber pine	BLM Sensitive
Meadow pussytoes	BLM Sensitive
Owl Creek miner's candle	BLM Sensitive
Persistent sepal yellowcress	BLM Sensitive
Porter's sagebrush	BLM Sensitive
Rocky Mountain twinpod	BLM Sensitive

Source: BLM 2010c
[1] There is designated critical habitat for this species in the planning area.

BLM Bureau of Land Management

The various climates, topography, soils, rock cliffs, and outcrops provide a diverse landscape in the planning area for special status plant species. These species can be found in grassland and shrubland communities, riparian-wetland and wetland habitats, and other habitats, including rocky outcrops and badlands. Due in large part to their rarity and lack of comprehensive inventories, precise information regarding the location, population size, and condition of each population in the planning area is relatively unknown. A brief description of each of the 14 special status plant species follows. Unless otherwise noted, there is no specific information on trends and occurrences for each of the species.

Blowout Penstemon

Blowout penstemon is listed as an endangered species. No blowout penstemon populations have been identified in the planning area; however, this species does occur in the neighboring BLM Rawlins planning area. This member of the figwort family takes its name from its typical type of habitat; a "blowout" depression is a sparsely vegetated area in sand dunes caused by wind erosion. Blowout penstemon is found primarily on the rim and lee slopes of blowouts, and associated steep slopes deposited at the base of foothills. This species occurs at elevations of 5,860 to 7,440 feet

(Heidel 2008). There is potential habitat for blowout penstemon south of Green Mountain in the planning area. Threats to this species might include habitat loss and degradation from sand mining, water development, energy development, motorized travel and associated destabilization, or spread of invasive species (Heidel 2008).

Desert Yellowhead

Desert yellowhead, listed as a threatened species, occurs in the planning area. The planning area contains the only known populations and designated critical habitat for desert yellowhead in the world. The initial population was discovered in 1990 and occurs in an area of approximately 8 acres that appears to be associated with a specific geologic formation. The plant occurs in sparsely vegetated cushion plant communities on low slopes, rim margins, colluvial fans, and bottoms in deflation hollows (Fertig and Heidel 2002). The USFWS has designated critical habitat for this population; the area is closed to vehicle traffic and withdrawn from locatable mineral exploration and development (Map 67). In 2010, a new population was discovered approximately 4 miles northeast of the original population. Plants in this population constitute approximately 1 acre that are scattered on escarpment slopes, generally south-facing, and on gravelly silt loam derived from the White River Formation. The two populations vary in the geology and vegetative composition of the sites. The second site is not included within the critical habitat boundary. Conservation measures have been developed as part of the Biological Assessment and the USFWS is working on a recovery plan for the species.

Ute Ladies'-tresses

Ute ladies'-tresses is listed as a threatened species. Ute ladies'-tresses is found on moist peat, sand, silt, or gravel soils near wet meadows, springs, lakes, ponds, or perennial streams. No Ute ladies'-tresses have been identified in the planning area; however, there is potential habitat for this species. Ute ladies'-tresses is known to occur in the neighboring BLM Rawlins planning area. Threats to this species include energy development, subdivision development, invasive plant species, and water developments (Heidel 2007).

Barneby's Clover

Barneby's clover is a BLM sensitive species. A local endemic known only from the southeastern foothills of the Wind River Range and southern Beaver Rim, this plant occurs on ledges, crevices, and seams on reddish-cream Nugget Sandstone outcrops at 5,600 to 6,700 feet elevation predominantly in the Red Canyon area. Threats such as livestock grazing are very low due to the plant's largely inaccessible habitat. Herbivory by rabbits, rodents, and insects may occur, but would not be considered threatening to this species. Barneby's clover may be displaced in advanced succession or die back in drought (Heidel 2009a).

Beaver Rim Phlox

Beaver Rim phlox is a BLM sensitive species. Endemic to the Wind River Basin, this plant occurs on sparsely vegetated slopes on sandstone, siltstone, or limestone substrates at 6,000 to 7,400 feet elevation. Potential threats include surface disturbance associated with oil and gas development, and road, pipeline, pump station, and transmission line construction (Heidel 2009b).

Cedar Rim Thistle

Cedar Rim thistle is a BLM sensitive species. Known from several sites in a number of Wyoming counties, this species prefers barren, chalky hills, gravelly slopes, and fine textured, sandy-shaley

draws at 6,700 to 7,200 feet elevation. Threats to Cedar Rim thistle include herbicide treatment or release of biocontrol insects intended to control other thistle species and soil erosion or displacement of plants by OHVs (Fertig 2000a).

Dubois Milkvetch

Dubois milkvetch is a BLM sensitive species. Known only in the area around Dubois, this species occurs near barren shale, limestone, or redbed badlands, on slopes and ridges from 6,900 to 8,800 feet in elevation. Potential threats to this species include soil erosion and compaction by OHVs and urban expansion in the Dubois area (Fertig 2000b).

Fremont Bladderpod

Fremont bladderpod is a BLM sensitive species. Endemic to the east slope of the Wind River Range, this sensitive species can be found on rocky limestone slopes and ridges at 7,000 to 9,000 feet elevation. Potential threats to this species include limestone quarrying and road construction (Fertig 2000c).

Limber Pine

Limber pine is a BLM sensitive species. This plant occurs at timberline and at lower elevations with sagebrush. Associated species are Rocky Mountain lodgepole pine, Engelmann spruce, whitebark pine, Rock Mountain Douglas fir, subalpine fir, Rocky Mountain juniper, mountain mahogany, and common juniper. Potential threats include blister rust, mountain pine beetle, and climate change.

Meadow Pussytoes

Meadow pussytoes is a BLM sensitive species. This plant species occurs in moist, hummocky meadows, near seeps or springs surrounded by sagebrush/grasslands at 4,950 to 7,900 feet elevation. Potential threats to this species include trampling by OHVs, mineral development, and water projects (Fertig 2000d).

Owl Creek Miner's Candle

Owl Creek miner's candle is a BLM sensitive species. Considered endemic to the Owl Creek and Bridger Mountains and northern Wind River Basin, this species occurs on sandy-gravelly slopes and desert ridges on Wind River formation sandstones at 4,700 to 6,000 feet elevation. Threats to this species are low due to its habitat being inaccessible; however, this small natural range of this species makes it vulnerable to extirpation from natural events (Fertig 2000e).

Persistent Sepal Yellowcress

Persistent sepal yellowcress is a BLM sensitive species. This riparian-wetland species occurs along riverbanks and shorelines, usually on sandy soils near the high water line at 3,660 to 6,800 feet elevation. This species is generally protected by a prohibition on disturbance or development within 500 feet of riparian-wetland areas. Threats to this species include changes in water management that reduce the periodicity of flooding, competition from invasive species, herbicide spraying, trampling by livestock, recreation activities, and coal mining (Handley and Heidel 2008).

Porter's Sagebrush

Porter's sagebrush is a BLM sensitive species. This sensitive plant inhabits sparsely vegetated badlands of ashy or tufaceous mudstone and clay slopes at 5,300 to 6,500 feet elevation. Although computer modeling suggests that there might be suitable habitat for this species across much of the planning area, the species has primarily been found in the Sand Draw and Lysite areas of the planning area. Threats to this species include habitat modification due to oil and gas development, road building, and vehicle disturbance (Fertig 2000f).

Rocky Mountain Twinpod

Rocky Mountain twinpod is a BLM sensitive species. Known from a number of locations in Wyoming, mostly in Fremont and Hot Springs Counties, this species occurs on sparsely vegetated rocky slopes of limestone, sandstone, or clay at 5,600 to 8,300 feet elevation. Potential threats to this species include road construction, pipeline construction, and OHV use (Fertig and Mills 2000).

Management Challenges for Special Status Species – Plants

The special status plant species described above are difficult to survey except during their flowering periods and might be disturbed by activities (e.g., grazing, motorized travel, and energy development) proposed or permitted during other seasons of the year. Management challenges for special status plant species include declining populations for select species; drought and other natural events; the spread of invasive species; maintaining PFC for riparian-wetland habitats; vegetation treatment with prescribed fire or herbicides; lack of periodic disturbance events (e.g., fire and flood); physical trampling (e.g., OHV use); loss of habitat resulting from altered hydrology; and challenges presented by special status plant populations occurring over multiple land ownerships. While threats to some species may remain low due to the remoteness of habitat, threats to other species could increase despite distance or restricted access. The BLM requires surveys for special status plants prior to authorizing surface disturbance on site-specific locations. The population of desert yellowhead is protected with a motor vehicle closure and mineral withdrawal.

3.4.8. Special Status Species – Fish

Fish habitats in the planning area include perennial and intermittent streams that support fish through at least part of the year. The Wind River and North Platte watersheds are the two major drainages in the planning area. The condition of fish habitat is related to hydrologic conditions of the upland and riparian-wetland areas associated with or contributing to a specific stream or waterbody. Aquatic habitat quality varies by location and orientation to geographic landforms and vegetation. Refer to the *Fish and Wildlife Resources – Fish* section of this document for more information about fish habitat in the planning area.

No federally listed fish species are known to occur in the planning area. The Yellowstone cutthroat trout is the only BLM sensitive fish species and only native trout in the planning area. This species is found in the Wind River drainage near Dubois. This drainage lies in the southern extent of the Yellowstone ecosystem. The species is found in relatively clear, cold streams such as the East Fork of the Wind River and its tributaries.

Sauger and burbot are WGFD species of concern and are found in the planning area. Actions affecting water quality and quantity for waters in which these species occur and upstream tributaries could adversely impact spawning success and the survival of early life stages for these

species. Early life stages are sensitive to environmental conditions and decreasing turbidity during spring could lead to increased predation of larval fish.

Sauger are present in the Wind River, Little Wind River, Popo Agie River, Little Popo Agie River, and Boysen Reservoir. Core spawning areas for sauger are in the Little Wind River downstream of the confluence with Beaver Creek and in the Popo Agie River upstream of its confluence with the Little Wind River. Lower Beaver Creek is ephemeral, which results in turbid spring flushes. Actions that could cause a shift toward perennial flow in Beaver Creek could result in clearer discharge and would be undesirable. Actions affecting water quantity and quality in the lower reaches of Beaver Creek could affect spawning success for sauger.

Burbot are present in Torrey Creek, Wind River, Popo Agie River, and Boysen Reservoir. Burbot spawn in January and February and prefer clear water. Threats that could affect spawning success for burbot would be activities that increase warm water or increase turbidity and sedimentation during late fall and winter.

In addition, the Sweetwater River drainage in the planning area is part of the North Platte system, which is subject to water depletion limitations to protect threatened and endangered species, including special status fish species, downstream and outside the planning area. Water depletions upstream can change the velocity, volume, and timing of downstream river water flows. Water development projects (e.g., dams, reservoirs, water and sediment control basins, irrigation diversions, sand and gravel mining, and wetland creation) have altered historic surface water hydrographs (e.g., water flow timing, volume, and velocity) in the North Platte River ecosystem through consumption and evaporation. The BLM consults with the USFWS for activities that might result in water depletions occurring in the Sweetwater River watershed.

Management Challenges for Special Status Species – Fish

Management challenges for the Yellowstone cutthroat trout include drought and other natural events, low water flows, sediment loading, declining population trends, and maintaining habitat for this species. Drought conditions have affected the volume of water available in streams that support Yellowstone cutthroat trout and have generally led to declines in the population. Low water flows can affect the timing and success of spawning efforts and lead to reduced reproduction rates. Some streams have experienced a loss in the number of deep pools needed to over-winter fish. In recent years, high water runoff that flushes sediment out of the deep pools and cleans spawning beds has been lacking. As the danger of wildfire increases, the likelihood of habitat degradation from the use of fire retardants also increases. Although there are no management protections specific for this species, Yellowstone cutthroat trout could be afforded some protection from sediment loading through the restriction of surface-disturbing activities within 500 feet of riparian-wetland areas.

Surface-disturbing activities can contribute sediment to spawning areas and can alter stream hydrology and degrade the stream or its water quality, which could adversely impact sauger and burbot habitat, reproduction, and survival. Changes in weather patterns (e.g., drought) could contribute to changes in stream systems such as flow, temperature, and turbidity. Discharge of CBNG produced water that would substantially alter temperature and/or turbidity of receiving waters could adversely impact the survival and reproductive potential of sauger in some systems.

3.4.9. Special Status Species – Wildlife

One endangered wildlife species (black-footed ferret), two threatened wildlife species (grizzly bear and Canada lynx), one proposed threatened species (mountain plover), one candidate species (greater sage-grouse), and one non-essential, experimental species (gray wolf) are known to occur in the planning area. Twenty-three additional BLM sensitive species are known to occur or have potential habitat in the planning area. Table 3.41, "Special Status Wildlife Known to Occur in Suitable Habitat" (p. 368) and the discussion of special status wildlife species in this section are organized by the applicable Wyoming statutory categories identified in the *Fish and Wildlife Resources – Wildlife* section. There is critical habitat for Canada lynx in the planning area; however, the critical habitat is on USFS-managed land, not BLM-administered land. Map 66 identifies Canada lynx analysis units in the planning area; Governor's greater sage-grouse Core Area and greater sage-grouse leks are displayed on Map 63.

Table 3.41. Special Status Wildlife Known to Occur in Suitable Habitat

Wyoming Statutory Wildlife Category	Common Name	Status
Trophy Game	Grizzly bear	Threatened
Predatory Animals	Gray wolf	Non-essential, Experimental
Game Birds	Trumpeter swan	BLM Sensitive
	Greater sage-grouse	Candidate BLM Sensitive
Nongame Raptors	Bald eagle	BLM Sensitive
	Northern goshawk	BLM Sensitive
	Ferruginous hawk	BLM Sensitive
	Peregrine falcon	BLM Sensitive
	Burrowing owl	BLM Sensitive
Nongame Neotropical Migrants	White-faced ibis	BLM Sensitive
	Mountain plover	Proposed Threatened BLM Sensitive
	Long-billed curlew	BLM Sensitive
	Yellow-billed cuckoo	BLM Sensitive
	Sage thrasher	BLM Sensitive
	Loggerhead shrike	BLM Sensitive
	Brewer's sparrow	BLM Sensitive
	Sage sparrow	BLM Sensitive
Nongame Mammals	Canada lynx	Threatened
	Black-footed ferret	Endangered
	Long-eared myotis	BLM Sensitive
	Spotted bat	BLM Sensitive
	Townsend's big-eared bat	BLM Sensitive
	Pygmy rabbit	BLM Sensitive
	White-tailed prairie dog	BLM Sensitive
	Swift fox	BLM Sensitive
Nongame Amphibians	Northern leopard frog	BLM Sensitive
	Great Basin spadefoot toad	BLM Sensitive
	Boreal toad	BLM Sensitive
	Spotted frog	BLM Sensitive

Sources: USFWS 2008a; BLM 2010c

BLM Bureau of Land Management

Special status wildlife species in the planning area occupy a variety of habitat types, including sagebrush shrublands, grasslands, and riparian-wetland and wetland habitats. There are no comprehensive data on population numbers and distribution in the planning area for most special status species. Unless otherwise noted, specific information on distribution and occurrences for each of the species is not available. The BLM consults with the USFWS before implementing any project that might impact federally listed species or their habitats. Measures to protect special status wildlife species are noted below, as applicable.

Trophy Game

The grizzly bear, a threatened species, is the only trophy game animal known to occur in the planning area. The USFWS delisted the grizzly bear in April 2007, but a court decision vacated the delisting rule and the species was relisted in September 2009. The grizzly bear can be present in dense forests to sub-alpine meadows and arctic tundra. Grizzly bear encounters with domestic livestock have been recorded in the Dubois area. Grizzly bears have expanded their range due in part to increasing population numbers resulting from protections for this species. In addition, during drought years, forage shortages have caused individual grizzly bears to range farther in search of adequate food supplies. Threats to the grizzly bear include loss and fragmentation of habitat, conflicts between grizzly bears and recreationists, and conflicts between grizzly bears and livestock. These conflicts typically result in the removal or death of the bear.

Furbearing Animals

No furbearing special status species are known to occur in the planning area.

Predatory Animals

The gray wolf is listed by the USFWS as an experimental population, non-essential, and this species primarily inhabits forested areas. Wolves were reintroduced to the Greater Yellowstone region in 1994 and the reintroduction has been successful in establishing a wide-ranging population with many packs in northwestern Wyoming. At present, the WGFD classifies gray wolves as predatory animals (Cerovski et al. 2004). Gray wolves could be classified as trophy game animals in the northwestern part of the planning area near Dubois if they are delisted from the ESA. Outside of this area, gray wolves would be classified as predatory animals and managed as furbearers. Gray wolves are known to occur in the northwestern corner of the planning area and are believed to occur elsewhere in the planning area. Threats to gray wolves include conflicts between gray wolves and livestock, conflicts between gray wolves and humans, and habitat loss and fragmentation.

Game Birds

Two special status game birds, the trumpeter swan and the greater sage-grouse, occur in the planning area. In March 2010, the USFWS designated the greater sage-grouse as a candidate species for listing. Both species are BLM sensitive species.

The trumpeter swan is generally associated with larger waterbodies such as lakes and rivers. In the planning area, most observations of trumpeter swans have been along the Sweetwater and Wind Rivers.

The greater sage-grouse is the most common and widespread game bird in the planning area and occurs in sagebrush habitats. There are 232 documented strutting grounds (leks) in the planning area, of which 224 are occupied and eight are unoccupied. Of the occupied leks, 126 are

on BLM-administered land, 50 are on the WRIR, 29 are on private land, 14 are on state land, and five are on Bureau of Reclamation land.

The planning area has been identified as supporting some of the best greater sage-grouse habitat in Wyoming and throughout the species range (Connelly et al. 2004). Of particular importance is the area between the Hudson and the Sweetwater River, which contains important breeding, nesting, brood-rearing, and winter habitats. The area is mostly undeveloped; thus habitats are mainly intact and not fragmented. The Audubon Wyoming designated the Ninemile Draw area south of Hudson as an IBA for greater sage-grouse. The area has been identified as a greater sage-grouse stronghold for breeding populations in western North America and contributes to the conservation of the species. The governor of Wyoming issued an Executive Order 2008-2 for increased protection of greater sage-grouse. This executive order delineated Core Area in the state, including the planning area, and restricted human activities in certain areas. Map 63 identifies the greater sage-grouse leks and the Governor's Core Area in the planning area. Governor's greater sage-grouse Core Area cover 2,664,509 acres (all ownership types) in the planning area.

Greater sage-grouse populations have been declining across the western United States, prompting several petitions to list them as threatened under the ESA. In March 2010, the USFWS announced its 12-month finding that listing of the greater sage-grouse is "warranted but precluded." Thus, the species is designated as a candidate for listing with the USFWS and will be reviewed annually to determine if the listing status should be changed. As identified in the USFWS 2010 finding, the greater sage-grouse population in the planning area is part of Management Zone II, one of seven Management Zones for greater sage-grouse delineated by the Western Association of Fish and Wildlife Agencies based upon ecological and biological attributes, which includes sage-grouse populations throughout the Wyoming Basin (USFWS 2010). Threats to greater sage-grouse in Management Zone II are discussed at length in the USFWS finding and would apply to the planning area.

Greater sage-grouse population levels throughout the planning area plummeted during the 1990s and then experienced a resurgence in the 2000s. This resurgence is thought to be related to precipitation events that promoted grass growth, thus aiding survival of young. Populations in areas of extensive energy development, including fields near Lysite, Moneta, and below Beaver Rim in the Wind River Basin, have not seen the same degrees of growth as other parts of the planning area.

At present, human-caused disturbance is seasonally restricted within 2 miles of greater sage-grouse strutting grounds to mitigate impacts to breeding and nesting. Additionally, NSO restrictions apply within a quarter-mile of an occupied lek. Based on recent research suggesting the current protective buffers do not provide adequate protection for nesting greater sage-grouse, and that greater sage-grouse tend to avoid nesting near vertical structures (e.g., overhead utility lines, and wind turbines), the BLM is considering extensive modifications to greater sage-grouse protections nationwide. Threats to greater sage-grouse include degradation, loss, and fragmentation of habitat, predation, West Nile virus, and human disturbance during sensitive periods.

Nongame (Raptors)

The bald eagle, northern goshawk, ferruginous hawk, peregrine falcon, and burrowing owl are BLM sensitive raptor species known to occur in the planning area. All raptors are protected under the MBTA, as are most avian species. For all raptor species, seasonal BLM stipulations that limit human-related activities near nests have been applied to surface-disturbing activities such as ROWs and oil and gas development. "Raptor-proofing" of electrical transmission facilities

is required to prevent electrocution of raptors. Threats to special status raptor species include human disturbance during sensitive periods and loss of habitat.

Bald eagle

The bald eagle inhabits large bodies of open water, including lakes, marshes, and rivers, where there is an abundance of tall trees to roost and fish to eat. Along the Middle and Little Popo Agie Rivers and the Wind River, winter sightings of bald eagles have occurred since as early as 1974. At present, there are no known nests on BLM-administered lands; however, there is one nest on USFS-managed land in the planning area. Identified active bald eagle nests and winter roost sites are protected from disturbance within a half-mile of the nest or site. A seasonal protection from disturbing activities is applied from February 1 through August 15 for active nests and from November 1 through April 1 for identified winter roosting areas. Additional restrictions on disturbance within suitable habitat may apply.

Northern goshawk

The northern goshawk is found in coniferous forests, especially Douglas fir, lodgepole pine, and aspen (Cerovski et al. 2004). The northern goshawk forages in a variety of habitats. There is suitable habitat for the northern goshawk primarily on Green Mountain and Lander Slope. Nests have been documented on Green Mountain.

Ferruginous hawk

The ferruginous hawk occurs in basin-prairie shrublands and mountain-foothills grasslands and usually nests on rock outcrops, tall sagebrush, or in trees. Nests have been documented throughout the planning area. Ferruginous hawk populations maybe declining; many previously active nests have been unoccupied in recent years.

Peregrine falcon

Peregrine falcons nest on tall cliffs and prey mainly on other bird species. Suitable habitat for peregrine falcons in the planning area includes the steep canyons along the Lander Slope and sites near Warm Springs Canyon and Arrow Mountain; they have also been documented in the Dubois area.

Burrowing owl

Burrowing owls are found in grasslands and basin-prairie shrublands. This species uses burrows built by other animals such as prairie dogs for nesting and roosting. Burrowing owls can be found in suitable habitat throughout the planning area.

Nongame (Neotropical Migrants)

There are eight BLM sensitive neotropical migrants in the planning area: white-faced ibis, long-billed curlew, yellow-billed cuckoo, sage thrasher, loggerhead shrike, Brewer's sparrow, sage sparrow, and mountain plover; the mountain plover is also a proposed threatened species under the ESA. These species occur in a variety of habitats throughout the planning area. The MBTA protects all of these species. Any additional protections are noted below for specific species. Threats to special status neotropical migrants include degradation, fragmentation, and loss of habitat.

White-faced ibis

This species is generally associated with marshlands and has been observed in suitable habitats in the planning area.

Mountain plover

This species is generally found in habitats with little or no vegetation structure, such as grasslands, alkali flats, or low shrubs (e.g., saltbush). Mountain plovers may nest on sites where vegetation is sparse to bare or closely cropped. This species is protected from disturbance during its nesting period (April 10 to July 10). Mountain plover habitat is found throughout the planning area but the most extensive habitat is located in the northeast part of the planning area in the Shoshoni-Moneta-Lysite areas. The species is on the BLM sensitive species list and is a proposed threatened species under the ESA.

Long-billed curlew

The long billed curlew is associated with wetlands, but may nest in dry meadows. This species has been observed in suitable habitats in the planning area.

Yellow-billed cuckoo

The yellow-billed cuckoo is associated with wooded riparian-wetland habitats. There are no occupied habitats for the yellow-billed cuckoo identified in the planning area.

Sage thrasher, loggerhead shrike, Brewer's sparrow, and sage sparrow

These species are associated with sagebrush-steppe or shrubland habitats and can be found throughout the planning area in suitable habitat. Threats to these species are similar to threats for the greater sage-grouse due to occupying similar habitats.

Nongame (Mammals)

There are eight nongame special status mammal species in or with potential habit in the planning area: black-footed ferret (endangered), Canada lynx (threatened), long-eared myotis (BLM sensitive), spotted bat (BLM sensitive), Townsend's big-eared bat (BLM sensitive), pygmy rabbit (BLM sensitive), white-tailed prairie dog (BLM sensitive), and swift fox (BLM sensitive). These species occupy a variety of habitats in the planning area. The BLM consults with the USFWS on all proposed activities that could impact threatened and endangered species. Unless otherwise noted below, there are no specific protection measures for these species. Threats to special status nongame mammals include human disturbance, pesticides that reduce the insect prey base, and degradation, loss, and fragmentation of habitat.

Canada lynx

Canada lynx occur in dense coniferous forests at high elevations. Canada lynx have not been documented on BLM-administered land in the planning area; however, there are five lynx analysis units adjacent to larger tracts of USFS-managed land in the northwestern part of the planning area (Map 66).

Black-footed ferret

The black-footed ferret is found in association with prairie dog colonies in basin-prairie shrublands, sagebrush-grasslands, and foothills grasslands. Prairie dogs constitute the main prey source for black-footed ferrets. Although historically distributed throughout much of Wyoming,

the only black-footed ferrets now in the state are in the Shirley Basin/Medicine Bow Management Area in Laramie (outside the planning area). These animals are a reintroduced, experimental population of descendents of the last wild ferrets trapped near Meeteetse in 1981. The only part of the planning area with potential to reintroduce black-footed ferrets is the Pathfinder White-tailed Prairie Dog Complex at the junction of Fremont, Natrona, and Carbon Counties. This area is proposed as an ACEC for protection of the black-footed ferret.

Declines in prairie dog populations, conversion of grasslands to agricultural uses, and prairie dog eradication are tied to the decline of black-footed ferret populations.

Long-eared myotis

The long-eared myotis seasonally inhabits coniferous forests and woodlands and forages over water in these habitats, primarily feeding on beetles and moths. The long-eared myotis is sensitive to human disturbance during hibernation. Habitat alteration, modification or loss of roosting habitat, and toxic chemicals are threats to bat species.

Spotted bat

The spotted bat is known to seasonally roost in cliff crevices near perennial water. The spotted bat is sensitive to human disturbance during hibernation. Habitat alteration, modification or loss of roosting habitat, and toxic chemicals are threats to bat species.

Townsend's big-eared bat

This species requires caves or mineshafts throughout its life-cycle. Suitable habitat in the planning area is limited to abandoned mineshafts. Many mineshafts and adits that support bats have been fitted with "bat grates" that allow use by bats but prevent human entry. The Townsend's big-eared bat is sensitive to human disturbance during hibernation. Habitat alteration, modification or loss of roosting habitat, and toxic chemicals are threats to bat species.

Pygmy rabbit

The pygmy rabbit inhabits dense, tall stands of sagebrush in deep soil. This species has been observed in the southern part of the planning area. Because pygmy rabbits do not venture far from these habitats, projects that remove this habitat could affect the pygmy rabbit. Avoiding pygmy rabbit habitat might be sufficient to sustain the population.

White-tailed prairie dog

This species inhabits rolling and level sagebrush-steppe and grassland habitats. Recreational shooting and management as an agricultural pest have contributed to the decline of this species. Conservation measures include avoiding surface-disturbing activities near occupied burrows.

Swift fox

Historically, this species occupied short- or mixed-grass prairies on level to moderately rolling terrain in the Great Plains. Although there is suitable swift fox habitat in the northeastern most part of the planning area, there are no recent observations of this species in the planning area.

Nongame (Amphibians)

There are four BLM sensitive amphibians in the planning area: northern leopard frog, Great Basin spadefoot toad, boreal toad, and spotted frog. These species are associated with riparian-wetland habitats and have been observed in suitable habitat in the planning area. No population estimates are available for these species. These amphibians are protected by prohibition of surface disturbance or development within 500 feet of riparian-wetland areas. Threats to special status amphibians include changes to water quality and degradation and loss of riparian-wetland areas.

Management Challenges for Special Status Species – Wildlife

Most of the trends that affect other species of wildlife in the planning area also affect special status species. These include habitat degradation and fragmentation, livestock grazing, invasive species, motor vehicles, and climate. Management challenges for special status wildlife species include habitat degradation, fragmentation, and loss; invasive species; and human disturbance during sensitive periods. Limited habitat for some special status species presents challenges to managing for multiple use. For grizzly bears and the gray wolf, limiting human/bear and human/wolf interactions are also management challenges for the BLM. Fencing can provide perches for raptors that prey on special status species such as greater sage-grouse. Management challenges for special status raptor species also include collision and electrocution from powerlines. For most neotropical migrants, there is no specific protection other than protections afforded under the MBTA.

3.4.10. Wild Horses

The BLM protects, manages, and controls wild horses and burros under the authority of the Wild Free-Roaming Horses and Burros Act of 1971. This law ensures that healthy herds thrive on healthy rangelands. Horses originally evolved on this continent and disappeared some 10,000 to 12,000 years ago. Spanish explorers introduced modern horses to the west in the 1500s. The BLM manages wild horses as part of its multiple-use mission.

Most wild horses in the nation are found on BLM-administered lands. The BLM is responsible for managing the size and distribution of the herds. Wild horses provide a historic resource of particular interest to the public. However, this species also competes with other grazing species for forage within its range.

As required by the Wild Free-Roaming Horses and Burros Act of 1971, the BLM designated 30 Herd Management Areas (HMAs) with populations totaling approximately 4,400 horses. Those 30 areas comprised roughly 6.6 million acres of public land, 400,000 acres of State of Wyoming land, and 2.5 million acres of privately owned lands. In recognition of the need to consolidate herds to ensure long-term genetic diversity, the BLM combined and consolidated these management areas. At present, there are 16 HMAs in the state and the statewide target is for a wild horse population of 2,700. The planning area has approximately 1,000 horses in seven HMAs (Map 68); there are no burros.

Table 3.42, “Herd Management Areas and Appropriate Management Levels in the Planning Area” (p. 375) identifies the HMAs, appropriate management levels, and the ROD dates. The appropriate management levels were established in 1993 and 1994, from a process that included five years of intensive monitoring, data evaluation, public input, and environmental analysis. Since that time, some boundary adjustments and realignments to the HMAs have been made via the RMP maintenance process. The appropriate management level is the herd population objective for the HMA that would ensure a thriving ecological balance among all the users and

resources of the HMA (e.g., wildlife, livestock, wild horses, vegetation, water, and soil). A 2003 Consent Decree between the BLM and the State of Wyoming described the appropriate management level for each HMA in Wyoming as of the date of the decree.

Indicators of health for wild horses can be broken down into two main areas: the health of the horses and the vegetative health of the habitat in which they live. Each is a reflection of the other.

Physical and genetic health can be estimated during inventory by observation of body conditions (e.g. the presence of physical abnormalities) at various times of the year. With the elimination of virtually all natural predators, wild horse herd size, unless artificially controlled, would increase. As herd sizes increase, individuals and herds may migrate outside of the existing boundaries of HMAs. As a result, increased herd size may or may not increase forage utilization within the boundaries of HMAs. Increased forage utilization within HMAs may exceed the established appropriate management levels and may result in over-utilized forage. The health of the vegetative communities in the HMAs is assessed using the Wyoming Standards for Healthy Rangelands (BLM 1997b).

Wild horses graze on the range throughout the year. The BLM uses an animal unit month (AUM) rate of 1.15 for horses. Using this rule, the 1,000 wild horses in the planning area consume 13,800 AUMs annually. By comparison, for the 20-year period 1989 through 2008, the BLM billed an average of 204,507 domestic livestock AUMs per year.

Table 3.42. Herd Management Areas and Appropriate Management Levels in the Planning Area

Herd Management Area	Appropriate Management Level (Number of Horses)	Record of Decision Date
Green Mountain	170 to 300	February 1993
Conant Creek	60 to 100	February 1993
Rock Creek Mountain	50 to 86	February 1993
Dishpan Butte	50 to 100	February 1993
Muskrat Basin	160 to 250	February 1993
Crooks Mountain	65 to 85	May 1994
Antelope Hills/Cyclone Rim	60 to 82	May 1994
Source: BLM 2009b		

Population control is maintained by periodic gathers in which the health of the population is assessed and horses removed to keep the population within the limits of the appropriate management levels and in compliance with the Consent Decree. Fertility control is administered to mares by the anti-fertility vaccine Porcine Zona Pellocida, which has declining impassiveness over time. By the fourth year following injection, the drug has only limited impassiveness. Study has determined that administering the drug does not cause early foaling (BLM 2009b). Natural predation on wild horses does occur in the Antelope Hills/Cyclone Rim HMA, Crooks Mountain HMA, and Green Mountain HMA with documentation showing that mountain lions are the principle predator. Table 3.43, "Wild Horse Removals from 1980 through 2006 by Herd Management Area" (p. 375) lists wild horse removals in the planning area from 1980 through 2006 by HMA.

Table 3.43. Wild Horse Removals from 1980 through 2006 by Herd Management Area

Year	Number Removed
Antelope Hills/Cyclone Rim HMA	
1986	88
1987	184

Year	Number Removed
1988	63
1989	154
2000	59
2001	50
2004	208
Crooks Mountain HMA	
1985	708
1996	319
1998	220
2002	103
2006	74
Green Mountain HMA	
1980	255
1984	199
1993	318
1995	88
1996	105
1997	145
2002	155
2003	75
2005	4990
2006	89
Muskrat Basin HMA	
1983	157
1985	285
1986	314
1988	159
1993	195
1995	206
1997	128
2001	152
2004	127
Dishpan Butte HMA	
1985	145
1995	214
2001	57
2004	123
Rock Creek Mountain HMA	
1985	131
1986	58
1995	10
2001	47
2004	0
Conant Creek HMA	
1985	115
1986	21
1993	89
1995	10
2001	66
2004	95
Source: BLM 2009b	

Monitoring of wild horse habitat includes the collection of precipitation data, rangeland condition and trend information, forage utilization data, data for permitted and actual use by livestock

by grazing allotment, wildlife use data, and forage requirements. Data collected on wild horses include population counts, reproductive rates, age/sex structure, fertility control work, identification of high use or concentration areas, and other factors that would develop as the herds are studied.

Herd Management Areas

Antelope Hills/Cyclone Rim HMA

The Antelope Hills HMA encompasses 158,609 acres, of which 96,071 acres are BLM-administered surface. The appropriate management level for this HMA is 60 to 82 adult horses. The area is approximately 15 miles south-southeast of Atlantic City at approximately 7,200 feet elevation. The Continental Divide National Scenic Trail (CDNST) bisects the HMA. The area receives 5 to 7 inches of precipitation annually. The predominant vegetation type is sagebrush/grass. Riparian-wetland zones are infrequent but very important to wild horses. The topography ranges from rolling flatlands south of Cyclone Rim to uplifted ridges along Cyclone Rim and abrupt rocky zones interspersed with rolling lands north of the rim to the Sweetwater River.

Many of the horses in this HMA exhibit traits of the Spanish mustang and are a variety of colors. As genetic research continues on the wild horse populations in the Red Desert meta-population (Green Mountain, Crooks Mountain, Stewart Creek, Antelope Hill/Cyclone Rim, and Lost Creek HMAs), the necessity to maintain the population of wild horses in the Antelope Hills/Cyclone Rim HMA in genetic isolation might change, if it is determined that populations adjacent to the HMA share enough genetic material so that the uniqueness of the herd will not be compromised with interbreeding. If surrounding HMAs do not share the uniqueness, further interbreeding could cause this genetic resource to disappear. Continued monitoring and research could result in adjustment to management decisions for the Antelope Hills/Cyclone rim and Lost Creek HMAs. This HMA is an appropriate location for a wild horse viewing scenic loop.

Crooks Mountain HMA

The Crooks Mountain HMA is directly southeast of Sweetwater Station and encompasses approximately 58,425 acres, of which 54,726 acres are BLM-administered surface. The appropriate management level for this HMA is 65 to 100 adult horses. Elevations range from 6,900 to 8,100 feet. The lower elevations receive approximately 10 to 14 inches of precipitation annually; the upper elevations receive 15 to 20 inches. The major vegetation types are sagebrush-grass, woodland, and riparian-wetlands. Topography is generally rolling hills and slopes to the north and south of Crooks Mountain. The Crooks Mountain portion of the herd area is quite steep and broken with mountainous terrain. The area supports substantial wildlife populations of elk, deer, and pronghorn. Most of the horses are bays or blacks, with an occasional paint and/or grey.

Muskrat Basin, Conant Creek, Rock Creek, and Dishpan Butte HMAs

These four HMAs are in the central part of Fremont County. They encompass approximately 375,300 acres of land, of which 337,305 acres are BLM-administered surface. Topography in the area includes high ridges and steep terrain with grand vistas. Beaver Rim, on the western edge of the HMAs, is a high escarpment with sweeping views of the Wind River Mountains, Copper Mountains, and Owl Creek Mountains. Elevations in the HMAs range from 5,300 to 7,200 feet. The area receives 5 to 12 inches of precipitation a year, depending on elevation, most

of it in the form of snow. Domestic cattle and sheep utilize the area during spring, summer, and fall. Vegetation is dominated by various sage and grass species. Elk, deer, and pronghorn also inhabit this area.

While the four HMAs are managed with recognized individual populations, there is no geographic separation of the HMAs and the gates between them remain open for most of the year. As a result, the horses move regularly among the HMAs, helping to ensure their overall genetic health. Horses in these HMAs are a range of colors, most being solid, and their health is good with few apparent problems. Muskrat Basin/Dishpan Butte is an appropriate location for a wild horse viewing scenic loop.

Green Mountain HMA

The Green Mountain HMA encompasses 116,680 acres, of which 99,231 acres are BLM-administered surface. The appropriate management level for this HMA is 300 horses. A full range of colors is present. Most horses are a solid color, but a noticeable number of tobiano paints are present. The horses range from 11 to 15 hands and 750 to 1,000 pounds mature weight. Health is good with few apparent problems.

Topography in the HMA is generally gently rolling hills and slopes north and south of Green Mountain. Green Mountain itself is quite steep, with mountainous terrain and conifer/aspen forests. Elevations range from 6,200 to 9,200 feet, with grand vistas of the Red Desert, Sweetwater Rocks, and the Oregon and California NHTs from the higher elevations. Precipitation ranges from 10 to 14 inches at lower elevations to 15 to 20 inches at higher elevations. Most of the precipitation is in the form of snow. Domestic cattle and sheep utilize the area in all seasons, with summer cattle use predominating. Vegetation around the mountain is dominated by various sage, grass, woodland, and riparian-wetland species. The area supports substantial populations of elk, deer, pronghorn, and moose.

Management Challenges for Wild Horses

Fluctuations in precipitation and drought conditions create management challenges for wild horses by reducing the food available for wild horses. Drought also increases the conflict between wild horses and livestock grazing, an already contentious situation in some parts of the planning area. While the trend for forage reduction started by the drought is expected to continue, drought alone would probably not cause a decrease in herd population below the levels needed to maintain genetic diversity. Successful wolf reintroduction could have an impact on herd size, particularly in harsh winter conditions that limit the horses' ability to evade predators. Wider dispersal of livestock grazing through range developments puts stress on upland range forage, providing competition to wild horses. Fences and cattleguards pose hazards to horses because these features limit the horses' ability to survive winter conditions.

Increasing mineral development affects wild horses as forage is reduced by surface-disturbing activities and the expansion of invasive plants. In HMAs where genetic mixing is desired, development and fragmentation of wild horse habitat can also separate herds and lead to reduced genetic variation, which can affect the long-term health of herd populations. Fragmentation also causes concentration of herd distribution, which can strain available forage.

Although monitoring data indicate horses have some localized impacts on vegetation in some areas near water, current management of the horse herds should not affect these vegetation communities. There could be impacts to rangelands if the horses populations are allowed to

increase. Continuing to implement fertility control during gathers would help maintain and improve the rangeland resources. Ongoing studies could verify impacts to riparian-wetland areas.

An additional management challenge is the intrusion of modern development, particularly mineral development, which has the potential to reduce the recreational aspect of viewing wild horses.

3.5. Heritage and Visual Resources

This section addresses the individual resources of cultural, paleontological, and visual resources. Each resource section includes a description of the resource, the existing condition of the resource, and management challenges.

3.5.1. Cultural Resources

Cultural history in the Rocky Mountain west began at least 11,500 years ago, when the first human groups entered this region. Since that time, human occupation of the area appears to have continued to the present without serious interruption.

Prehistoric, Historic and Spiritual/Sacred/Traditional Cultural Properties

Generally, cultural resources can be grouped into three categories: prehistoric resources, historic resources, and spiritual/sacred/Traditional Cultural Properties (TCPs).

- Prehistoric cultural resources are sites, structures, objects, or materials deposited or left behind prior to the entry of non-American Indian (European) explorers and settlers into an area. In this part of Wyoming, the prehistoric stage spanned from approximately 11,500 years Before Present (BP) to approximately 250 years BP.
- Historic cultural resources are sites, structures, objects, or materials deposited or left behind after the European presence was established.
- Spiritual/sacred/TCPs can include prehistoric or historic resources, structures, topographic features, habitats, plants, wildlife, and/or minerals that Native Americans or other groups consider essential for the preservation of traditional culture.

The Prehistoric Stage

The Prehistoric Stage dates from at least 11,500 years BP to around 250 years BP. The Prehistoric Stage is characterized by a stable cultural phase in which the way of life appears to have changed little throughout the period. The peoples utilizing this region were hunters and gatherers who adapted their lifestyle to the high-plains environment and roamed the region in search of food and shelter. The movements of these nomadic peoples were generally determined by seasonal changes in resource availability. These peoples probably traveled mostly in small bands, spending only a limited amount of time in any one location. For the most part, the material goods of these groups were made from naturally available resources, including stone, wood, bone, pelts, sinew, and plant fibers.

Within the Prehistoric Stage, there are three broadly defined periods. The Paleoindian Period, from about 11,500 to 8,500 years BP, is the period for which the first evidence of humans in the region is found. The Paleoindian Period is characterized by big game hunting traditions utilizing typically well-made spear points. At the beginning of the period, the Paleoindians hunted animals

that are now extinct, such as mammoth and giant bison, and used Clovis, Folsom, and Agate Basin projectile points, among others. As conditions became drier and warmer and as many of these Pleistocene species died out, Paleoindians had to adapt to hunting more modern species such as bison, deer, and mountain sheep. Paleoindian sites and artifacts are rarely found in the planning area.

The Archaic Period, from about 8,500 to 1,800 years BP, signals a shift to a wider use of available resources and less specialization. The climate had changed from an earlier wetter and cooler regime to dryer and hotter conditions. Projectile points changed in response to this shift, and generally became smaller through time. This period is broken down into the following divisions: the Great Divide Phase (8,500 to 6,000 years BP), the Opal Phase (6,200 to 3,700 years BP), the Pine Springs Phase (3,700 to 2,900 years BP), and the Deadman Wash Phase (2,900 to 1,800 years BP). The Opal Phase, with its housepits and reuse of site areas, is especially well represented in the planning area.

The Late Prehistoric Period, from about 1,800 to 250 years BP, begins with an apparent increase in population and a technological change signaled by the introduction of the bow and arrow. The Uinta Phase of this period (about 1,800 to 1,000 years BP) is characterized by Rose Springs projectile points and numerous short-term foraging and processing camps, sometimes with house-floor types of features. The Uinta is followed by the Firehole Phase (1,000 to 250 years BP). This phase is characterized by a sudden shift to small, tri-notched and side-notched projectile points, and a change in site types. Population densities also appear to have decreased in the Firehole Phase, and it is postulated that old and new cultural groups were moving and/or being displaced. Uinta Phase sites, with their cylindrical roasting pits and shallow floor features, are well represented in the planning area.

Because there are no written records for prehistoric resources, most of these types of resources are evaluated under NRHP Criterion D. That is, they are evaluated on their potential for information about the lifeways and practices of prehistoric peoples. Prehistoric resources can also be evaluated as spiritual or sacred properties or TCPs if they are thought to be important to specific modern cultural groups. Occasionally, prehistoric resources are evaluated under Criterion C if there are distinctive stylistic, artistic, or architectural components present. Loss of integrity for prehistoric resources can result from long-term deterioration or erosion, direct or indirect disruption by modern activities, or vandalism/looting.

Common cultural resources of the prehistoric stage include lithic scatters, stone circle habitations, petroglyphs and/or pictographs, open campsites, fire hearths or firepits, lithic quarries, and housepit habitations.

The Historic Stage

This stage is commonly considered to be the time for which there is written documentation of the events that occurred in the area. The Historic Stage is generally considered to have begun in the early 1800s, when there are records of the arrival of Euro-American explorers and traders into the region. Fur trappers, missionaries, emigrants, miners, ranchers, farmers, and merchants followed the explorers. The history of the lands within the planning area shares in many of the major themes in Western American history:

- Fur trade (1811 to 1840)
- Exploration (1811 to 1870s)
- Historic military (1830s to 1890s)

- Emigration (1840 to 1869)
- Historic mining (1867 to 1930s)
- Native American Reservation (1868 to present)
- Settlement (1870s to present)
- Ranching (1870s to present)
- Homesteading (1870s to 1930s)
- Expansion era, early commerce and industry (1880s to 1928)
- Historic oil and gas exploration (1884 to 1930s)
- Regional railroad (1906 to present)
- Irrigation ditches and districts (1880s to present)
- Automobile roads (1910s to present)
- Tie-hack industry (1880s to 1940s)
- The Great Depression (1929 to 1939)
- Modern mining and oil and gas exploration (1940s to present)

Highlights of Western American history specific to the planning area include the discovery of South Pass and a feasible overland route over the continental divide in 1812 and again in 1824; the great overland migrations on the Oregon, Mormon, and California Trails from 1840 to 1869; the mapping of the Oregon Trail by John C. Fremont in 1842; the creation of the Pony Express and the transcontinental telegraph line along the California Trail in the early 1860s; the founding of South Pass City, Atlantic City, and Miner's Delight during the South Pass gold rush of 1867 to 1872; the creation of the WRIR in 1868, and the later incorporation of Northern Arapahos into the reservation; the early settlement of the Lander Valley in the 1870s; the founding of the Sun Ranch in 1872, the first ranch in Sweetwater Valley; settlement of the Wind River Basin in the 1880s; the first oil well west of the Mississippi River, at Dallas Dome, in 1884; the founding of Riverton, Shoshoni, and Moneta and the railroad reaching those towns and Lander in 1906; the creation of the Riverton Irrigation Project in 1905/1906; establishment of the early Yellowstone National Park automobile tour routes in the 1910s and 1920s; the Hudson coal mining boom from 1907 to the 1920s; the tie-hack industry around Dubois and Riverton from 1907 to the 1940s; and the uranium boom in the Gas Hills, Crooks Gap, and Jeffrey City in the 1950s.

Historic resources can be evaluated under any of the NRHP criteria. Some historic resources can be associated with important historic events or persons (Criterion A and B), while others can contain important archeological information (Criterion D). Historic resources can also be evaluated under Criterion C if there are distinctive architectural or artistic components present. In rare instances, historic resources are evaluated as spiritual or sacred cultural properties if they are important to specific modern cultural groups. Loss of integrity for historic resources can result from deterioration or erosion, direct or indirect disruption by modern activities, or vandalism/looting.

The following historic cultural resources are commonly found in the planning area: ranching developments; trash scatters and dumps; mining prospects, developments, and mines; emigrant and stage trails, sites, and landmarks; livestock herder campsites; and abandoned homesteads.

Spiritual/Sacred/Traditional Cultural Resources and Properties

Spiritual, sacred, and traditional cultural resources and properties can be from both the prehistoric and historic phases. They include prehistoric or historic resources, structures, topographic features, habitats, plants, wildlife, and/or minerals that Native Americans or other groups consider essential for the preservation of traditional culture. These properties often are the sites of events

important to a cultural group or sites of past or present spiritual/sacred practices. They might also be the locations of traditional practices, such as gathering plants for use in ceremonies. TCPs are understood to be eligible for listing on the NRHP as defined in the NHPA, but other, non-eligible traditional use resources might be protected under the Native American Graves Protection and Repatriation Act (NAGPRA), the American Indian Religious Freedom Act (AIRFA), or BLM policy. When addressing spiritual, sacred, or traditional cultural resources, more ephemeral indicators of condition can come into play. These types of properties can be considered significant to specific cultural groups, even if the integrity of the properties has been compromised. Indicators in these cases depend more on the cultural importance of a property, as defined by traditional elders or authorities.

Sacred sites might or might not be still used by the group, while spiritual sites and TCPs are still used by at least some members of the particular group. Sacred and spiritual sites and TCPs are not common, but do occur in the planning area. They usually have not been publicly identified, but some are known to the BLM and are protected in a discreet manner. The location of most of these sites is kept undisclosed because of their vulnerability to looting or vandalism, and because the groups have requested they remain unidentified. Rock figures and unusual shapes, burials, medicine wheels, and vision-quest sites are examples of these kinds of sites. Martin's Cove, a site sacred to the Church of Jesus Christ of Latter-Day Saints, could also be considered a TCP. The conditions of these types of properties can range from good to poor.

Sacred and spiritual sites and TCPs derive their significance from their importance to specific modern cultural groups, such as Native American tribes or religious groups. The BLM relies on traditional elders or authorities from these groups to help evaluate the importance and condition of the properties.

The following resource or property types, found in the planning area, might have spiritual, sacred, and/or traditional values: burials; battlefields; medicine wheels; sun dance locations; prayer circles and lodges; sweat lodges; and altars, cairns, and rock alignments. When these types of resources are found, traditional elders or authorities are consulted to determine if they are considered spiritual, sacred, or traditional properties, and if they qualify as TCPs.

Resources Requiring Special Management

This section highlights those resources and resource types in the planning area that require special management beyond that mandated in the NHPA. Table 3.44, "Selected Cultural Resource Sites and NRHP Status in the Planning Area" (p. 383) lists these cultural resources, which are sensitive or significant enough that standard NHPA regulations are not adequate for their management. These resources require proactive management to maintain the qualities that make them significant (see Map 69 for locations of these resources).

Table 3.44. Selected Cultural Resource Sites and NRHP Status in the Planning Area

Resource Name	Type	Designation Status	Location of Resource	Section of Affected Environment Chapter Where Site is Discussed
1. Castle Gardens Petroglyph/ Pictograph Site	Prehistoric Rock Art Site	Listed on the NRHP	Eastern Fremont County near the Gas Hills	Cultural Resources – Prehistoric Resources and Areas of Critical Environmental Concern – Proposed ACECs
2. Oregon, Mormon Pioneer, California, and Pony Express National Historic Trails	Historic Emigrant Trails	Congressionally Designated National Historic Trails; also an existing ACEC	Along the Sweetwater River, from near Independence Rock to Burnt Ranch, south of Atlantic City	Congressionally Designated Trails – National Historic Trails
• Martin's Cove	Historic Emigrant Site	Listed on the NRHP	Southwestern Natrona County	Congressionally Designated Trails – National Historic Trails
• Devil's Gate	Historic Emigrant Site	Part of a National Historic Landmark	Southwestern Natrona County	Congressionally Designated Trails – National Historic Trails
• Split Rock	Historic Emigrant Site	Listed on the NRHP	Southwestern Natrona County	Congressionally Designated Trails – National Historic Trails
• Ice Slough	Historic Emigrant Site	Considered eligible for the NRHP	Southcentral Fremont County	Congressionally Designated Trails – National Historic Trails
• Rocky Ridge	Historic Emigrant Site	Considered eligible for the NRHP	Southwestern Fremont County	Congressionally Designated Trails – National Historic Trails
• Rock Creek Hollow	Historic Emigrant Site	Considered eligible for the NRHP	Southwestern Fremont County	Congressionally Designated Trails – National Historic Trails
• Gilespie Place	Historic Emigrant Site	Considered eligible for the NRHP	Southwestern Fremont County	Congressionally Designated Trails – National Historic Trails
3. Warm Springs Canyon Flume, Natural Bridge, and Geyser	Historic Tie Flume and natural features	Considered eligible for the NRHP	Northwestern Fremont County near Dubois	Cultural Resources – Historic Resources
4. South Pass Historic Mining Area	Historic Gold Mining District, with mines, settlements, and military outposts	Miner's Delight and South Pass City listed on the NRHP; the entire historic mining area and several sites within it are NRHP eligible	Southwestern Fremont County, on the southern edge of the Wind River Mountains	Cultural Resources – Historic Resources and Areas of Critical Environmental Concern – Existing ACECs With Proposed Expansions

Resource Name	Type	Designation Status	Location of Resource	Section of Affected Environment Chapter Where Site is Discussed
• Miner's Delight	Historic Mining-Related Site	Listed on the NRHP	Southwestern Fremont County, on the southern edge of the Wind River Mountains	Cultural Resources – Historic Resources and Areas of Critical Environmental Concern – Existing ACECs With Proposed Expansions
• South Pass City	Historic Mining-Related Site	Listed on the NRHP	Southwestern Fremont County, on the southern edge of the Wind River Mountains	Cultural Resources – Historic Resources and Areas of Critical Environmental Concern – Existing ACECs With Proposed Expansions
5. Regionally Significant Historic Trails • Bridger Trail	Historic Wagon Trail	Considered eligible for the NRHP	Northeastern Fremont County near Lost Cabin	Cultural Resources – Historic Resources and Areas of Critical Environmental Concern – Proposed ACECs
• Rawlins to Fort Washakie Stage Trail	Historic Wagon Trail	Considered eligible for the NRHP	South of Green Mountain to Lander	Cultural Resources – Historic Resources and Areas of Critical Environmental Concern – Proposed ACECs
• Casper to Lander Road	Historic Wagon Trail	Considered eligible for the NRHP	Eastern Fremont County, near Deer Creek to near Alkali Butte	Cultural Resources – Historic Resources and Areas of Critical Environmental Concern – Proposed ACECs
• Point of Rocks to South Pass Stage Road	Historic Wagon Trail	Considered eligible for the NRHP	Southwestern Fremont County, from Burnt Ranch to South Pass City	Cultural Resources – Historic Resources and Areas of Critical Environmental Concern – Proposed ACECs
• Green River to South Pass to Fort Washakie Stage Trail	Historic Wagon Trail	Considered eligible for the NRHP	Southwestern Fremont County, from South Pass City to Lander	Cultural Resources – Historic Resources and Areas of Critical Environmental Concern – Proposed ACECs

Resource Name	Type	Designation Status	Location of Resource	Section of Affected Environment Chapter Where Site is Discussed
• Birdseye Pass Stage Trail	Historic Wagon Trail	Considered eligible for the NRHP	Northeastern Fremont County, near Wind River Canyon	Cultural Resources – Historic Resources and Areas of Critical Environmental Concern – Proposed ACECs
6. Regionally Significant Historic Highways • Yellowstone/ National Park to Park Highway	Historic Auto Highway	Considered eligible for the NRHP	Northeastern Fremont County, from east of Moneta to Shoshoni	Cultural Resources – Historic Resources and Areas of Critical Environmental Concern – Proposed ACECs
7. Cedar Ridge Traditional Cultural Property	Prehistoric - Historic, sacred Traditional Cultural Property	Considered eligible for the NRHP	Northeastern Fremont County near Lost Cabin	Cultural Resources – Native American Spiritual, Sacred and Traditional Resources and Areas of Critical Environmental Concern – Proposed ACECs
Sources: BLM 2009b, BLM 2009a ACEC Area of Critical Environmental Concern BLM Bureau of Land Management NRHP National Register of Historic Places				

Prehistoric Era Resources Requiring Special Management

Castle Gardens Petroglyph/Pictograph Area

The Castle Gardens Petroglyph/Pictograph site is a well-known rock art area in the eastern part of the planning area. The site contains a large number of prehistoric drawings etched in and/or painted on sandstone. The rock art is recognized as some of the best in the Wyoming region, and has become well known in the Northwestern Plains. Several styles of art are evident, and many excellent shield motif representations are present. The prehistoric rock art is estimated to date from the Late Prehistoric Period (about 1,800 to 250 years BP), and the functions of the drawings are assumed to be mostly concerned with spiritual beliefs or a record of important events. The rock art can be found over a large portion of the Castle Gardens uplifted area, which covers an area 6 miles long by 1 mile wide. The majority of the rock art is, however, located at the far eastern end of the Castle Gardens area. The site is considered to be a spiritual site to the Eastern Shoshone, Northern Arapaho, and other tribes and modern traditional use of the site has been documented as well.

The Castle Gardens Petroglyph/Pictograph site was first recorded in the early 1940s (Sowers 1941). Since then, it has become well known to the general public, and the rock art has suffered from vandalism and weathering. In the 1970s, the BLM constructed a road into the site. At that time, it was thought that increased access and fencing would slow the damage, and a road, parking lot, toilets, picnic tables, fences around panels, and signs were installed. However, instead of

decreasing the vandalism, the development caused it to increase. Today the site is damaged but retains much of its character and spiritual value.

The Castle Gardens Rock Art Site is listed on the NRHP and is managed for cultural and recreational values. The immediate site vicinity is protected from oil and gas development, locatable mineral exploration (segregated from mining), grazing (fenced exclosure), and is closed to motorized travel. Castle Gardens has been nominated for ACEC designation.

Historic Era Resources Requiring Special Management

Congressionally Designated Trails

The *Congressionally Designated Trails* section discusses the CDNST and the Oregon, Mormon Pioneer, California, and Pony Express NHTs.

Warm Springs Canyon Flume, Natural Bridge, and Geyser

The Warm Springs Canyon Flume, Natural Bridge, and geyser are in a unique historical and natural area on the lower slopes of the northern Wind River Mountains near Dubois. The natural and historical elements of this area are closely related, and management must consider both aspects.

The historical element is a flume that runs down Warm Springs Canyon. In the 1920s, there were no adequate haul roads; instead, the Warm Springs Canyon Flume was built to transport hand-hewn railroad ties down to the Wind River. Once on the Wind River, the ties were floated downstream to a processing plant in Riverton, where railroad companies picked them up for use on the many railroad lines in the region. The flume, completed in 1928, was part of an early system of railroad-tie procurement that relied on few machines. Instead, mountain camps were established, and woodcutters hewed the ties from trees, mostly by hand. The flume spanned nine steep, twisting miles and was often suspended on the walls of the canyon because of the stream's narrow course. The flume utilized water to run the ties down to the Wind River and during its active life carried hundreds of thousands of ties out of the mountains. The flume was abandoned in 1942, when a haul road was completed and trucks became a more economical way to transport the ties (Pinkerton 1981).

The natural element of this resource lies on BLM-administered land near the lower end of Warm Springs Canyon. It is here that the flume crosses the "Natural Bridge." This natural bridge is a limestone cavity through which Warm Springs Creek flows. The flume was built through the natural bridge and is suspended on its walls. Another nearby natural phenomenon unique to the area is an inactive geyser, which lies just above the canyon. This geyser resembles a warm spring situated deep inside the old geyser pipe.

Weather and landslides have deteriorated portions of the flume on BLM-administered lands. Despite these ongoing processes, some of the flume is still in good condition, and the segment within the natural bridge has been shielded and remains in good condition. The inactive geyser has some modern trash around it but is otherwise in good condition. Limited access to the area has probably deterred much damage to the area's features, and this would probably continue to be the situation in the future.

The Warm Springs Canyon Flume site is managed for historical and natural values. The site is protected from oil and gas development (NSO) and from other uses incompatible with its historic qualities. The Warm Springs Canyon Flume was recommended in the existing Lander RMP to

be withdrawn from locatable mineral entry; however, the withdrawal has not been completed. Though the site was the subject of an engineering and stabilization study, the management plan and stabilization has not been completed. Warm Springs Canyon Flume has been nominated for ACEC designation.

Most of the original flume was on USFS-managed land. A small part near the lower end of the flume's course lies on BLM-administered and private land. The natural bridge and geyser are on BLM-administered lands. The Warm Springs Flume, Natural Bridge, and geyser area are considered eligible for listing on the NRHP, but no formal nomination procedures have been completed for this site.

South Pass Historic Mining District and Associated Features

This area consists of approximately 12,576 acres of BLM-administered surface encompassing a historic gold mining region southwest of Lander on the southern end of the Wind River Mountains, and is protected as an ACEC. It is discussed here because of its relevance to the history of the area. Characterized by both sagebrush steppe and forested areas with steep to rolling hills, the area contains important historic resources and geological hazards resulting from mining activities. South Pass was and is the largest gold mining area in Wyoming. The influences of this marginal gold mining area on the early development of the Wyoming Territory and the State of Wyoming were considerable.

South Pass Historic Mining Area

A trapper with the American Fur Company first discovered gold in the South Pass area in 1842. This was followed by limited prospecting in the 1850s and early 1860s, but no organized operations were established because of Indian hostilities and/or unprofitable diggings. It was not until 1867 that large numbers of prospectors entered this area, which was known at that time as the "Sweetwater Mines" area. The year 1867 was notable for the discovery of most of the major gold deposits in the area, including the Carrissa, Miner's Delight, and King Solomon Lodes. By 1868, up to 1,000 people might have lived in the area, and the towns of South Pass City, Atlantic City, and Miner's Delight were established. However, the mining boom died quickly, and by 1872 the original gold prospects were played out and the area (including the towns) became almost deserted. There were recurrent periods of gold mining activity in the South Pass region in the 1880s, from 1907 to 1911, and in the 1930s, but the efforts were never very profitable.

Although the mining activities proved short-lived and mostly unprofitable, development in the South Pass region resulted in social and cultural impacts to Wyoming. The South Pass towns were some of the first permanent European settlements and generated a new economic base. The economic stimuli from mining operations also encouraged growth of the regional economy.

Freighting companies, merchants, and speculators benefited from the import of equipment and the sales of basic supplies, land, and claims. Stagecoach lines also sprang up to carry people, goods, and mail to and from the mining area market. The increased economic activity affected markets as far away as Salt Lake City and Denver. Settlement of the Wind River Basin and development of Lander Valley's economy were also highly influenced by the South Pass mining activity. The first settlers in the Lander area came mainly from the South Pass settlements, and the early farming communities in the valleys were able to rely on the mining area markets for much of their livelihoods. The mining settlements also provided added impetus to the coming cattle industry by contributing capital and markets for some of the first cattle ranching outfits in the state.

Along with the mining industry came early military and transportation endeavors. Camp Stambaugh, built in 1870, was an army post constructed near Atlantic City to offer protection to the miners and other settlers from hostile Indians. Occupied until 1877, the camp was not involved in hostilities; instead, it became an important supply station for the local area.

Stagecoach lines sprang up to serve the needs of the miners and bring new people into the area. Stage roads from the Green River, Point of Rocks, and Lander all went through the South Pass area. They continued to provide an important service until the early 1900s.

The South Pass settlements have survived up to the present by supporting limited gold mining operations, cattle and sheep grazing, small commercial concerns, and recent iron-ore extraction operations. In the 1960s and 1970s, historical interest in the area sparked a movement to preserve the old towns and mines. Some of the more important sites in the South Pass Historic Mining District were stabilized or reconstructed. At present, the area has several historical sites that visitors frequent, but several others are deteriorating due to weathering and lack of care.

Weathering, collection, and occasional vandalism are deteriorating the South Pass Historic Mining Area. Some of the more important sites in the district were stabilized or reconstructed. At present, the area has several historic sites that attract visitors, but others are suffering from weathering degradation. The same is true for Miner's Delight, where stabilization efforts have slowed deterioration to some extent but not stopped the effects of weathering and vandalism. In contrast, South Pass City is stable or improving, because coordination with the State of Wyoming has resulted in improved management and stewardship of the historic site.

Without additional stabilization efforts at certain sites in the South Pass Historic Mining Area, standing structures would eventually be lost as they deteriorate beyond repair. As physical degradation continues and requires more effort and funding to reverse, the necessary efforts to stabilize and restore these resources would continue to increase. Looting and vandalism would also continue to affect sites in the historic mining area unless they are controlled.

The South Pass Historic Mining Area is eligible for listing on the NRHP and is managed as an ACEC for cultural and recreational values. The area has an NSO restriction on mineral leasing; is segregated from locatable mineral exploration (requires a Plan of Operations); is an avoidance area for utility ROWs; and motorized travel is limited.

Miner's Delight Townsite

Miner's Delight Townsite is a historic site associated with the South Pass Historic Mining Area. Established in 1868, it was one of the three original towns that sprang up in the initial gold rush at the south end of the Wind River Mountain Range. Despite several small booms (followed by busts), the town never became established and lingered on with only a few residents into the 1930s. By the 1960s, the townsite was abandoned and falling into disrepair. In the 1980s, there were limited stabilization efforts, and today the site is in fair condition; the BLM manages the site as a "ghost town."

Miner's Delight is listed on the NRHP. Approximately 100 acres of this site are on BLM-administered surface and are managed for historical and recreational values. The site is protected from oil and gas development (NSO), locatable mineral exploration (segregated from mining), major utility systems, and from other uses incompatible with its historic qualities. A cultural resources management plan was developed and approved for Miner's Delight; some

fencing, historic surveys, structural stabilization, protection, and archeological excavations have been performed at the site, but further work is needed at the site to maintain and protect it.

South Pass City

A success story for cultural resources in the planning area is South Pass City, another historic site associated with the South Pass Historic Mining Area and in the ACEC. About 8 miles southwest of Miner's Delight, South Pass City was the original settlement when the gold rush occurred and was the largest town in the original mining district. South Pass City also experienced booms and busts and was mostly abandoned by the middle of the 20th Century.

Local interest in the town's preservation eventually resulted in the State of Wyoming purchasing some of the town. With substantial funding, historic buildings were reconstructed and the site was developed as a heritage tourism destination. Additional historic structures from the old town site were on BLM-administered surface and leased to the State of Wyoming to enhance its historic preservation efforts. At present, the Wyoming Department of State Parks and Cultural Resources manages the site to portray life in an early mining town. Recently, the BLM-administered surface lands have been transferred to the state for consolidation with its state park for improved management. The BLM may consider additional transfers to the state in the future.

Regionally Significant Historic Trails and Early Highways (excluding National Historic Trails)

Regionally significant historic trails and early highways are historic era resources requiring special management in the planning area. This section discusses NRHP eligible linear transportation features in the planning area that are not part of the National Trails System. The *Congressionally Designated Trails* section discusses the CDNST and the Oregon, Mormon Pioneer, California, and Pony Express NHTs.

There are a number of regionally significant historic trails and early highways in the planning area (Map 69). These linear resources were important in the early development of Wyoming and Montana, and include the Bridger Trail, the Rawlins-Fort Washakie Stage Trail, the Casper to Lander Stage Road, the Point of Rocks to South Pass to Lander Stage Trail, the Birdseye Pass Stage Trail, the Green River to South Pass to Fort Washakie Stage Trail, and the Yellowstone/National Park to Park Highway. All have been determined eligible for listing on the NRHP and all have been nominated for ACEC designation and proposed as a single regional trails ACEC. To some extent, all these routes are eligible for listing on the NRHP based on their association with events important to understanding American history on either the national or local level, links to historically significant people, and their potential to yield information important to history.

Regionally Significant Historic Trails

Bridger Trail

The Bridger Trail is a historic wagon trail that connected the Oregon Trail near Casper to the Montana gold fields. This trail passes through the northeastern portion of the planning area, and runs from the southeast past Lost Cabin and up over the Bridger Mountains near Bridger Pass. Jim Bridger blazed this regionally significant historic trail in 1864 as an alternative to the Bozeman Trail. It later became an important route for settlers headed for the Bighorn Basin.

After the railroad arrived in the early 1900s, this trail became a local access route, and its intact historic setting remained for the next 50 years.

Because the Bridger Trail's location had not been specifically identified, oil and gas activities were allowed to affect the trail in the 1970s, 1980s, and 1990s. Once the trail's location was clarified, protection measures began. Recently, oil and gas activity has increased around the trail; at the same time, protection measures have been instituted that are designed to help protect its historical character. Most of the trail through the planning area is still visible as a single set of ruts or as a swale. Because of increased oil and gas activity in the last 15 years, the Bridger Trail's condition trend is down. More recent mitigation measures have slowed the rate of intrusions.

Rawlins-Fort Washakie Stage Trail

The Rawlins-Fort Washakie Stage Trail connected the transcontinental railroad at Rawlins with the new settlements of Fort Washakie and Lander. This trail was established in the 1870s and was a major transportation link until 1906, when the railroad reached Lander. Used by freighters, stagecoaches, and the military, this route was an important early link to the outside world for the Sweetwater Valley, the South Pass Mines, and the Lander Valley. At present, the trail ranges from slightly-to-moderately-to-severely damaged by modern intrusions, and some parts of the trail have been completely obliterated. About two-thirds of the original trail is still visible as one or more ruts or as one or more swales. The condition trend is slowly down. Occasional oil and gas development and ROWs have threatened the trail over the last 25 years, and this trend is expected to continue.

Casper to Lander Road

The Casper to Lander Road became an important transportation artery between Casper and the Lander Valley after the railroad arrived in Casper in the 1880s. It, too, lasted until the railroad reached Shoshoni, Riverton, and Lander in 1906. It was a freight and stagecoach route and an important part of the development of the Wind River Basin. At present, the road ranges from slightly-to-moderately-to-severely damaged by modern intrusions, and some parts have been completely obliterated. Most of the road through the planning area is still visible as a single set of ruts or as a swale. The condition trend is slowly down. Occasional development and ROWs have threatened the trail over the last 25 years; this trend is expected to continue, although mitigation measures have slowed the rate of intrusions.

Point of Rocks to South Pass to Lander Stage Trail

The Point of Rocks to South Pass to Lander Stage Trail was a supply route for the South Pass area mines in the 1870s. This transportation corridor was an important link for the entrepreneurs developing the South Pass mining area, but was supplanted when a main rail depot was established at Green River. At present, the trail ranges from slightly-to-moderately damaged by modern intrusions, and some parts of the trail have been completely obliterated. The condition trend is very slowly down. Developments and ROWs have threatened the trail over the last 25 years, and this trend is expected to continue. Part of the Point of Rocks to South Pass to Lander Trail is in the South Pass Historic Mining Area ACEC.

Green River to South Pass to Fort Washakie Stage Trail

The Green River to South Pass to Fort Washakie Stage Trail was an important trail from the railroad at Green River to the mines at South Pass and the Lander Valley. It began in the 1870s and

was used until 1906, when the railroad reached Lander. Together with the Rawlins-Fort Washakie Stage Trail, this was the major supply route into the South Pass and Lander areas for several decades. At present, the trail ranges from slightly-to-moderately-to-severely damaged by modern intrusions, and some parts of the trail have been obliterated. The condition trend is slowly down. Occasional development and ROWs have threatened the trail over the last 25 years; this trend is expected to continue, although mitigation measures have slowed the rate of intrusions. Parts of the Green River to South Pass to Fort Washakie Stage Trail pass through the South Pass Historic Mining Area and Red Canyon ACECs. The trail itself has been nominated for ACEC designation.

Birdseye Pass Stage Trail

The Birdseye Pass Stage Trail connected the Wind River Basin to the Bighorn Basin in the late 1800s. It was the main route from the Lander and Riverton areas to Thermopolis and points farther north until the early 1900s, when the railroad reached Worland. At present, the trail ranges from slightly-to-moderately-to-severely damaged by modern intrusions, and major parts of the trail through the planning area have been obliterated. The condition trend is slowly down. Occasional development and ROWs have threatened the trail over the last 25 years. This trend is expected to continue, although mitigation measures have slowed the rate of intrusions.

Early Highways

Yellowstone/National Park to Park Highway

The Yellowstone/National Park to Park Highway is an early auto road in central Wyoming. It was publicized as a road system that connected National Parks all over the western United States. Local towns attempted to generate tourist income from automobile tourists through improved roads and advertisements, claiming that this route was the best way to Yellowstone and Rocky Mountain National Parks. The Yellowstone/National Park to Park highway was used in the 1910s and 1920s until Wyoming State Highways supplanted it as a tourist route. At present, the highway ranges from slightly-to-moderately-to severely damaged by modern intrusions, and major parts of the highway through the planning area have been completely obliterated. The condition trend is down. Oil and gas development and ROWs have dramatically increased effects to this early automobile road over the last 25 years; this trend is expected to continue, although mitigation measures have slowed the rate of intrusions.

Native American Spiritual, Sacred, and Traditional Resources

There are a few Native American spiritual, sacred, or TCPs in the planning area and these are being managed for their corresponding values. The sites are protected on a case-by-case basis from oil and gas development (NSO) and from other uses incompatible with their special qualities. Sites that might also have cultural, traditional, or sacred importance include rock art and rock alignments, including medicine wheels, burials, and vision quest sites. Cairns, habitations, rock shelters, and caves might also have special importance to Native Americans.

Cedar Ridge Complex

Cedar Ridge Complex is a specific spiritual/sacred/TCP in the northeastern portion of the planning area. Most of Cedar Ridge lies within the BLM Casper Field Office planning area to the east, but its western limits extend into the Lander Field Office planning area. Cedar Ridge is protected by special management in the Casper Field Office RMP. In the Lander planning area, Cedar Ridge is not part of any existing ACEC, but it has been nominated and proposed as an ACEC.

Cedar Ridge was used for more than 5,500 years as a ceremonial site for prayers and rituals and continues to be a sacred place for Eastern Shoshone to conduct religious observances. The site is considered integral to the proper functioning of contemporary Shoshone ways of life, a right that is specified in Executive Order 13007, Indian Sacred Sites (May 24, 1996), and AIRFA. The part of the ridge in the planning area has not experienced much modern development. The Cedar Ridge complex is also culturally important to the Crow and possibly other tribes. It was established as a TCP in 1997 after extensive consultation with the Eastern Shoshone and the Wyoming State Historic Preservation Office (SHPO).

Other Sacred Sites

There are other sacred sites within the planning area in addition to Cedar Ridge. They are occasionally discovered and are protected as required by laws, regulation, and Executive Orders. The sensitivity of these sites precludes disclosure of their locations.

Resource Management

Cultural Resources Significance

Cultural resources are evaluated in the context of eligibility for listing on the NRHP. Eligibility is based on whether the resource meets the criteria for evaluation as defined by the National Historic Preservation Act (NHPA) (36 CFR Part 60.4). For NHPA purposes, cultural resources, including both prehistoric- and historic-era sites, that meet one or more of these criteria are called historic properties. The criteria as identified in the NHPA are:

> The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association; and
>
> (a) that are associated with events that have made a significant contribution to the broad patterns of our history; or
>
> (b) that are associated with the lives of persons significant in our past; or
>
> (c) that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
>
> (d) that have yielded, or may be likely to yield, information important in prehistory or history.

Cultural resources might also have status under a number of other legislative and regulatory standards, or as conferred by a specific religious or cultural group.

Identified Cultural Resources

File search inventories (Class I) and intensive field inventories (Class III) have been conducted for BLM sponsored or sanctioned projects since about 1975. Inventories within the planning area have primarily been related to oil and gas exploration and development, utility ROWs, and mining.

The Lander Field Office maintains a file of known cultural resources with records dating back to 1948. The data have been gathered from various sources, including universities, archeological and historical contractors, local informants and sources, the BLM and state government agencies, and historical accounts. The files include information about many types of prehistoric and historic cultural resources. Table 3.45, "Cultural Resource Statistics for the Planning Area" (p. 393) briefly describes those resources.

Table 3.45. Cultural Resource Statistics for the Planning Area

Total Acreage of Class III Inventories	Total Documented Cultural Resource Sites	Total Number of Sites Listed on or Eligible for the NRHP	Total Number of Sites Not Eligible for the NRHP	Total Number of Sites of Undetermined Eligibility for the NRHP
179,000 Acres	5,486 Sites	885 Eligible Sites	2,397 Ineligible Sites	2,204 Undetermined Sites
Source: BLM 2010d NRHP National Register of Historic Places				

BLM Cultural Resources Management

The BLM is legally mandated to identify, evaluate, and manage cultural resources under at least 10 federal laws and four Presidential Executive Orders, most prominently the Antiquities Act of 1906, the NHPA of 1966, the NEPA of 1969, the FLPMA of 1976, as amended, and Executive Order 11593, Protection and Enhancement of the Cultural Environment (1971). BLM policy and cultural resource program guidance are outlined in BLM Manuals 8100, 8110, 8120, and 8130. The BLM approach to managing NHTs was detailed in 1986 in the *Oregon/Mormon Pioneer National Historic Trails Management Plan*. The *Congressionally Designated Trails* section discusses the Oregon, Mormon Pioneer, California, and Pony Express NHTs, but the same principles can be applied to management of regionally significant historic trails, in accordance with Appendix IV of the plan (BLM 1986), which addresses overall concerns and management issues. The BLM intends to revise the plan to meet current preservation needs.

In 1997, the BLM developed an agreement to address the means of complying with NHPA, expressed in the *Programmatic Agreement Among the Bureau of Land Management, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers Regarding the Manner in which BLM will meet its Responsibilities Under the National Historic Preservation Act* (BLM 2006). Pursuant to this national Programmatic Agreement, the BLM Wyoming State Office developed a specific process by which NHPA compliance is accomplished, detailed in the *State Protocol Agreement Between the Wyoming BLM State Director and the Wyoming State Historic Preservation Officer* (BLM 2006). Apart from certain considerations derived from specific cultural resource statutes, management of cultural resources on public lands is primarily based on FLPMA, and is fully subject to the same multiple-use principles and the same planning and decision-making processes applied to managing other public land resources.

Specific objectives for cultural resource management are expressed in BLM Manual 8130, Planning for Uses of Cultural Resources (incorporating Information Bulletin No. 2002-101, Cultural Resource Considerations in RMPs), which states that all RMPs will include at least the following goals:

- Preserve and protect significant cultural resources and ensure that they are available for appropriate uses by present and future generations. This goal requires use allocation decisions in the RMP, in which all cultural properties in the planning area must be allocated to the following uses according to their nature and relative preservation value: Scientific Use – preserved until research potential is realized; Conservation for Future Use – preserved until conditions for use are met; Traditional Use – long-term preservation; Public Use – long-term preservation and onsite interpretation; Experimental Use – protected until used; and Discharged from Management – no use after recordation and not preserved.

- Seek to reduce imminent threats from natural or human-caused deterioration or potential conflict with other resource uses by identifying priority geographic areas for new field inventory, based upon a probability for unrecorded significant resources. This goal requires a Class I regional overview of the planning area to identify priority areas in need of new field inventory where unrecorded significant resources could be found.

Use Categories

BLM Manual 8110, Identifying Cultural Resources, defines six use categories: scientific use, conservation for future use, traditional use, public use, experimental use, and discharged from management. "A cultural property may be allocated to more than one use category. Allocations should be reevaluated and revised, as needed, when circumstances change or new data become available" (BLM 2004d).

Scientific Use

Scientific use implies that the value of the property lies in information that can be extracted from the property. This use category usually corresponds to NRHP Criterion D, which recognizes the value to society of properties that can yield or have yielded information important to expanding understanding of history or prehistory. Archeological sites are generally evaluated under this criterion, although other kinds of cultural resources can also be evaluated under this criterion. NRHP Criterion D eligibility is the regulatory threshold for management of a cultural resource for its scientific values; management opportunities include in situ preservation and protection, or extraction of the scientific information by means of excavation and analysis.

Conservation for Future Use

BLM Manual 8110 defines conservation for future use as "reserved for any unusual cultural property which, because of scarcity, a research potential that surpasses the current state of the art, singular historic importance, cultural importance, architectural interest, or comparable reasons, is not currently available for consideration as the subject of scientific or historical study that would result in its physical alteration." This use category pertains to all cultural resources regardless of age or thematic associations, unless the resources have been formally determined to be ineligible for listing on the NRHP under all of the NRHP criteria for evaluation. Sites that might be of scientific value but are not immediate candidates for study under the scientific use category are managed under the conservation for future use category. The Lander Field Office cannot feasibly perform site testing for all archeological sites and otherwise evaluate the NRHP eligibility of all of the recorded cultural resources in the planning area. Therefore, conservation for future use involves monitoring of other public land uses, evaluation of specific proposed activities that might disturb specific cultural resources, erosion control of the resources, and active stabilization of the resources as appropriate.

Traditional Use

Traditional use of cultural resources is the use of the cultural resource itself, rather than uses of a property that do not rely directly on the existence of the cultural resource. Cultural resources can include TCPs, which are properties that are critical to a living community's beliefs, customs, and practices. The regulatory threshold for management of a property as a TCP is eligibility for listing on the NRHP under any of the criteria for evaluation, although Criterion A is the most commonly appropriate for representation of an event or broad pattern in history. Cedar Ridge Complex is the only explicitly identified TCP as defined in NRHP Bulletin 38 (Parker and King 1998). However, rock art localities throughout the planning area are candidates for the traditional use category.

Public Use

Long-term preservation and onsite interpretation are most appropriate for cultural resources that have visually obvious manifestations of the site's historical or archeological importance. This resource type is represented by rock art occurrences in the planning area. The intent of interpretive efforts is that education will help preserve the site and similar examples.

All BLM-administered surface lands are managed in the public interest and there is no distinct regulatory threshold for management of cultural resources through long-term preservation and onsite interpretation. Considerations for management in this manner are: (1) the relative significance of the resource within historical, archeological, or other cultural context(s), (2) the sensitivity of the cultural resource to loss or degradation as a result of increased public access, and (3) the ability of the BLM to install and maintain interpretive features and support facilities while protecting the cultural values of the site. Management under this use category is therefore driven more by practical considerations than by regulatory requirements. Onsite interpretation is also not appropriate for most Native American TCPs because of the possible degrading effects of public presence on the setting and feeling of these locations.

Experimental Use

Experimental use is rarely appropriate for cultural resources because of the singular, nonrenewable, and typically fragile nature of the resource. However, certain archeological sites, particularly rock shelters that contain well-defined stratified deposits might be appropriate for management under this use category. The regulatory threshold for management of cultural resources for experimental use is likely to be eligible under NRHP Criterion D, which involves the likelihood of yielding information important to expanding knowledge of history or prehistory. Archeological sites that could be adversely affected by development or other factors might also be candidates for experimental use as mitigation for adverse effects.

Discharged from Management

This use category applies to any cultural resource that the BLM and the Wyoming SHPO have determined to be ineligible for nomination to the NRHP. Sites placed in this use category "remain in the inventory, but they are removed from further management attention and do not constrain other land uses" (BLM 2004d).

Management Challenges for Cultural Resources

Prehistoric Resources

As a nonrenewable resource, cultural resources in general and prehistoric resources in particular are vulnerable to effects from use and other management actions. While the protection of cultural resources has some of the strongest regulatory basis of any of the multiple uses, increasing development, particularly oil, gas, and mineral extraction and ROW development, presents a long-term threat to the resources. Over the last 20 years, effects from development to prehistoric resources have increased in the planning area. Undiscovered buried sites are especially vulnerable to destruction during construction. Increased awareness of the potential for buried resources and improved data recovery measures have increased the knowledge of the prehistoric resources present in the planning area. Consultation prior to development and avoidance are the best management approaches.

Natural impacts to prehistoric cultural resources from weather and exposure amplify effects related to development or other management actions and public use. Within the last two decades, public knowledge of the existence and location of cultural resources has increased, while management techniques necessary to protect the resources for the future are still being developed.

Collecting, looting, and vandalism of prehistoric sites have been and continue to be serious problems and have contributed to the deterioration of sites through the loss of scientific information and effects on site integrity and context. Certain types of sites, such as rock art and historic structures have been seriously damaged from these kinds of activities. For example, Castle Gardens continues to deteriorate despite attempts to protect it. Vandalism is an ongoing problem that threatens the site, as does erosion. Vandalism has not abated, partially because the site has not been actively managed. Development and implementation of a carefully developed management plan is essential to reverse this trend. Recent analysis of the Castle Gardens site by a conservation expert will provide insight to managing this property in the future (BLM 2009b).

Historic Resources

As with prehistoric resources, increasing development presents a long-term threat to historic cultural resources. However, historic resources have not been affected as much as prehistoric resources, attributable in part to the location of historic-period resources away from present-day development activities. Over the last 20 years, effects from development to historic resources have remained unchanged but could change in the future if development begins near historic areas and sites.

Vandalism of historic sites is a greater concern than development, and continues to be a problem. Vandalism has contributed to the deterioration of several sites, especially sites that are easy to access. Certain types of historic sites, such as abandoned towns, mines, and ranches have been damaged, as is the case for the Warm Springs Canyon Flume, Natural Bridge, and geyser, where the condition continues to deteriorate. Landslides and natural weathering continue to destroy and degrade the remaining intact portions of the flume. Unless stabilization and preservation measures are implemented, the entire flume might be lost.

Management Challenges for Regionally Significant Historic Trails and Early Highways (excluding National Historic Trails)

The regionally significant historic trails and early highways discussed in this section face management challenges similar to identified cultural resources, as described above. These trails are fragile and managing surface disturbance associated with motorized travel to limit degradation of the trails is a challenge.

Spiritual, Sacred, and Traditional Resources and Properties

This resource type is hard to quantify, because locations might not be well known or monitored by federal agencies. As development activities continue, impacts to spiritual and sacred sites and TCPs have increased. However, perhaps the best known resource in this category, Cedar Ridge, remains stable. The portion of Cedar Ridge in the planning area has not had much modern development and is being managed to protect its spiritual and sacred values.

General Issues and Management Challenges for Cultural Resources

Under current management, the BLM will continue to try to meet cultural resource management goals. Pressures on cultural resources will likely increase from continued oil and gas exploration and other development, and direct and cumulative effects will continue to degrade a portion of the cultural landscape. Case-by-case inventory in compliance with Section 106 of the NHPA will prevent harm to most individual sites, but the lack of comprehensive inventory coverage will continue to hamper broad-scale interpretation and assessment of cumulative effects. Inventories would probably continue at roughly 250 or more projects per year, with inventories covering approximately 7,500 acres per year.

Impacts to prehistoric resources that cannot be mitigated could be expected to occur once every 5 to 10 years; however, as oil and gas exploration and development increases, the potential for difficult cultural resource issues also increases. Impacts to trail resources that cannot be fully mitigated are expected to occur once each year, and the historic integrity of these resources is expected to continue to degrade as time goes on.

The demand for consumptive use of cultural resources through tourism and archeological research projects is low, but anticipated to increase over time. This reflects an increasing interest in history and the fragile nature of the resource. Historic trails, particularly those falling under the NHT system, could see increased visitation. Maintaining the historic setting is critical to providing a quality experience for visitors. The setting is an essential component in determining whether a trail segment contributes to the trail's overall significance.

The effects of natural weathering also will continue; these effects do not proceed in a linear fashion. As conditions deteriorate, there is a loss of plant cover and weather resistance, and the rate of deterioration increases. As physical degradation becomes more apparent and requires more effort (money) to restore, the necessary efforts to stabilize and restore these resources would continue to increase.

Collecting, looting, and vandalism of prehistoric and historic sites, which are difficult to quantify, is nevertheless forecast to continue to be a serious problem in the planning area. These activities contribute to the deterioration of sites. Certain types of sites, such as rock art sites, rock shelters, certain open sites, and historic structures would continue to suffer damage from these kinds of activities.

New types of motorized and nonmotorized vehicles have increased the access to remote parts of the planning area. This factor has accordingly increased the vulnerability of remote cultural resource sites through human-caused activities and degradation.

3.5.2. Paleontological Resources

Paleontological resources are defined as any fossilized remains, traces, or imprints of organisms, preserved in or on the Earth's crust, that are of paleontological interest and that provide information about the history of life on Earth. Paleontological resources (or fossils) can be the altered remnants of plants or animals (body fossils), or reflect their presence or actions (impressions and trace fossils). Fossils are typically preserved in sedimentary rocks, or in unique situations, igneous rocks. Paleontological resources can be microscopic (such as single-celled animals [bacteria] or pollen), or macroscopic (such as fossils of leaves, petrified wood, shells of invertebrate animals, bones, teeth, tracks, feeding traces, and burrows) and include fossils of animals including dinosaur bones or teeth and petrified wood.

Paleontological Resources Management

Management of paleontological resources is focused on protecting vertebrate and other scientifically significant fossils for the benefit of the public. Significant fossils include all vertebrate fossil remains, and plant and invertebrate fossils determined on a case-by-case basis to be scientifically unique. Abundance of these resources varies, with some geologic formations containing few or no significant fossils, and other formations known to commonly produce significant numbers of fossils throughout the formation.

Recently signed legislation supplements existing laws and guidance regarding paleontological resources on BLM-administered lands (e.g., FLPMA, BLM Manual 8270, and BLM Handbook H-8270-1). The Paleontological Resources Preservation Act became law on March 30, 2009, as part of the Omnibus Public Lands Management Act of 2009 (Public Law 111-011). The BLM has followed up with Instruction Memoranda that reinforce policies regarding confidentiality and casual collecting in light of the new law (IM dated April 24, 2009, "Casual Collecting of Common Invertebrate and Plant Paleontological Resources under the Paleontological Resources Preservation Act of 2009" and IM dated June 5, 2009, "Confidentiality of Paleontological Locality Information under the Omnibus Public Lands Act of 2009") (BLM 2009f and BLM 2009g).

Paleontological Collection Permits and Monitoring

Collecting fossils on BLM-administered lands is allowed with some restrictions, depending on the significance of the fossils. Hobby collecting of common invertebrate or plant fossils is allowed in reasonable quantities, using only hand tools. Commercial collecting of fossils is not permitted. Collection of all vertebrate and any administratively designated plant or invertebrate fossils may be conducted only under permits issued to qualified researchers for reconnaissance work and collection of surface finds, with a 1 square meter surface disturbance limit. If the disturbance will exceed 1 square meter or require mechanized equipment, the researcher must apply for an excavation permit, which requires NEPA analysis. All paleontological resources collected under a paleontological resource use permit remain public property and must be curated in an approved repository.

The BLM Wyoming State Office issues permits and monitors these permits on an as-needed basis. In some cases, the permittee must be accompanied by a qualified paleontologist. At present, there are 31 active paleontological permits for various types of work in the planning area. Thirteen are for consultants working for land users; 17 are for research institutions performing surveys; and one is for a researcher performing excavation. The number of paleontological permits is expected to remain stable. Mitigation actions performed by qualified paleontological consultants

would lead to an increase in known fossil localities and recovery of significant fossils that would otherwise have been undiscovered. This would result in an improvement of scientific knowledge and better management of the resource in the long term.

Potential Fossil Yield Classification

The BLM utilizes the Potential Fossil Yield Classification (PFYC) system to classify the potential to discover or effect significant paleontological resources. The PFYC is intended to assist in determining proper mitigation approaches for surface-disturbing activities, disposal or acquisition actions, recreation possibilities or limitations, and other BLM-authorized activities. The system also highlights areas likely to be a focus of paleontological research efforts or illegal collecting. There are five classes of potential fossil yield, ranging from Class 1 ("No Potential") to Class 5 ("Very High Potential"), for vertebrate or scientifically important paleontological resources. The formations listed in Table 3.46, "Formations Containing "High" and "Very High" Potential Fossil Yield Classifications in the Planning Area" (p. 399) have been identified as having "high" or "very high" potential for containing fossil remains.

The formations that have high or very high potential for paleontological resources might be key features and could guide land use allocations or management decisions in the planning area (Map 70). Table 3.46, "Formations Containing "High" and "Very High" Potential Fossil Yield Classifications in the Planning Area" (p. 399) identifies these formations. Of known specific interest are the Wind River Formation (especially in the Lysite area), Mesozoic deposits in the Gas Hills and along Lander Slope, and Tertiary deposits near Bison Basin and Beaver Rim.

Table 3.46. Formations Containing "High" and "Very High" Potential Fossil Yield Classifications in the Planning Area

Formation	Age	Potential Fossil Yield Classification
White River Group	Oligocene and Eocene	5 – Very High
Wiggins Formation	Upper Eocene	5 – Very High
Washakie Formation	Upper Eocene	5 – Very High
Tepee Trail Formation	Upper Eocene	5 – Very High
Aycross Formation	Middle Eocene	5 – Very High
Wagon Bed Formation	Middle Eocene	5 – Very High
Bridger Formation	Middle Eocene	5 – Very High
Wind River Formation	Lower Eocene	5 – Very High
Indian Meadows Formation	Lower Eocene	5 – Very High
Lance Formation	Upper Cretaceous	5 – Very High
Niobrara Formation	Upper Cretaceous	5 – Very High
Cloverly Formation	Lower Cretaceous	5 – Very High
Morrison Formation	Upper Jurassic	5 – Very High
Sundance Formation	Upper Jurassic	5 – Very High
Thermopolis Shale	Lower Cretaceous	4 – High
Wasatch Formation	Lower Eocene	5 – Very High
Source: BLM 2009b		

Formations of Class 3 potential are fossiliferous units where fossil content varies in significance and abundance. For Class 3 units the management concern is moderate or cannot be determined from existing data. Class 3 units include a broad range of paleontological potential. They include geologic units of unknown potential, as well as units of moderate or infrequent occurrence of significant fossils. Management considerations cover a broad range of options and could include predisturbance surveys, monitoring, or avoidance. Surface-disturbing activities will require sufficient assessment to determine whether significant paleontological resources occur in the area

of a proposed action, and whether that action could affect the paleontological resources. In addition, these units may contain areas that would be appropriate to designate as hobby collection areas due to the higher occurrence of common fossils and a lower concern about affecting significant paleontological resources.

As shown on Map 70, the majority of the planning area is classified as Class 3 and Class 5 geological formations.

Identified Paleontological Resources

Known fossil deposits represent a relatively young period of geologic history, starting with the Upper Jurassic Era, approximately 145 million years BP. During management analyses, these formations are being scrutinized more closely for their paleontological resources. Projects in areas with the above formations exposed at or near the surface might require further paleontological assessment before or during surface-disturbing activities.

Additional knowledge of paleontological resources in the planning area would be useful to managing and protecting these resources. Site-specific areas are undergoing intense investigation from academic institutions and consulting paleontologists. Areas of interest include Cenozoic formations exposed between Boysen Reservoir and Madden, between the Antelope Hills and Crooks Mountain, near Bison Basin, and Beaver Rim, and Mesozoic formations along the Lander Front and in the Gas Hills.

Indicators of location are based on the presence of the geologic formations. Indicators of condition measure the loss of characteristics that make the fossil locality or feature important for scientific use. Natural weathering, decay, erosion, improper collection, and vandalism can remove or damage characteristics that make the resource scientifically important.

The most prolific vertebrate-bearing formations are the Wind River, Wagon Bed, White River, and Morrison Formations. The Wind River Formation has produced early mammal fossils and is the focus of several national paleontological institutions. The Wagon Bed and White River Formations contain marine vertebrate fossils such as turtles. The Morrison Formation has been shown in this area to contain dinosaur remains.

Special Management for Paleontological Resources

Recently, paleontological resource management policies have been updated for the entire BLM. Additional information about formations known to contain significant fossil resources is being gathered and applied to better manage these resources. The BLM is now actively managing paleontological resources on public land, and land uses in high or very high potential fossil yield formations might be subject to survey, monitoring, avoidance, or recovery of significant fossil resources. There is active hobby collecting of invertebrate fossils in the planning area, although information documenting this type of use is limited.

Five specific areas have been identified as “High Potential Paleontological Areas,” as follows:

Bonneville to Lost Cabin

This large area contains extensive exposures of the Wind River Formation, a high-potential formation for fossil resources. In this area, the Wind River Formation contains significant fossils of early mammals and plants from the Eocene Epoch, which dates from about 55 to 34 million

years BP. The development of early mammals after the demise of the dinosaurs is the main research focus of several institutions that work in this area.

Gas Hills

This area contains exposures of the Sundance Formation, a high-potential formation for fossil resources. In this area, the Redwater Shale of the Sundance Formation, which dates from about 155 to 160 million years BP, occasionally contains significant fossils of sea-going reptiles from the Upper Jurassic. The development of marine reptiles in North America is the main research focus of institutions that work in this area.

Lander Slope

This area contains exposures of the Morrison Formation, a high-potential formation for fossil resources from the Upper Jurassic Era. In this area, the Morrison Formation, which dates from about 156 to 147 million years BP, occasionally contains significant fossils of dinosaurs. The development of dinosaurs in North America is the main research focus of institutions that work in this area.

Beaver Rim Proposed National Natural Landmark

This proposed landmark covers an area of 1,120 acres and lies along the western end of the Beaver Divide in Fremont County. This area is considered significant for its well-defined stratigraphic sequence of Tertiary deposits, which are exposed along the slopes of the rim. The proposed National Natural Landmark (NNL) includes representative exposures of virtually complete Early Eocene Epoch through Miocene Epoch stratigraphic sequences. This nearly complete sequence is very rarely exposed and is important to the understanding of Wyoming Tertiary geology. The area also is highly representative of the geological difference between the degrading Wind River Basin to the north and west and the more stable upland Sweetwater Plateau. The possibilities of exposed fossil materials and the stark scenic beauty of the area also add to the significance of this area. The proposed NNL is composed entirely of BLM-administered public lands and the agency manages this area for protection of its natural values.

Bison Basin Proposed National Natural Landmark

This locality covers 1,280 acres and lies on the south flanks of the Sweetwater Arch in southern Fremont County, just north of the Great Divide Basin. The proposed NNL is considered significant because of its mammalian fossil remains. These remains are from late Paleocene Epoch sediments, and have been studied by several geological surveys and institutions. The fossil types have been found to be highly significant for scientific research and have been found in unusual quantities. Future use of the area for paleontological research could significantly add to the base of scientific knowledge about Paleocene mammalian typology. The proposed NNL is composed entirely of BLM-administered public lands.

Management Challenges for Paleontological Resources

Management challenges for paleontological resources focus on preservation of the resources. Increased levels of identification, avoidance, and recovery of significant fossils through increasing application of mitigation measures help to protect paleontological resources and add to the base of scientific knowledge. Although energy-related development over the next 5 to 10 years would result in increased adverse effects to paleontological resources, additional mitigation efforts would offset many of the adverse effects caused by this development and are addressed at

project-level NEPA analysis. Some significant fossils will be destroyed during surface-disturbing activities, but predisturbance surveys and onsite monitoring efforts would also protect many that would have been lost without these efforts.

Natural weathering and erosion will continue to destroy fossils and management or mitigation cannot alter this deterioration, although actions that would deter accelerated erosion would also serve to indirectly protect paleontological resources from some natural or human-caused erosion. Collecting and looting of paleontological resources, which are difficult to quantify, continue to be a problem in the planning area. These activities contribute to the deterioration of paleontological localities due to the loss of scientific information and due to the loss of locality integrity and context. Providing adequate law enforcement to deter this type of activity also remains a challenge.

3.5.3. Visual Resources

The BLM has a stewardship responsibility to identify and protect visual resources on BLM-administered lands. This section describes the BLM Visual Resource Inventory (VRI) and Visual Resource Management (VRM) systems and summarizes important visual resources in the planning area.

Visual Resource Inventory Classes

The BLM uses a VRI and VRM system, respectively, to classify the aesthetic value of its lands and set management objectives during the planning process. The system involves assessing visual values and assigning them to one of four VRI classes (Classes I to IV) based on three factors: scenic quality, visual sensitivity, and distance from travel or observation points. VRI classes are a general measure of the visual value of a landscape. Scenic quality is a measure of the visual appeal of a tract of land, while visual sensitivity is a measure of public concern for scenic quality in a given area. Distance is assessed by breaking the landscape into three zones (foreground and middleground, background, and seldom seen areas) based on relative visibility from travel routes or other observation points.

The BLM completed a VRI of the planning area in 2009 that represents the current conditions (baseline) for this document. The new VRI will provide the basis of VRM Classes and new management decisions in this RMP.

Visual Resource Inventory Classes in the Planning Area

Table 3.47, "Visual Resource Inventory Classes" (p. 402) lists acreage by VRI Classes for all lands in the planning area from the new VRI. Map 74 shows the new VRI classes, and Maps 71 through 73 show the three inventory considerations (distance zone, visual sensitivity, and scenic quality) used to develop the new inventory classes. For reference, Map 75 shows the VRM classes established in the existing 1987 RMP. Under the new VRI, the majority of the planning area is within VRI Classes III and IV.

Table 3.47. Visual Resource Inventory Classes

Visual Resource Inventory Class	BLM-administered surface (acres)
I	54,698
II	570,297
III	849,138
IV	917,434
Source: BLM 2009a	

VRI Class III and IV areas are generally on or near linear infrastructure routes, in areas undergoing oil and gas exploration or other development, and in areas with less visual variety. VRI Class I and II areas possess outstanding scenic quality and high visual sensitivity. Such areas in the planning area include Sweetwater Rocks, Beaver Rim, Sweetwater Canyon, Red Canyon, South Pass Historic Landscape, Green Mountain, the Lander Slope, and Dubois Badlands. VRI Class I and II areas associated with travel corridors include:

- Sweetwater Basin to Beaver Rim (from Highway 220 south to State Highway 287 from Muddy Gap northwest to Beaver Creek);
- Highway 28 starting at or near Commissary Hill through the South Pass historic landscape to the planning area boundary;
- State Highway 287 from the WRIR boundary north to the planning area boundary, including small portions of the Wyoming Centennial Scenic Byway;
- Highway 20/789 from Shoshoni to the WRIR line, recently designated as the Wind River Canyon Scenic Byway; and
- The NHTs and CDNST Corridors.

Visual Resource Management Classes

VRM Classes are different than VRI Classes and are established during the RMP planning process and approved in the ROD. The management classes establish a measurable standard for the amount of change allowed to a specific area's visual resource.

The following are the objectives or standards for each VRM Class:

- Class I: The objective of this class is to preserve the existing character of the landscape. This class provides for natural ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention.
- Class II: The objective of this class is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.
- Class III: The objective of this class is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.
- Class IV: The objective of this class is to provide for management activities that require major modifications to the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements.

Visual Resource Management in the Planning Area

Visual resources are currently managed according to VRM Classes established in the 1987 RMP (Map 75). The inventory that was utilized in the 1987 RMP was neither complete nor conducted under current guidance. VRM Classes were discussed in the EIS prepared for the RMP but did not update earlier management actions and VRM Classes were not transferred to the ROD.

Modern management techniques for visual resources incorporate mitigation methods and best management practices (BMPs) for minimizing the impact of BLM-authorized activities on visual resources. BMPs are utilized to limit impacts from development on visual resources. The recent trend in VRM and mitigation of impacts to visual resources has been upward, reflecting a change in earlier management that allowed developments such as citing towers on mountaintops or fencing and water development projects near the NHTs.

Currently, site-specific mitigation of impacts to visual resources is being implemented through project level analysis, with reference to the 1987 RMP and EIS. The VRI that produced these VRM Classes did not map distance zones and visual sensitivity levels. This factor contributes to an overall challenge of managing neighboring visual planning units with contrasting objectives (such as actions in a Class IV area viewed from a Class II). The route for the CDNST was delineated after the VRM Classes were established resulting in visual impacts to the trail's viewshed resulting in adverse impacts to the recreational experiences and benefits of the user.

Visual Resource Conditions

The planning area contains a moderate number of areas that possess a high degree of scenic quality and visual sensitivity. In general, high scenic quality is a product of the area's topography, geology, and cultural history. Scenically diverse vistas and canyon riverways, unusual geologic formations, colorful and highly contrasting sandstones, and numerous historic remnants contribute to the area's high scenic quality. Areas with high visual sensitivity (e.g., Split Rock, Red Canyon, Dubois Badlands, and NHTs) are the result of visitor interest in and public concern for a particular area's visual resources, an area's high degree of public visibility, the level of use by the public, or the type of visitor use an area receives.

Important Visual Resources

The planning area encompasses two major physiographic provinces, the middle Rocky Mountains and the Wyoming Basin, which form the base of the visual resources key features. Table 3.48, "Unique Scenic Features in the Planning Area, Current Management, and New Inventory Classes" (p. 405) lists unique scenic features by physiographic province, the VRM classes for the area under current management, the new VRI classes, and a short discussion of the visual characteristics in the area (factors influencing visual resource class designation and management).

Table 3.48. Unique Scenic Features in the Planning Area, Current Management, and New Inventory Classes

Unique Scenic Features	Current Visual Resource Management Class[1]	New Visual Resource Inventory Class	Factors Influencing Class Designation or Management
Wyoming Basin Physiographic Province			
Beaver Rim	II, III	II, III	The area is a large landscape feature with a lot of contrast. The area creates a strong lateral horizon line across U.S. Highway 287 and State Highway 135 corridors. The top of the rim provides views of adjacent mountain ranges and the Wind River Basin.
Burnt Ranch	II	II	The area consists of mixed private and public lands that, coupled with the historic landscape, create a viewshed with high visual sensitivity.
Castle Gardens Petroglyph Site	II, III	IV	The site is an important cultural resource area with high recreational use. Visual sensitivity in this area is high.
Cedar Ridge	III	II	The area is a high-use recreation area, with color contrast and large sandstone abutments.
Continental Divide National Scenic Trail Corridor	II, III, IV, V	II, III	The trail corridor through the planning area is an important recreation setting. Visual sensitivity along the route is high; in addition, this is part of a small section of the entire trail that displays the physiographic province.
Green Mountain	II, III, V	II, III	The area is a mountainous landscape unique to the Wyoming Basin and is popular for recreational use. The landscape contains high amounts of contrast and scenic overlooks spanning the Sweetwater Valley and Continental Divide Basin.
National Historic Trail Corridor	I, II	I, II	High visitation and public interest coupled with a historic landscape create high visual sensitivity. Adjacent views of Sweetwater Rocks and Wind River Mountains are of historical significance.

Unique Scenic Features	Current Visual Resource Management Class[1]	New Visual Resource Inventory Class	Factors Influencing Class Designation or Management
Rattlesnake Hills	II, III, IV	IV	The area contains high-contrast mountainous terrain with mixed conifer and aspen pockets unique to the physiographic province.
Red Butte	II, III	II	This is a highly visible feature from Lander and surrounding areas.
Red Canyon	I	II	The area is a designated National Natural Landmark with high visual sensitivity. The canyon is considered an identifying landscape for the Lander area.
South Pass Historic Landscape	I, II, III, IV	II, III	This landscape contains historic and prehistoric resources, developed recreation sites, and a moderate scenic quality.
Copper Mountains Lysite Mountain	II, III, IV	I, II, III	The area is mountainous and includes rugged cliffs and slopes. Views of Boysen Reservoir and Wind River Canyon complement this viewshed. The WSA in this area contributes to the area's visual sensitivity level.
Sweetwater Canyon	II	I	This canyon runs through a prairie canyon ecosystem and includes diverse topography with high-contrast riparian-wetland vegetation types such as aspen and cottonwood. The WSA in this area contributes to the area's visual sensitivity.
Sweetwater Rocks/Granite Mountains/Sentinel Rocks	II, III	I, II	There is a high degree of contrast between the high granite mountains and the adjacent plains. The area provides the backdrop for the historical trail, and the Sweetwater River is visible from many areas within the rocks. Four WSAs in this viewshed contribute to the area's visual sensitivity.
Table Mountain-Lander	II, III	II	This highly visible feature is in view from the city of Lander and surrounding areas.

Unique Scenic Features	Current Visual Resource Management Class[1]	New Visual Resource Inventory Class	Factors Influencing Class Designation or Management
Twin Creek	II, III, IV	II, III	The chugwater formations in the area create high color and landform contrast. Adjacent scenery and features add to the visual setting.
Mixed Middle Rocky Mountains and Wyoming Basin Physiographic Province			
Dubois Area	II, III, IV, V	I, II, III	This high-contrast viewshed spans floodplains, badlands, mountainous terrain, and peaks. The area serves as an identity landscape for the town of Dubois and supports a number of recreational uses. The two WSAs in this area contribute to the area's visual sensitivity.
Eastern Aspect of the Wind River Range	I, II, III	II, III	This area is within view from most residential areas near Riverton, Lander, and Hudson and produces a high degree of visual sensitivity. Numerous canyon riverways and rugged terrain support a number of recreational uses. The area contributes to several adjacent viewsheds within the planning area.

Sources: BLM 1987a; BLM 2009a

[1]The existing plan utilized an outdated classification system; management under this system included a VRM Class V. VRM Class V was established to manage areas primarily for rehabilitation or enhancement of landscape character.

U.S. United States
VRM Visual Resource Management
WSA Wilderness Study Area

Management Challenges for Visual Resources

The nature of development in the planning area and the slow rehabilitation of lands following disturbance have resulted in cumulative adverse impacts to scenic quality. The current management of visual resources to control the contrast, location, finishing, and staging of developments on BLM-administered lands allows the BLM to control for the impacts of such projects, and has helped to minimize adverse effects on visual resources in the planning area. However, impacts from the increases in recreation and tourism, travel, ROW development (especially development of large wind turbines), mineral development, activities in support of livestock grazing, and other land use disturbances still occur despite management.

Historic land uses also continue to affect viewsheds because these activities were permitted before the current system of visual contrast rating and implementation of visual mitigation were instituted. VRM objectives are being met in most places, but the challenge of meeting these objectives in the future is expected to increase. Of particular concern are areas managed to

maintain the existing visual environment (e.g., VRM Class I and II areas) that are within view of areas managed to allow more intensive development (e.g., VRM Class III and IV areas).

There have been conflicts between visual resources and these other uses in the Beaver Rim, South Pass, Oregon Trail (and other NHTs), and CDNST landscapes. Conflicts associated with visual resources typically are a product of maintaining VRM objectives and the increased importance of the visual environment to the public (due to increased use, better public access and changes in land use patterns such as the designation of the CDNST).

The visual environment may experience moderate to major modification pending the approval of large, utility-scale renewable energy development, such as wind energy, and electrical transmission lines to transport energy generated from these potential facilities. These high profile intrusions do not lend themselves to the typical sighting and design methods used to mitigate the impact to visual resources. Wind potential is higher in locations of high visual prominence at elevated locations and on ridges and rims such as Cyclone Rim or Beaver Rim. Recreational opportunities, experiences, and benefits often depend on the scenic quality of landscapes, and these developments have the potential to affect recreational use, including along the CDNST and NHTs.

3.6. Land Resources

Land resources include lands and realty, renewable energy, ROWs and corridors, comprehensive trails and travel management, livestock grazing, and recreation. Each resource section describes the resource, its existing condition, and management challenges related to the resource.

3.6.1. Lands and Realty

The lands and realty program manages BLM-administered land that supports all resource and management programs in the planning area. Management decisions for lands and realty are limited to BLM-administered public lands, although lands and realty actions during the life of the plan could involve other surface managers (through easements and land tenure adjustments). The primary activities of the lands and realty program include (1) land use authorizations such as Recreation and Public Purposes (R&PP) leases, FLPMA leases and permits, (2) land tenure adjustments, including sales and other types of disposal actions, exchanges, donations, land acquisitions and interests in lands (access easements), and (3) withdrawals, classifications, and segregations. As part of the processing of lands and realty actions, the BLM works cooperatively with other federal agencies, the State of Wyoming, cities, counties, and public and private landholders.

3.6.1.1. Land Status

The planning area is composed of mixed surface ownership totaling 6,487,464 acres (Map 1). The BLM manages the largest amount of land in the planning area, administering a total of 2,394,210 acres (Table 3.49, “Surface Ownership in the Planning Area” (p. 409)).

Table 3.49. Surface Ownership in the Planning Area

Surface Manager	Acres Managed	Percent of Planning Area
Bureau of Land Management	2,394,210	37
United States Forest Service	875,605	13
Bureau of Reclamation	125,706	2
Bureau of Indian Affairs (Wind River Indian Reservation)	1,546,505	24
United States Fish and Wildlife Service	112	<1
Department of Defense	1,340	<1
State of Wyoming	278,131	4
Private	1,223,421	19
Water	42,434	<1
Total	**6,487,464**	**100%**
Source: BLM 2009a		

There are many isolated parcels of state land and private land dispersed throughout the planning area interspersed with public land. Map 1 shows the existing surface management pattern; Table 3.50, "BLM-administered Surface by County in the Planning Area" (p. 409) lists the acreage of BLM-administered surface by county.

Table 3.50. BLM-administered Surface by County in the Planning Area

County	BLM-administered surface (acres)
Carbon	38,406
Fremont	1,933,364
Hot Springs	1,779
Natrona	297,991
Sweetwater	122,670
Total	**2,394,210**
Source: BLM 2009a BLM Bureau of Land Management	

3.6.1.2. Land Use Authorizations

Land use authorizations include various authorizations to use public surface for leases, including permits and easements under Section 302(b) of FLPMA; R&PP leases under the R&PP Act of 1926 (43 U.S.C. 869 et seq.); and airport leases under the Federal Public Airport Act of 1928, as amended (49 U.S.C. Appendix, Sections 211-213). This section briefly describes land use authorizations and the authorizing regulations for these lands and realty actions.

Leases, Permits, and Easements

Section 302(b) of FLPMA authorizes the BLM to issue leases, permits, and easements for the use, occupancy, and development of public lands. Since the 1987 RMP, the most common type of this land use authorization has been minimum impact land use permits for commercial filming on public lands. Additionally, the BLM issued permits for water well testing and monitoring and short-term equipment storage. At present, the Lander Field Office administers three land use leases: one for the Martin's Cove Site consisting of 927 acres, an agricultural lease consisting of 11 acres (authorized as resolution of unauthorized use), and a corral and barn consisting of less than 1 acre (authorized as resolution of unauthorized use). The Lander Field Office authorizes numerous easements across BLM-administered land for access to private land.

Recreation and Public Purposes Act Leases and Conveyances

The R&PP Act authorizes the BLM to lease or convey public surface to state and local governments and qualified nonprofit organizations for recreation and/or public purpose uses. Typical uses under the R&PP Act include historic monument sites, campgrounds, schools, parks, public works facilities, and hospitals. Lands are typically leased first until development of the site is completed and then, if appropriate, the BLM may convey title. Lands proposed to be leased or conveyed under the R&PP Act must first be classified as suitable for such use. R&PP classifications segregate the land from operation of the public land laws except for the R&PP Act, which precludes disposal by sale, exchange, or other means, but specifically allows for R&PP lease or conveyance. R&PP classifications also segregate the lands from operation of the mining laws, closing the area to mining of locatable minerals. R&PP classifications do not segregate lands from mineral leasing.

Since the 1987 RMP, the Lander Field Office has issued two R&PP leases for a total of 35 acres, and seven patents under the R&PP Act authority.

3.6.1.3. Unauthorized Use/Trespass

Unauthorized use/trespass is the use, occupancy, or development of public land or its resources without a required authorization, or in a way that is beyond the scope and terms and conditions of an authorization; this definition excludes uses defined as casual use in the regulations (43 CFR 2920.1-2[a]).

Existing management guides the resolution of unauthorized land uses through cessation of use, authorization by ROW, lease or permit, or disposal (though direct sale under FLPMA Section 203). The existing plan identified specific criteria for considering decisions about unauthorized use and directed that new cases of unauthorized use would generally be immediately terminated (see management challenges at the end of this section for a discussion of challenges associated with unauthorized use) (BLM 1987b). Under existing management, the BLM might issue temporary permits to provide short-term authorization, unless the situation warrants immediate cessation of the use and restoration of the land. The BLM gives highest priority to the following unauthorized uses: new authorized activities or uses where prompt action could minimize damage to public resources; cases in which delay might be detrimental to authorized users; cases involving special areas, sensitive ecosystems, and resources of national significance; and cases involving malicious or criminal activities. The most common occurrences of unauthorized use/trespass in the planning area are illegal dumping, roadways, home sites, irrigation and agricultural development, pipelines, and powerlines.

Trespass is an ongoing problem in the planning area. Limited staff and funding is a contributing factor, allowing trespass to continue unabated. When trespass actions go undetected or unresolved, there is no incentive or deterrent for offenders to cease further trespass action. At present there are 30 unresolved potential unauthorized use/trespass cases pending in the planning area. On average, the Lander Field Office resolves one unauthorized use/trespass case per year. Resolution of trespass in the planning area includes payment of administrative costs, rental value for period of use, penalties (assessed based on the non-willful, willful, or repeated willful nature of the use), and can include removal, rehabilitation, and restoration of affected lands or authorization of the use. Authorization of an unauthorized use/trespass in the planning area, when appropriate, has been accomplished through issuance of a land use permit, land use lease, or a ROW, whichever authorization is most appropriate based on the use.

3.6.1.4. Land Tenure Adjustments

Adjustments to land ownership (land tenure) are an important component of the BLM land management strategy. The Lander Field Office completes land tenure adjustments when such transactions are in the public interest and consistent with local land use plans. Land tenure adjustment refers to lands and realty actions that result in the BLM disposing of public land or acquiring non-federal lands or interests in lands. FLPMA requires that public land be retained in public ownership unless, as a result of land use planning, disposal of certain parcels is justified. Parcels designated as potentially available for disposal are more likely to be conveyed out of federal ownership through an exchange rather than a sale. Acquisition of land and interests in lands are important components of the BLM land tenure adjustment strategy. Acquisition of and interests in land can be accomplished through several methods, including exchange, purchase, donation, and condemnation (there have not been nor are there likely to be donation or condemnations in the planning area). The BLM often acquires lands and interests in lands for the following actions:

- Improve management of public land resources through consolidation of federal, state, and private lands.
- Secure key property necessary to protect endangered species, promote biological diversity, increase recreational opportunities, and preserve archeological and historical resources.
- Implement specific acquisitions authorized or directed by acts of Congress.
- Improve access to BLM-administered lands across private lands.

The land ownership pattern in the planning area mainly consists of large blocks of public land surrounding scattered parcels of private and state lands (Map 1). The percentage of ownership in the planning area is identified in Table 3.49, "Surface Ownership in the Planning Area" (p. 409). In addition to these large blocks, there are areas of scattered public lands within parcels of state and private lands. These scattered parcels can be difficult to manage as part of the public land system. In many cases the small size of the scattered parcels, their isolation from other parcels of public land, and lack of legal access can make their retention in public ownership of marginal utility. Occasionally, these isolated parcels can serve other resource purposes, such as providing wildlife habitat in an area that has been fragmented by suburban development.

Appendix R (p. 1517) identifies lands that the public proposed for land tenure adjustment. These lands are not on the list of lands being carried forward from the existing plan as lands that the BLM has identified for land tenure adjustment. The public proposed these lands for a variety of reasons such as for protecting wildlife habitat and open space and preserving cultural, historic, and recreational values.

Purchases

Under Section 205 of FLPMA, the BLM has the authority to purchase lands or interests in lands. Similar to other acquisitions, purchase is used to acquire key natural resources or to acquire legal ownership of lands that enhance the management of existing public lands and resources. Acquisition of land through purchase helps consolidate management areas to strengthen resource protection. Acquisition of land by purchase is used sparingly given the limited funds available through appropriations.

The primary purpose of purchase within the planning area has been to provide easements or access to BLM-administered lands or for the benefit of other resources such as wildlife management areas. The federal Land and Water Conservation Fund provides money to federal agencies, as well as state and local governments, to acquire land that would benefit the public such as for improved recreational access and the protection of historical sites. Acquiring access easements across non-federal lands for roads and trails provides for legal public access to "landlocked" public lands and for the connectivity of trails. Easement acquisition has been a long-term goal in the planning area, primarily because of the scattered land pattern. Since the 1987 RMP, the Lander Field Office has obtained 12 easements for access. A typical example of an easement in the planning area is the Shoshone Lake Road easement, which provides public access to BLM-administered lands.

Public scoping has identified areas in which improved access to BLM-administered lands would improve public access. Improved public access would likely be accomplished through the acquisition of easements (through purchase or donation) or acquiring lands or interests in lands for access through exchange or donation. The Sweetwater Rocks has been identified as a particular area in which improved access would benefit public use of BLM-administered land.

Land Disposal (Land Sales)

Public lands have the potential for disposal when they are isolated and/or difficult to manage. Disposal actions are usually in response to a public request, such as community expansion. Disposals result in a title transfer, wherein the lands leave the public domain. The BLM coordinates all disposal actions with adjoining landowners, local governments, and existing land users.

The BLM manages public sales under the disposal criteria set forth in Section 203 of FLPMA. Public lands determined suitable for sale are offered on the initiative of the BLM or through a public nomination/request for sale. The BLM does not sell lands for less than fair market value. The RMP must identify lands suitable for sale. Any lands to be disposed of by sale that are not identified in the current RMP require a plan amendment. Lands identified for disposal under current management are identified in Appendix S (p. 1521).

At present, there are two categories for lands identified for disposal in the planning area. Lands identified for disposal with restrictions must meet specific restrictions before they can be disposed. These restrictions include limitations to whom the lands can be disposed to (such as lands that can only be disposed of to the WGFD) or the purposes for which the lands may be used, and the resource values that must be acquired if a parcel of land is disposed through exchange (lands must be acquired with similar or higher resource values than the lands that are disposed of). The remaining lands identified for disposal are general lands identified for disposal with no specific restrictions. A total of 1,475 acres of BLM-administered surface lands are identified for disposal with restrictions in the planning area, and 8,053 acres of BLM-administered surface lands are identified for disposal without restrictions (Map 94).

Since approval of the existing plan, approximately five parcels, totaling 1,468 acres of BLM-administered surface, have been disposed of under the authority of Section 203, including the Riverton Landfill and Railroad Grade to South Pass City.

Exchanges

Exchange is the process of trading lands or interests in lands between the BLM and a second landowner. Conducted under the authority of Section 206 of the FLPMA, exchange is a tool that

enables the BLM and other landowners to improve land management, consolidate ownership, and protect environmentally sensitive areas. By exchanging public land that is isolated and difficult to manage, the BLM is able to acquire other lands with importance for recreation, wildlife, fisheries, wetlands, habitat for threatened and endangered species, wilderness, open space, scenic, cultural and other resource conservation purposes. Land exchanges allow the BLM to reposition lands into more manageable units and to meet community expansion needs.

Exchange is the preferable means by which land is disposed of and primarily the means by which land is acquired. Except for exchanges that are congressionally mandated or judicially required, exchanges are voluntary and discretionary transactions with willing landowners. Lands to be exchanged must be of approximately equal monetary value and in the same state. Exchanges must also be in the public interest and conform to applicable BLM land use plans and other relevant guidance.

Since approval of the 1987 RMP, three exchanges have been completed that affected lands in the planning area. The Steers exchange (80 acres) allowed the Lander Field Office to acquire lands for wildlife and recreation. The Red Creek (2,862 acres acquired) and Eastman (1,030 acres acquired) exchanges facilitated the acquisition of lands in the Whiskey Mountain area for the protection of bighorn sheep range and sensitive cultural areas. In recent years, there has been only modest exchange activity in the planning area, although interest in exchanges is increasing.

Lands Identified for Retention

The FLPMA enunciates a federal policy of retention of BLM-administered lands for multiple use management, unless the lands are specifically identified for disposal (through the land use planning process) and would serve the public interest (such as classification and ultimate disposal under the R&PP Act). Pre-FLPMA classifications also identified lands that were classified for retention.

Lands identified for retention in the planning area are BLM-administered surface lands not identified for disposal. The BLM is to retain the parcels identified for retention for multiple use management, but the agency may consider the parcels for disposal on a case-by-case basis. At present, there are 2,386,157 acres of BLM-administered surface identified for retention in the planning area (Map 94).

3.6.1.5. Withdrawals and Classifications

Lands are withdrawn under the authority of Section 204 of the FLPMA or by Congressional Act. A withdrawal is a formal action that withholds an area of public land from specific actions, such as settlement, sale, location, and entry under the mining laws (locatable mineral development). Withdrawals are made with the purpose of limiting activities under those laws in order to maintain other public and resource values in the area, to reserve the area for a particular public purpose or program, or to transfer jurisdiction over an area of federal land from one department, bureau, or agency to another. Withdrawals are established for a wide range of public purposes, including military reservations, reclamation projects, and power site reserves.

The BLM has established withdrawals in the planning area to close specific sites and protect existing resource values (such as wildlife, sensitive species habitat, and historic and cultural sites) as part of the classification process (in preparation for lease or conveyance of land) and to transfer public land to other federal agencies to accomplish their mission goals. Existing withdrawals, classifications, and other segregations in the planning area are identified in Table 3.51, “Existing Withdrawals, Classifications, and other Segregations in the Planning Area” (p. 414) and

withdrawals are displayed on Map 21. At present, approximately 31,767 acres in the planning area are withdrawn from location and entry under the Mining Laws including 8,634 acres of pre-FLPMA segregations (as discussed below).

Table 3.51. Existing Withdrawals, Classifications, and other Segregations in the Planning Area

Name	Acres	Segregates/Withdraws from	
		Disposal	Locatable Minerals
Resource Protection			
Elk Range	11,085	X	X
Elk Pasture	3,229	X	X
Whiskey Mountain Big Horn Sheep Winter Range	11,019	X	X
Warm Springs Canyon	188		
Oregon Trail (Sites along the Oregon Trail that are withdrawn are identified below)	315	X	X
Split Rock (NRHP and Interpretive Site)	887	X	X
Devil's Gate (Including Interpretive Site)	508	X	X
Rocky Ridge Site	555	X	X
Aspen Grove Site	889	X	X
Castle Gardens	78	X	X
Martins Cove	927	X	X
Green Mountain (Campground and Picnic Sites)	100	X	X
Wildhorse Point	20	X	X
South Pass Area	751	X	X
Miners Delight NRHP Site	173	X	X
South Pass City NRHP Site	698	X	X
Yermo Xanthocepalus (Desert Yellowhead) plant habitat	357	X	X
Classifications			
R&PP Classifications	247	X	X
Land Patents (Under Section 203 & 206 of FLPMA or R&PP Act Conveyances)	1,899	X	X
Proposed Land Exchange	122	X	X
Classification and Multiple Use	1,623	X	X

Source: BLM 2009a

FLPMA Federal Land Policy and Management Act
NRHP National Register of Historic Places
R&PP Recreation and Public Purposes

Pre-FLPMA classifications also identified lands for segregation from application of the mining laws. These segregations (8,364 acres), adopted through Act of Congress, are not subject to the time limits of segregations and withdrawals under current mineral laws. Lands proposed to be leased or conveyed under the R&PP Act must first be classified as suitable for such use. R&PP

classifications segregate the land from operation of the public land laws except for the R&PP Act, which precludes disposal by sale, exchange, or other means, but specifically allows for R&PP lease or conveyance. R&PP classifications also segregate lands from operation of the mining laws, closing the area to mining of locatable minerals. R&PP classifications do not segregate lands from mineral leasing (oil and gas development). R&PP leases and conveyances reserve all minerals in the land to the United States. At present, there are no pending R&PP classifications in the planning area associated with an application through the R&PP Act, although two potential R&PP leases for recreational use have been identified as possible actions to be considered to meet identified public demand. A small number of R&PP applications are expected over the next two decades in the planning area. Public land could be needed for expansion of existing facilities and for new facilities to support growing local communities. The growth of Lander, Riverton, and Dubois has been slow but steady for the last decade. However, the small amount of BLM-administered land near the growth areas is also important to wildlife and recreational uses, and might not meet the BLM's criteria for disposal.

Some lands in the planning area that were previously used for uranium mill sites, processing, and storage of processing waste (tailings) should be managed by the DOE for long-term monitoring and oversight due to radioactivity levels in the tailings. There are several former mill sites for which this process is underway in the planning area. Lands transferred to the DOE are withdrawn from operation of public land laws, mining laws, and all other public activities. The area currently identified is approximately 2,100 acres, but it is likely that additional areas will be identified in the future. Refer to the *Locatable Minerals* section of this chapter for more information.

Management Challenges for Lands and Realty

A variety of management challenges exist for the lands and realty program based on historic activities and trends as well as current and future needs of public resources by both internal and external customers. Most management challenges for the lands and realty program are associated with balancing land tenure adjustments and land use authorizations with the maintenance of BLM resource objectives and the needs and desires of the public and other federal agencies.

Managing isolated tracts of BLM-administered lands surrounded by private land poses considerable challenges by limiting administrative access to carry out management and fulfill management objectives. In some cases, new owners of recently transferred private land in the planning area no longer allow the BLM to cross their private land to access BLM-administered land. Facilitating access to these parcels through acquiring easements or considering land tenure adjustments to resolve access issues is a management challenge for the lands and realty program. Subdivision of private land in the planning area also creates challenges related to the access of BLM-administered lands by both private users and for administrative access by the BLM. Subdivision of private land also creates fragmentation and isolates BLM-administered lands. Additional management challenges associated with access result from limited or unavailable access to BLM-administered lands by recreational users, resulting in unauthorized access across private land. Challenges associated with recreation access are an issue in the Sweetwater Rocks area.

Unauthorized use and illegal dumping are additional management challenges for the lands and realty program. Trespass actions such as illegal dumping can cause unmitigated damage to public lands and natural resources. If the BLM is unable to identify a responsible party, the cost to resolve trespass and to clean up and reclaim the affected public land is often passed on to the public. These costs direct appropriated funds away from planned work and affect the BLM's

ability to complete its mission. In addition, the public does not realize the fair market value for unauthorized use of the public lands. Unauthorized use has increased in the planning area due to increased motorized vehicle use, which allows access to previously inaccessible areas.

The BLM faces a staffing and resources challenge related to resolving unauthorized use issues and fulfilling other lands and realty actions (such as reviewing leases and permits, performing cultural and biological surveys before a land tenure adjustment, monitoring land conditions, and ensuring ROW compliance). The increasing number of applications for ROWs for wind-energy development and other land use authorizations requires considerable time and effort for lands and realty personnel to process. This constrains the time and availability of lands and realty personnel to fulfill other related actions.

3.6.2. Renewable Energy

Solar, wind, biomass, and geothermal resources are considered renewable energy resources. Wind energy produces electrical energy through the use of large wind turbines. Solar power refers to energy from the sun that is converted into thermal or electrical energy. Geothermal energy is derived from the heat stored in the interior of the Earth. Biomass energy is the burning or use of organic materials as a source of energy. Wind, solar and biomass facilities are processed through the lands and realty program and authorized under Title V of the FLPMA as ROW actions. Geothermal resources are considered a fluid leasable mineral, and the BLM processes geothermal actions according to the provisions of the Mineral Leasing Act, see the *Leasable Minerals – Geothermal* section.

The BLM policy is to encourage the development of renewable energy in acceptable areas. Additionally, Executive Order 13212, Actions to Expedite Energy-Related Projects (May 18, 2001), instructs the BLM "to expedite projects that will increase the production, transmission, or conservation of energy." As demand has increased for clean and viable energy to power the nation, consideration of renewable energy sources on BLM-administered land has become a necessary component of land management planning.

In March 2009, the Secretary of the Interior issued a secretarial order making the production, development, and delivery of renewable energy on public land a top priority for the DOI. In addition to making renewable energy production a top priority for the department, the secretarial order established an energy and climate change task force to spur the renewable energy agenda and identify specific zones on U.S. public lands where the DOI can facilitate a rapid and responsible move to large-scale production of solar, wind, biomass, and geothermal energy.

In cooperation with the DOE National Renewable Energy Laboratory (NREL), the BLM assessed renewable energy resources on BLM-administered land in the western United States, including Wyoming (BLM and DOE 2003). The BLM reviewed the potential for solar power, wind, biomass, and geothermal energy on DOI, Bureau of Indian Affairs, and USFS lands in the western United States. Additional programmatic level documents for wind, geothermal, and solar (a Draft Solar PEIS is under development) describe development potential and policies and BMPs for renewable energy resources on public lands. Development of renewable energy resources on public lands follows policy and BMPs identified in these PEISs and other resource specific guidance.

Based on current policy direction and advances in technology, there is potential for renewable energy development in the planning area during the life of this RMP. Resource potential and

the affected environment for all types of renewable energy resources in the planning area are discussed below. Wind energy has the highest potential for development in the planning area, and is discussed in more detail than other renewable resources.

Wind Energy

The BLM completed a ROD for a Wind Energy Development Program in 2005 for the western United States (BLM 2005a). The ROD amended the Lander RMP by implementing Programmatic policies and BMPs for wind-energy development in the planning area. Subsequent policy (IM 2009-043) has provided additional guidance for wind-energy development on BLM-administered land. The BLM issues ROW grants for wind energy projects for: specific sites for meteorological towers, sites for meteorological towers and a project area (for the purpose of excluding other wind energy ROWs while site testing and monitoring is being completed), and for full wind-energy development.

Applicants may apply for ROW grants for one of the following types of wind energy projects:

- A site-specific wind energy site testing and monitoring ROW grant for individual meteorological towers, access to the sites, and instrumentation facilities with a term limited to three years.

- A wind-energy site testing and monitoring ROW grant for a larger site testing and monitoring project area, with a term of three years that may be renewed beyond the initial three year term.

- Long-term commercial wind-energy development ROW grant with a term that is not limited by the regulations but usually is in the range of 30 to 35 years.

Wind power classifications are used to identify wind resource potential based on wind power density at 50 meters above ground level. Wind power classes, as identified by the NREL, range from 1 (lowest) to 7 (highest) (Table 3.52, "Wind Energy Potential by Wind Power Class in the Planning Area" (p. 417)). The BLM wind energy PEIS determined which areas on BLM-administered lands have low (classes 1 and 2), medium (class 3), and high (wind power classes 4 to 7) potential for wind-energy development based on their wind power classification. Wind power is considered economical for large turbines (commercial utilities scale) at class 3 and higher, although a small noncommercial turbine can be used at class 1. Wind resource potential in the planning area varies from poor to superb (Table 3.52, "Wind Energy Potential by Wind Power Class in the Planning Area" (p. 417)). The majority of the planning area is rated as wind-power class 4 or lower. Less than 5 percent of the planning area is rated at wind-power classes 6 and 7.

Table 3.52. Wind Energy Potential by Wind Power Class in the Planning Area

Wind-Power Class	Resource Potential	Wind Speed (mph)	Planning Area Total		BLM-administered Surface	
			Acres	Percent	Acres	Percent
1	Poor	0-12.5	528,652	16	319,576	13
2	Marginal	12.5-14.3	658,185	20	423,753	18
3	Fair	14.3-15.7	969,347	29	718,339	30
4	Good	15.7-16.8	743,242	22	587,432	25
5	Excellent	16.8-17.9	307,888	9	240,402	10
6	Outstanding	17.9-19.7	120,210	4	88,195	4

Wind-Power Class	Resource Potential	Wind Speed (mph)	Planning Area Total		BLM-administered Surface	
			Acres	Percent	Acres	Percent
7	Superb	> 19.7	23,365	<1	16,512	<1

Source: BLM 2005a; BLM 2009a

Note: The estimates have been validated by the National Renewable Energy Laboratory; however, the numbers are just measurements and should be confirmed by direct measurement.

mph miles per hour

There are areas with high wind energy potential (mostly classes 5 and 6) in the south and southeast portions of the planning area in the Green Mountains south of Jeffrey City and in the Antelope Hills east of Atlantic City and South Pass City (Map 96). There are other areas with high wind energy potential (classes 5 and 6) along the Rattlesnake Range and in the north central portion of the planning area near the border of Hot Springs and Fremont Counties north of Shoshoni. Most of these high potential areas are closed due to designated NHTs and/or core greater sage-grouse habitat.

In addition to wind power class ratings, other factors influence the potential for wind-energy development in the planning area. Proximity to transmission lines to transfer energy produced at wind facility sites influences the potential for wind energy facilities. Protections to avoid adverse impacts to other resources and resource programs also affect the potential for wind-energy development in the planning area. Large wind turbines are often considered a visual intrusion and affect the visual landscape. Adverse impacts to other resources and management objectives of resources can also be limiting factors to the development of wind energy resources. Other key factors affecting wind-energy development potential in the planning area are the Congressionally Designated National Historic and Scenic Trails and WSAs, which are excluded from development through the BLM wind energy PEIS.

In the planning area, there is currently one ROW grant for installation of meteorological towers for wind site testing and monitoring, which includes a project area (17,456 acres of BLM-administered surface) where no additional facilities are authorized (BLM 2009b). The authorization for the project area serves to exclude issuance of other wind ROW grants.

Solar Energy

The BLM processes solar energy ROW applications for lands under its Solar Energy Development Policy (BLM 2010e). The DOE's Energy Efficiency and Renewable Energy Program and the BLM are preparing a solar energy development PEIS to evaluate utility-scale solar energy development, to develop and implement Agency-specific programs that would establish environmental policies and mitigation strategies for solar energy projects, and to amend relevant BLM land use plans with the consideration of establishing a new BLM solar energy development program.

Although the PEIS does not specifically include Wyoming, policy direction, BMPs, and mitigation would likely be applied to any solar development projects in Wyoming.

There are no commercial level solar facilities or applications for commercial level solar facilities in the planning area. If any commercial or industrial level application were received, it would need to be evaluated to determine if it was within the reasonably foreseeable development considered in this RMP and EIS. If not, a plan amendment would likely be needed.

Based on the findings of the Renewable Resource Assessment Project (BLM and DOE 2003), there are no locations in the planning area that receive a high amount of solar insolation (6

kilowatt-hours per square meter per day or higher). As a result, the potential for development of solar resources in the planning area is unlikely. Advances in technology and policy direction encouraging the development of solar energy resources during the life of the RMP could improve the potential for solar development in the planning area; however, the widespread development of solar facilities is not likely.

Biomass Energy

Biomass power is obtained from the energy in plants and plant-derived materials, such as food crops and grassy and woody plants, residues from agriculture or forestry, and the organic component of municipal and industrial wastes. Biomass can be used for direct heating (such as burning wood in a fireplace or wood stove) and for generating electricity or it can be converted directly into liquid fuels to meet transportation energy needs.

There are currently no biomass facilities and no pending applications for biomass facilities in the planning area. The potential for biomass energy facilities in the planning area is low due to low precipitation, a short-growing season, allocation of grassland resources to livestock grazing, and minimal availability of commercial timber land. Increases in pine beetle kill timber could raise the potential for biomass energy production in the planning area; however, large-scale use of beetle kill timber for biomass energy production is limited by the amount of timber land in the planning area.

Geothermal Energy

Geothermal resources are considered a fluid leasable mineral and are processed according to the provisions of the Mineral Leasing Act. Geothermal resources are discussed in the *Mineral Resources* section of this chapter.

Management Challenges for Renewable Energy

The potential development of wind energy resources presents a management challenge in the planning area. To increase efficiency and power production from wind energy, turbines are becoming increasingly taller and have larger footprints. The increased magnitude of these structures creates management challenges in meeting objectives for other resources caused by visual intrusions on the landscape, surface disturbance, and other associated impacts. Most high wind potential areas in the planning area are in close proximity to Congressionally Designated Trails and greater sage-grouse Core Area. Development of large wind turbines could create substantial adverse impacts to both Congressionally Designated Trails (due to visual impacts) and greater sage-grouse cores areas (due to disturbance during construction, habitat fragmentation, and increased predation from raptors perching on wind turbines).

An important management challenge associated with renewable energy resources is the ability to transmit power generated from renewable energy sources to the grid and to deliver it to the load centers. There is no excess capacity for transmitting power out of the planning area and the development of new power transmission lines in the planning area would increase management challenges associated with linear infrastructure development, such as disturbances to resources and increased demands on BLM personnel for ROW grants. Like wind turbines, power transmission lines include vertical structures, but also introduce a linear feature that can be particularly noticeable on a visual horizon on certain landscapes. Adverse impacts to other resources and resource programs from the development of renewable energy facilities can create additional management challenges.

3.6.3. Rights-of-Way and Corridors

Section 501 of FLPMA authorizes the BLM to grant ROWs for infrastructure and facilities that are in the public interest and require ROWs over, under, upon, or through BLM-administered lands. The BLM ROW program consists of the evaluation, authorization, and management of ROWs, including corridors, for a variety of uses on BLM-administered land. A ROW grant is an authorization to use specific pieces of public land for certain projects, such as developing roads, pipelines, and transmission lines. The grant authorizes rights and privileges for a specific use of the land for a specific period. A ROW corridor is an area with specific boundaries that has been designated as the preferred location for certain specific uses, while it excludes others. Land uses that typically do not require a ROW are those defined as "casual use" (43 CFR 3809.5). Casual use activities are those involving practices that do not ordinarily cause any appreciable disturbance to BLM-administered lands, resources, or existing improvements.

An important component of the ROW program is the intrastate and interstate transportation of commodities that are ultimately delivered as utility services (e.g., natural gas and electricity) to residential and commercial customers. Equally important on the local level is the growing demand for legal access to private homes and ranches using ROW grants. While the majority of existing ROW actions in the project area are for linear facilities, there are also many existing site ROWs for non-linear communication sites, well pads, compressor sites, water reservoirs, and energy resource distribution and transmission.

Under current management, ROW corridors are not formally designated other than the Westwide Energy Corridor; however, areas are identified for avoidance by major utility ROWs (Map 101). The BLM and other agencies (DOE and the USFS) prepared a PEIS for the Designation of Energy Corridors on Federal Land in Eleven Western States. The PEIS evaluates potential impacts associated with the proposed action to designate corridors on federal land in 11 western states (including Wyoming) for oil, gas, and hydrogen pipelines and electricity transmission and distribution facilities. The ROD for the PEIS amended the existing Lander RMP by designating energy corridor 79-216 (Westwide Energy Corridor) as a multi-modal energy corridor. A small portion of energy corridor 79-216 runs through the northeast portion of the planning area in a northwest to southeast direction (Map 105); there are no other designated corridors in the planning area.

ROW avoidance in the planning area is identified for areas with the greatest potential conflicts. Areas currently designated as ROW avoidance areas are generally associated with existing ACECs. Within WSAs, existing ROWs may be renewed if they are being used for their authorized purpose. The existing plan identified six WSAs, including the Copper Mountain WSA, the Sweetwater Canyon WSA, and four WSAs in Sweetwater Rocks. In January of 1990, two additional WSAs, the Dubois Badlands WSA and the Whiskey Mountain WSA, were designated in the planning area. New ROWs in WSAs may be approved for temporary uses if they satisfy the non-impairment criteria (Section III. C. 3 of BLM H-8550-1).

The existing plan encourages ROWs to be co-located where possible. This practice also serves to meet the ROW program objective of protecting natural resources through limiting the proliferation of scattered ROWs. Co-location of ROWs encourages proponents to site facilities where there are similar existing authorized uses. Examples of this would be siting of a power distribution line (linear facility) along the alignment of an existing highway or pipeline ROW (also linear). Although not formally designated as a ROW corridor, the Beef Gap area has been a

concentration area for ROWs; however, there is no more ROW capacity in the Beef Gap area and the BLM is not considering any more authorizations in this location.

The BLM authorizes ROWs in the planning area for the development of powerlines, communication facilities, access roads, water-related facilities (wells and pipelines), and pipelines and ancillary facilities for the transportation and delivery of mineral-related commodities. A total of approximately 1,060 existing ROWs are authorized in the planning area (Table 3.53, "Existing Rights-of-Way in the Planning Area" (p. 421)). Roads, pipelines, and powerlines comprise the largest amount of ROW authorizations by type in the planning area.

Table 3.53. Existing Rights-of-Way in the Planning Area

Authorization Type	Number of Existing Right-of-Way Authorizations
Roads	272
Pipelines and Associated Sites	271
Powerlines and Associated Sites	262
Telephone and Fiber Optic Lines	92
Water Facilities, Ditches and Reservoirs	55
Federal Highway Administration Roads and Material Sites	74
Established Communication Sites (Multiuser)	3
Communication Use Authorizations	31
Total	**1,060**
Source: BLM 2009b	

Communication sites are authorized under a lease. Communication sites are typically a site ROW, which consists of facilities such as small buildings, towers, antenna and other structures. Communication site concentration areas are typically located on mountaintops, ridgelines, or other high elevation areas to allow uninterrupted transmission of the associated communication signal. There are approximately 34 communication site and use authorizations in the planning area (not including telephone and fiber optic lines). The existing plan did not identify preferred locations for communication sites in the planning area. Current management has authorized communication sites on a case-by-case basis; however, communication sites have been concentrated in four multiple owner-approved areas within the planning area including Horse Heaven, Cedar Rim, Crooks Mountain, and the Atlantic City/South Pass communication site areas (Map 105). Communication site plans have been prepared for each of these communication site areas. The plans govern specific development and management of communication sites in the area. Regularly updated information on communication site facilities, concentration areas, links to site plans and other information for communication sites in the planning area can be found on the BLM website at http://www.blm.gov/commsites/.

In the past 10 years, regional demand for ROWs on BLM-administered land in the planning area has increased (BLM 2009b). Much of this demand has focused on conveyance of energy products through and from the sparsely populated western states to population centers, most recently dominated by west coast power demands. The upsurge in exploration and development of fuels such as natural gas has resulted in the need for more pipelines and higher pipeline capacities. Technological advancements have also resulted in new demands on public land, largely related to wind energy and communication sites for telecommunications (e.g., cellular and fiber optic).

Under the current rate of development, areas where there are major ROWs in common could become more heavily used. Crowding is not anticipated (BLM 2009b), although there are certain areas of capacity limitation such as in the Beef Gap area. Designation of ROW corridors would

serve to protect natural resources by identifying areas where installation of new major ROWs would result in the least impacts to sensitive resources.

If the current rate of development continues and there is no additional electrical generation, the existing transmission infrastructure is expected to adequately meet future needs over the next 10 to 20 years (BLM 2009b). Existing electrical power transmission infrastructure is considered inadequate to support additional utility-scale power generation in the planning area. In the event utility-scale power facilities are developed in the planning area, there would likely be a need to upgrade or construct new transmission lines to distribute the generated electricity (BLM 2009b). Due to the interest the Lander Field Office is experiencing in ROW grants for wind site testing and monitoring, there is potential for limited utility-scale wind-energy development (discussed in more detail in the *Renewable Energy* section), which would most likely require additional transmission infrastructure. Natural gas pipeline capacity is also limited in some areas, and depending on the future development of mineral resources, there could be a need for new natural gas pipelines in the planning area (BLM 2009b).

Management Challenges for Rights-of-Way

Management challenges for ROWs include meeting national and regional demands for energy, telecommunications, and other services while balancing management objectives for other resources. The lack of designation of ROW corridors in the existing plan has presented management challenges.

Disturbance and resource impacts associated with ROW authorizations and the development that they allow creates management challenges in reaching management objectives for other resources and resource uses. Major infrastructure associated with ROW development, including large high-voltage transmission lines and wind turbines, creates a variety of adverse resource impacts, including impacts to visual resources, soil erosion, habitat fragmentation, and disturbance of greater sage-grouse habitat.

The central location of the planning area in Wyoming creates additional management challenges associated with disturbance from the development of large high-voltage transmission lines (and other intrastate and interstate linear infrastructure development). There are currently at least seven proposed major transmission lines (345 or more kilovolts) under consideration in Wyoming to support nationally reliable energy infrastructure and facilitate the development and transmission of renewable energy (WIA 2009). Due to the central location of the planning area, it is likely that at least a few of these major transmission lines will pass through the planning area to deliver energy from production areas in Wyoming and the Great Plains states to load centers in other western states.

Another management challenge for ROWs has been created by recent planning efforts in adjacent BLM field offices, specifically the Casper Field Office and the Rawlins Field Office. Through RMP revisions, these field offices have designated ROW corridors that terminate at the Lander Field Office planning area boundary, where the Lander Field Office has not designated corridors (Map 105) and is unlikely to because of serious resource conflicts such as Congressionally Designated Trails and historic sites. The Lander Field Office is working with the Bighorn Basin RMP plan revision and the Rock Springs Field Office to better coordinate adjoining land management. This constitutes a major planning gap between BLM field offices that limits the ability for proponents to gain connectivity for facilities and energy infrastructure. As ROW applications for linear infrastructure to transport energy and other commodities increase in

Wyoming, the lack of consistency and location of ROW corridors between field offices increases processing time and creates inefficiencies for both the BLM and private sector clients.

Increased demand for ROW authorizations and the management challenges described above place limitations on the ability of BLM personnel to process ROW applications in a timely manner, to conduct other lands and realty related actions, and to fulfill other BLM responsibilities. Management challenges associated with increased ROW applications and other demands on BLM personnel are expected to increase in the future.

3.6.4. Comprehensive Trails and Travel Management

Travel and transportation are a part of virtually every activity on BLM-administered public lands, including recreation, livestock management, wildlife management, management of commodity resources, ROWs to private in-holdings, maintenance of electronic sites, and management and monitoring of public lands. The transportation network on public lands in the planning area consists of federal and state highways, county roads, and roads built to facilitate industrial and commercial development (Map 81). Map 82 through Map 85 show the detailed transportation network in and around Jeffrey City, Lander, Lysite, and the Dubois areas.

Comprehensive trails and travel management is the proactive management of public access, natural resources, and regulatory needs to ensure consideration of all aspects of road and trail system planning and management. This includes resource management, road and trail design, maintenance, and recreational and nonrecreational uses of the roads and trails. Travel in the context of comprehensive trails and travel management incorporates access needs and the effects of all forms of travel, both motorized and nonmotorized. Comprehensive trails and travel management planning involves providing specific direction on the proper levels of land and water access for all modes of travel. Travel management objectives are the foundation for appropriate travel and access prescriptions.

Travel Management Designations

All public lands are required to have travel management designations. Federal regulations (43 CFR 8342.1, designation criteria) state that "the Authorized Officer shall designate all public lands as either open, limited, or closed to off-road vehicles. All designations shall be based on the protection of the resources of the public lands, the promotion of the safety of all the users of the public lands, and the minimization of conflicts among various uses of the public lands." Subsequent travel guidance at the national level (e.g., the OHV management strategy [BLM 2001], the mountain bike action plan [BLM 2002b], and a nonmotorized/nonmechanized management strategy [in development]) has provided the BLM direction to proactively apply these designations to all forms of travel (mechanized and other forms of nonmotorized travel) where necessary to conserve natural resources while providing for ample recreation opportunities (BLM 2009b).

Travel management designations apply to existing ROWs in the following manner: The State of Wyoming and various counties in the planning area may hold valid existing ROWs in the planning area pursuant to Revised Statute (RS) 2477, Act of July 28 1866, chapter 262, 8, 14 Stat. 252, 253, codified at 43 U.S.C. 932. On October 21, 1976, Congress repealed R.S. 2477 through passage of FLPMA. This RMP does not adjudicate, analyze, or otherwise determine the validity of claimed ROWs. However, nothing in the RMP extinguishes any valid ROW, or alters in any way the legal rights the state and counties have to assert and protect RS 2477 rights or to

challenge in federal court or other appropriate venue any use restrictions imposed by the RMP that they believe are inconsistent with their rights.

Open

Lands designated as open are available for travel, on or off established roads and vehicle routes, as long as this activity does not cause unacceptable levels of resource damage. Areas are designated as open to motorized travel based on analysis that determines there are no compelling resource protection needs, user conflicts, or public safety issues to warrant limiting cross-country travel. Demand for open areas in the Lander Field Office tend to be in locations close to towns. Potential does exist to explore options to manage open areas in the Coal Mine Draw area and lands outside of the town of Dubois.

There are no areas currently open to motorized travel in the planning area. The 1987 RMP did not limit, restrict, or close any areas to mechanized or nonmotorized travel. Therefore the entire planning area is open to mechanized and nonmotorized travel. This has proven to create resource conflicts especially where repeated use or illegal development results in creation of a trail. With trail development comes increased conflicts with natural resources and increased conflicts amongst users. Areas that are open to mechanized travel include Johnny Behind the Rocks/Blue Ridge, Sweetwater Mining District, Sinks Canyon Climbing Area, the Bus @ Baldwin Creek, and the Dubois Mill Site.

Limited

Motorized vehicle travel within specified areas and/or on designated routes, roads, or trails is subject to restrictions (see the Glossary for definitions of route, road, and trail). The "limited" designation is used where OHV use must be restricted to meet specific resource management objectives. Examples of limitations include number or type of vehicles; time or season of use; permitted or licensed use only; use limited to designated roads and trails; or other limitations if restrictions are necessary to meet resource management objectives, including certain competitive or intensive use areas that have special limitations (see 43 CFR 8340.05).

Limited to Existing Roads and Trails

Travel is limited to existing roads and trails on approximately 2,226,504 acres of BLM-administered surface. This designation was created to allow travel without increasing the number of acres disturbed by route creation. Unless otherwise noted, the BLM manages travel in the planning area as limited to existing roads and trails. In areas (and only in these areas) where motorized travel is limited to existing roads and trails, the BLM makes exceptions for the performance of necessary tasks requiring the use of motor vehicles (e.g., picking up big game kills, repairing range improvements, managing livestock, and mineral activities). This necessary task exemption has resulted in the creation of numerous new roads especially in areas receiving repeated travel for maintenance purposes (fence lines, salt licks, etc.). This RMP will clarify the process for receiving exemptions from travel restrictions and clarify what actions constitute a necessary task.

Field observations, documented increases in road densities, and public feedback has indicated that the 'limited to existing' designation has not reduced route proliferation nor adequately mitigated travel conflicts with other resource values. The limited to existing designation has three major shortcomings: 1) the designation is hard to enforce, 2) the 1987 RMP provided no point of reference as to what constituted an existing road or trail, and 3) the 'limited to existing'

designation does not lend itself to management scenarios where managers can adjust the travel network to better achieve land use planning goals and objectives. Some areas where conflicts have arose as a result of the 'limited to existing' designation include: East Fork, the Beaver Rim ACEC, NHT area, the Sweetwater Mining District, South Pass Historic Mining Area, Johnny Behind the Rocks/Blue Ridge, and areas adjacent to WSAs.

Some of these shortcomings associated with the 'limited to existing' designation will be addressed through this planning process. An inventory of existing roads and trails will be included in the Approved RMP and ROD.

Limited to Designated Roads and Trails

Motorized vehicle use is limited to designated roads and trails on approximately 163,075 acres of BLM-administered surface, primarily in environmentally sensitive areas. In addition, motorized travel is limited to designated roads and trails in the following locations: Lander Slope, Red Canyon, Green Mountain, and Whiskey Mountain. Travel in WSAs (with the exception of the Dubois Badlands WSA which is closed to motorized vehicles) is limited to the roads and trails that existed at the time the area became a WSA. This applies to both motorized and mechanized transport.

Seasonal and Over-Snow Closures

A number of locations in the planning area are generally limited to designated (or occasionally existing) roads and trails, but also have a seasonal closure or restrictions for part of the year (111,002 acres of BLM-administered surface). These seasonal restrictions are designed to protect the values of other resources such as crucial wildlife winter range. Areas limited to designated roads and trails but subject to seasonal closures include Lander Slope, Red Canyon, Whiskey Mountain, and Green Mountain (closed December 1 through June 15). Additional seasonal restrictions may be necessary to protect sensitive resource values. This is especially true in wildlife winter concentration areas.

The Red Canyon area is closed to all forms of over-snow travel. The remainder of the planning area is open to over snow vehicle travel (2,379,481 acres of BLM-administered surface).

Closed to Motorized Vehicle Use

Approximately 5,923 acres of BLM-administered surface in the planning area are closed to travel. Closed means an area is closed to all motorized travel, with exceptions granted by the Authorized Officer only for emergencies, firefighting, public safety, or related incidents. A closed designation might also exclude nonmotorized or mechanized travel. Areas are closed in order to protect resources, ensure visitor safety, or reduce user conflicts. The Dubois Badlands WSA and portions of the Castle Gardens area are closed to motorized travel. Additional areas closed to motorized vehicles may be necessary in order to meet public demand for quiet recreational areas. In addition closures to mechanized travel may be necessary to protect resources, especially in light of the spread and amount of user created mountain bike trails. These trails are often located in areas where the trail and associated use stands to directly conflict with other resource values (wildlife, cultural resources, etc.).

Travel Management Areas

All public lands are placed in travel management areas. Travel management areas address acceptable modes of access and travel. They are also used to prescribe objectives for allowing

travel in the area and setting characteristics that are to be maintained. Travel management plans identify the appropriate network of roads and trails, including nonmotorized access, in travel management areas.

The current RMP limits motorized travel to designated roads and trails in the Whiskey Mountain, Lander Slope/Red Canyon, and Green Mountain areas. Implementation was never completed for these areas because all designated roads and trails were not identified. The current RMP does not restrict or limit mechanized or nonmechanized travel in any travel management area. Table 3.54, "Travel Management Designations in the Planning Area" (p. 426) summarizes the travel management designations for the planning area.

Table 3.54. Travel Management Designations in the Planning Area

Area	Designation	Acreage	Notes
Lander Slope/Red Canyon	Limited to designated roads and vehicle routes. Seasonal closures to protect wintering wildlife December 1 to June 15.	~40,000	Implementation was not fully completed to identify the designated roads/routes. Seasonal closures have been implemented; however, adjacent land and route managers (WGFD, state and county governments) currently implement contrasting seasonal closures.
Green Mountain	Limited to designated roads and vehicle routes. Seasonal Closures to protect wintering wildlife December 1 to June 15	~56,000	Implementation was not fully completed to identify the designated roads/routes.
Whiskey Mountain	Limited to designated roads and vehicle routes. Seasonal Closures to protect wintering wildlife December 1 to June 15	~8,390	Implementation was not fully completed to identify the designated roads/routes. Acreage also includes lands acquired in exchanges in the 1990s (post-1987 RMP).
Castle Gardens	Closed	78	Archeology/Recreation site
Dubois Badlands	Closed	~4,520	Public lands within the Wilderness Study Area
All other public lands in the planning area	Limited to existing roads and vehicle routes.	~2,200,000	Several specific roads were closed through Federal Register Notice procedures (Rocky Ridge Historic Trail Corridor, Desert Yellowhead site).

Source: BLM 1987b

RMP Resource Management Plan
WGFD Wyoming Game and Fish Department
~ approximately

At present, the BLM has completed route inventories for Green Mountain, Lander Slope, the Dubois Badlands WSA, Whiskey Basin, and the Sweetwater Canyon WSA. The BLM is using existing route inventories and data from remote sensing to fully implement travel management designations in a number of other areas.

Primary Travelers and Modes of Travel in the Planning Area

Public land users employ roads and trails for a variety of recreational and utilitarian activities. Nonmechanized modes of travel include cross-country skiing, dog sledding, snowshoeing, horseback riding, hiking, boating, hang-gliding, paragliding, and ballooning. Mechanized vehicles predominantly involve mountain bikes and specialized equipment such as mountain skateboards. Motorized travel includes standard passenger vehicles on maintained roads and OHVs on primitive roads and trails. OHVs include all motorized travel devices such as motorcycles, all-terrain vehicles, jeeps, specialized 4 x 4 trucks, over-snow vehicles, and motor boats.

In addition to federal and state highways, county roads, and other roads for commercial and industrial purposes, public land users employ a road network consisting of official BLM roads that are regularly maintained, ditched, and crowned gravel roads, as well as unofficial roads and vehicle routes that were never formally constructed and rarely receive maintenance. Many unofficial roads are two-track vehicle trails that were created (pioneered) by public land users and are maintained simply by the passage of motor vehicles. These routes were not purposefully designed and, as a result, vary greatly in condition and stability. Limited enforcement of travel restrictions, high levels of use, and improvements in mechanized and motorized vehicle technology have increased the number of user pioneered routes in recent years. This network of two-track roads and trails is important for recreational and ranching uses of public lands. There are approximately 2,400 miles of routes, for an average density of 2.7 miles of routes per square mile. Almost 90 percent of these routes are open to motorized travel.

The most popular areas for motorized recreational travel are Coalmine Draw, Dubois Badlands, Shoshoni Lake Road, and to a lesser extent, the Sand Draw area. This use occurs nearly year-round, and for many users the act of recreational driving is the primary reason for their visit. Most of these visitors live within an hour's drive of the area and enjoy practicing their technical skills, using their equipment, and spending time with family and friends. During the autumn hunting season, most parts of the planning area experience increased motorized travel. Much of this use is focused in the Lander Slope, Red Canyon, South Pass, Green Mountain, and Dubois areas. These tend to be destination hunting areas, with visitors coming from other parts of Wyoming and the greater Rocky Mountain region.

In addition to heavier OHV use, increased urbanization on adjacent private lands has created additional nonmotorized use and new expectations for recreation experiences. BLM-administered lands close to expanding urban areas provide convenient areas for recreation including hiking, mountain biking, dog walking, and rock climbing. Mountain biking and casual hiking (as opposed to destination hiking) has become very popular at Johnny Behind the Rocks, Baldwin Creek, Red Canyon, and the Dubois Badlands.

Management Challenges for Comprehensive Trails and Travel Management

As is the case throughout the western United States, OHV use has increased dramatically since the approval of the existing plan. Lands that once did not experience impacts because of light use now commonly experience damage to cultural resources and impacts to recreation. Travel routes, especially user pioneered routes, are often unsustainable and can cause resource damage. Environmental concerns associated with OHV use include a loss of soil and damage to vegetation due to surface disturbance, the creation of scars on hillsides, habitat loss, disturbance of wildlife in crucial habitats such as winter ranges, siltation of streams due to erosion from roads and trails, and degradation of scenic qualities.

Nonmotorized use and new expectations for recreation experiences have increased in areas adjacent to private lands with expanding urbanization. Many of these users recreate on

BLM-administered surface because the lands are close to home and provide a convenient place to exercise, relieve stress, or spend time with family and friends. Until recently, there has been little demand, and consequently few resources allocated for nonmotorized recreation travel. This type of use has been increasing in all of the public lands bordering municipalities. The towns of Lander, Riverton, and Dubois have all experienced population growth. Subsequently, the public lands adjacent to these towns have the highest incidence of nonmotorized use. At times, these uses and expectations conflict with the experiences desired by motorized users.

Correlated with the growth of communities is the subdivision of private lands adjacent to BLM parcels and subsequent issues of trespass and access restriction. Often, BLM-administered lands are isolated and provide limited public access. In these instances, enforcement of travel restrictions is difficult, and motorized trespass can frequently occur from adjacent private land. Subdivisions are generally not designed to give public access to the BLM-administered lands, which can limit access to isolated parcels of public land. However, it has been observed that often the new community provides stewardship to the adjacent lands, potentially making BLM monitoring and management more efficient.

Many areas used by recreationists do not have trails that were built with recreation experiences in mind. The types and amounts of use and the location of roads and trails influence the physical, social, and administrative recreation setting and the overall quality of the recreation experience. Most routes in the planning area either follow historic nonrecreational routes or were created when OHV users repeatedly drove cross-country. Many other routes were constructed to create access to public land improvements and projects for timber/vegetation management, gas/mineral development, range management, and various ROWs. Permittees maintain some of these roads to ensure access to improvements such as livestock/wildlife ponds or fences. Numerous roads were not necessarily intended to be left open for recreational use but have become popular routes for visitors engaged in mechanized/motorized recreation activities. In many cases, the roads and trails available do not provide desirable recreation experiences. Increased transportation demands by nonrecreational uses (e.g., oil and gas exploration and grazing) have also affected recreational travel in some areas. Recreation experiences can suffer when transportation systems for other uses are increased or created.

3.6.5. Livestock Grazing Management

The BLM is responsible for administering livestock grazing on BLM-administered land. Livestock grazing is the grazing of domestic animals (cattle, sheep, horses, and goats) and is one of the most visible and established uses of BLM-administered lands. For most operators, holding a BLM grazing permit or lease provides an important component of their overall ranching operations. Grazing on public land provides forage for livestock during a crucial time of year when base ranch operations are being used to grow forage for the winter months. Livestock grazing is an authorized, discretionary use of public lands by individuals who qualify to hold a grazing permit/lease under federal grazing regulations.

Prior to 1934, the General Land Office managed grazing on public lands outside forest perimeters. Comprehensive management of these lands was initiated in 1934 when Congress passed the Taylor Grazing Act. The Grazing Service was established and charged with implementing the provisions of the Act. Specific tasks included establishment of a permit/lease system, organization of grazing districts, fee assessment, and consultation with local advisory boards.

In 1946, the Grazing Service and General Land Office merged to form the BLM. The Taylor Grazing Act was the principle legislation used to administer livestock grazing on public lands until 1976 when Congress passed the FLPMA. The Public Rangelands Improvement Act of 1978 (43 U.S.C. § 1901-1908) established a grazing fee formula that sets and adjusts annual fees for grazing on public land.

In 1985, the BLM established three categories for allotments to identify areas that needed management and to prioritize workloads and the use of range improvement dollars. The BLM categorized allotments as Improve Existing Resource Conditions (I), Maintain Existing Resource Conditions (M), or Custodial Management (C). Appendix K (p. 1447) includes the criteria for placing allotments into these three categories and a complete list of allotments in each of the categories for the planning area.

In August 1995, new regulations changed the BLM administrative procedures to manage public lands. These regulations directed the establishment of standards and guidelines for rangeland health to achieve properly functioning ecological systems for both upland and riparian-wetland areas. The Standards for Healthy Rangelands & Guidelines for Livestock Grazing Management for the Public Lands Administered by the BLM in the State of Wyoming were submitted to the Secretary of the Interior in July 1997 and approved on August 12, 1997 (Appendix J (p. 1437)).

Approximately 97 percent of the public lands in the planning area are available for livestock grazing (Map 117). The other 3 percent are primarily lands in highway easements, very rocky areas, and areas that have been mined and have little vegetation. Oil and gas development and associated infrastructure (roads, pipelines) has contributed to the reductions in surface area available for grazing. A few allotments have been closed to livestock grazing because of other land use priorities, such as the bighorn sheep wintering areas in Dubois.

Livestock grazing in the planning area consists primarily of cattle, but also includes sheep and horses (Table 3.55, "Livestock Grazing Permits and Leases on BLM-administered Lands in the Planning Area" (p. 429)). Goats have sometimes been authorized, primarily for the purposes of suppressing invasive plant species.

Table 3.55. Livestock Grazing Permits and Leases on BLM-administered Lands in the Planning Area

Livestock Use Category	Number of Permits	Number of Leases
Cattle	129	34
Cattle and Sheep	6	4
Cattle, Sheep, and Horses	8	-
Horses	1	17
Cattle and Horses	27	10
Cattle and Goat	1	-
Total	**172**	**65**

Source: BLM 2009b

BLM Bureau of Land Management

Stock driveways were authorized under the Stock Raising Homestead Act of 1916, and created by a Secretarial Order for the specific purpose of creating trailing routes and reserving water sources for trailing livestock. Stock driveway withdrawals prohibit disposal of these lands.

Grazing Allotments and Animal Unit Month Allocations

The BLM authorizes grazing under two different sections of the Taylor Grazing Act, Section 3 and Section 15. Section 3 permits are authorizations to graze areas within the original grazing districts as established in 1934. Section 3 allotments are usually larger, contiguous tracts of land and incorporate unfenced state and private lands. A portion of the grazing fees from these permits is available for investment in range improvements on the Section 3 allotments.

Section 15 allotments are leases, not permits, and are generally small parcels outside the original grazing districts. The majority of grazing leases in the planning area are located on the Lander Slope and the Dubois area. These leased parcels provide little opportunity for intensive grazing management due to their size, access and isolation from other BLM-administered lands. Although Section 15 leases are small and isolated, they generally tend to provide important wildlife habitat and recreational opportunities within the Lander Slope and town of Dubois. Section 15 lessees pay the same grazing fee as Section 3 allotments, but funds are generally not used for range improvements on Section 15 leases due to their small size and little benefit to be obtained from additional infrastructure. Much of the Section 15 leases already are fenced.

Forage is allocated based on the carrying capacity of the land. Carrying capacity reflects the maximum level of grazing public lands can sustain over the long term. A more specific definition of carrying capacity is "livestock carrying capacity," which means the maximum stocking rate possible without inducing damage to vegetation or other resources values. Carrying capacity can vary from year to year on the same area due to fluctuating forage production. In addition, available forage for livestock grazing varies with changes in climatic conditions, forage production, and the availability of water.

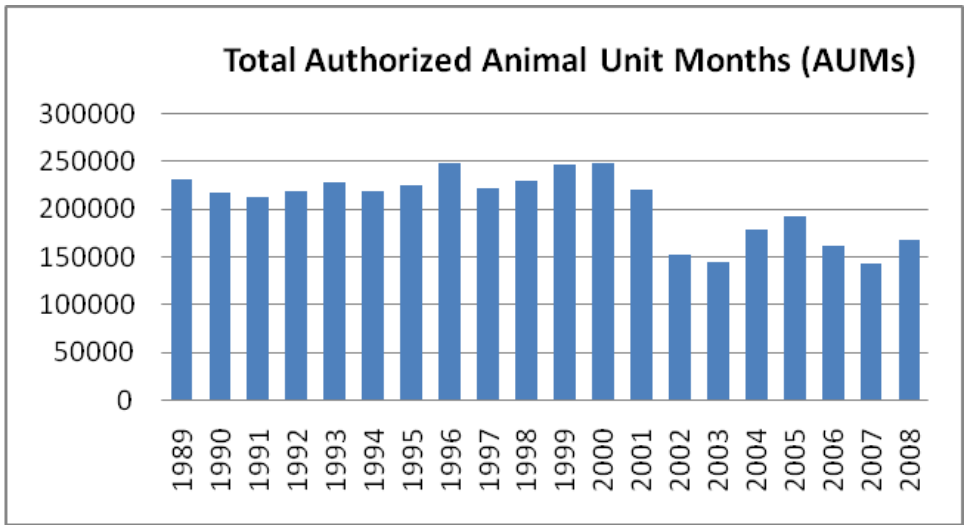
The BLM administers livestock grazing on 310 allotments covering 2,324,934 acres of BLM-administered surface lands and 279,000 AUMs allocated within the planning area (BLM 2009b) (Map 117). An AUM is the amount of forage necessary to sustain one cow and her calf or its equivalent for a period of one month. The AUM levels were allocated during the 1930s and adjustments were made from the 1940s through 1960s. Adjustments in allotment carrying capacities since the late 1970s have been based on long-term monitoring, allotment evaluations, and most recently Standards and Guidelines Assessments.

The size of grazing allotments in the planning area ranges from 40 acres to more than 500,000 acres of public land (Appendix K (p. 1447)). Collectively, 24 of the largest allotments within the planning area are categorized as "common allotments" that are grazed by livestock owned by several permittees. Examples of some of these common allotments include the Green Mountain, Granite Mountain and Silver Creek allotments. Managing grazing on these lands can have more of a beneficial outcome because the allotments tend to have a large percentage of public lands within their boundaries. Allotments in which public lands provide only a minority of the forage are more difficult to manage because BLM prescriptions can only be applied to public lands.

The large allotments generally provide spring, summer, and fall forage for local operators and are important to their operations as livestock move from winter feed grounds or pastures, to summer pastures. Winter and early spring use does occur in limited areas east of Boysen Reservoir and northeast of Shoshoni.

Portions of some allotments may be unsuitable for grazing due to resource conflicts, terrain, lack of forage, distance from water, and other factors. Although there has been no overall reduction in the number of allotments since the 1986 RMP ROD was approved, conditions on the ground have generally not supported authorizing full AUMs. The BLM management focus is directed toward achieving and maintaining rangeland health.

Since 1989, the number of AUMs authorized (Appendix K (p. 1447)) has been approximately 73 percent of the permitted AUMs. Some of this is a result of the negotiated and voluntary reductions due to a prolonged drought. The downward trend in permitted AUMs coincides with a decrease in actual cattle numbers in Fremont County during times of drought. Figure 3.19, "Total Authorized Animal Unit Months in the Planning Area, 1989-2008" (p. 431) shows the authorized AUMs in the planning area from 1989 through 2008.



Source: BLM 2009b

Figure 3.19. Total Authorized Animal Unit Months in the Planning Area, 1989-2008

Allotment Management Plans and Rangeland Management Agreements

Allotment Management Plans (AMPs) and rangeland management agreements have been used to improve rangeland health through detailed planning, monitoring, and implementation. AMPs or rangeland management agreements have been developed for 52 allotments covering 790,346 acres of BLM-administered surface (Appendix K (p. 1447)). Most were developed in the 1980s and 1990s. These allotments were prioritized for developing site-specific objectives and implementing management changes.

Rangeland Health/Productivity

The existing plan placed all allotments in the following categories "I" (Improve), which includes most of the large allotments, "M" (Maintenance), and "C" (Custodial). The BLM used these classifications to identify areas with a potential need for management to prioritize workloads and use of range improvement dollars. The BLM placed allotments containing larger tracts of public land with natural resource issues in the I and M categories, and allotments containing smaller tracts of public land with little to no resource issues in the C category. The BLM gave priority for managing these allotments to category I allotments, followed by category M allotments. There are a total of 123 category I allotments, 83 category M allotments, and 82 category C allotments in the planning area (BLM 2009b). Some allotments would not change category because resource uses, values, and issues will not change. Although management might have been implemented on an allotment, the allotment could remain in category I because it might present resource concerns such as crucial wildlife winter range (Appendix K (p. 1447)).

The BLM uses a number of methods to evaluate rangeland health, which could reveal trends in the composition of the plant community or productivity of a plant community. Some methods

yield qualitative data; others are quantitative. Rangeland is monitored throughout the planning area as part of the rangeland health assessment process.

Many allotments are managed under allotment management plans or agreements which include grazing rotations and authorized season of use. These are designed to meet soil cover and desired plant species growth requirements. Observations of old headcuts, roads, and other disturbances show that perennial plant species have increased once non-livestock disturbances end. Generally, these observations have been confirmed in the rangeland health determinations completed to date. Where livestock grazing has been identified as the causal factor for not meeting rangeland health standards, appropriate actions to correct the problem have been implemented. However, disturbance related to other ongoing resource uses, including oil and gas development and mining, could affect adjustments.

Additional factors other than rangeland health are changing the face of public land grazing in the planning area. Since 2000, the BLM has experienced a larger than normal turnover in permits/leases. These permits/leases tend to be purchased by both traditional and nontraditional ranching interests, with the latter averaging about 25 percent of total permits/leases authorized.

Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management

In 1998, the Lander Field Office began assessing grazing allotments for consistency with the Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management for the Public Lands Administered by the BLM in the State of Wyoming (Wyoming Standards for Healthy Rangelands) (Appendix J (p. 1437)), as mandated in the 1995 revision to the 43 CFR 4100 grazing regulations. Grazing permits/leases are offered and accepted with the understanding that prior to reissuance, resource conditions will be evaluated. It is then determined whether the resource conditions conform to the Wyoming Standards for Healthy Rangelands approved by the Secretary of the Interior on August 12, 1997. Management decisions and actions are made in accordance with the Wyoming Standards for Healthy Rangelands (Appendix J (p. 1437)). These standards are used to allow sustainable livestock grazing management to continue while protecting watersheds, riparian-wetlands, upland ecosystems, and wildlife habitat.

The Wyoming Standards for Healthy Rangelands address the health, productivity, and sustainability of BLM-administered public rangelands and represent the minimum acceptable conditions for the public rangelands. The standards apply to all resource uses on public lands and ensure that management of resources of particular concern to ecosystem health do not degrade the quality of rangelands (soils, riparian-wetland areas, upland vegetation, rangeland management, water quality, and air quality). Their application is determined as use-specific guidelines are developed. Standards can be synonymous with goals and are observed on a landscape scale.

The Wyoming Standards for Healthy Rangelands describe healthy rangelands rather than rangeland byproducts. The achievement of a standard is determined by observing, measuring, and monitoring appropriate indicators. An indicator is a component of a system whose characteristics (e.g., presence, absence, quantity, and distribution) are observed, measured, or monitored based on sound scientific principles as identified in the Wyoming Standards for Healthy Rangelands. Indicators associated with each standard are identified in Appendix J (p. 1437).

In general, rangeland health throughout the West has improved since the 1930s. However, the BLM has acknowledged that nationally, rangeland health is not at its potential. It was for this

reason that the Wyoming Standards for Healthy Rangelands were adopted by the BLM (Appendix J (p. 1437)).

Rangeland health assessments have been ongoing in the planning area since 1998; approximately 73 grazing allotments and 401,975 acres have been assessed. Of the 73 allotments assessed, 54 allotments (200,429 acres) are meeting or making substantial progress toward meeting the standards (Appendix K (p. 1447)). For allotments that were determined not to meet standards because of livestock grazing, corrective action was put in place. These allotment issues are addressed in site-specific range permit renewal NEPA actions.

Appropriate actions to correct problems related to livestock grazing are implemented in allotments that have been assessed if it is found that the allotment does not meet the Wyoming Standards for Healthy Rangelands. Appropriate actions may include development of range improvements and/or prescribed grazing, which may or may not be part of an AMP or rangeland management agreement. Changes in livestock management practices within that allotment are implemented as terms and conditions in accordance with 43 CFR 4180.2(c)(2). In most allotments that failed an assessment of standards, not all of the public lands in the allotments were considered to be failing. Additionally, most of these standards were not met for reasons other than current livestock management, such as historic livestock grazing use, motorized travel, oil field development, and mineral extraction. In accordance with Standard 4, where current livestock grazing management has been identified as contributing to an allotment failing the Wyoming Standards for Healthy Rangelands, the guidelines for livestock grazing management are used to direct new grazing management stipulations for the allotment (Appendix J (p. 1437)).

Of the rangelands that are not meeting the standards or not making acceptable progress because of livestock grazing, 11 allotments (584,195 acres) now have AMPs designed to ensure progress toward meeting the standards. Not all of the implemented AMPs have been effective in achieving rangeland health. In some cases, there has been insufficient monitoring to determine what impacts range improvement projects and changes in livestock grazing management have had on rangeland health.

In some allotments, it appears that grazing plans are making progress toward meeting the Wyoming Standards for Healthy Rangelands. In the Atlantic City allotment the permittees agreed to manage the riparian-wetland areas under an AMP. These areas are fenced into riparian-wetland pastures that are grazed during a short time period during the grazing season. Then these pastures are rested so that riparian-wetland vegetation can regrow and recover. The riparian-wetland conditions in these pastures has improved with increased water flow and holding capacity, along with new willow growth and stabilized banks occurring within the pasture.

Seven allotments (105,291 acres) in the planning area are not meeting rangeland health standards. In most cases, failure to meet standards for riparian-wetland areas contributes to the failure to meet rangeland health standards (BLM 2009b).

Three other allotments (31,771 acres) are not meeting rangeland health standards due to factors other than livestock that adversely impact the rangeland resource, such as improperly cut roads, causing soil erosion and runoff. In the last 20 years, approximately 40 miles of roads have been closed because they contributed to rangeland health degradation.

There are currently 250 allotments (1,422,491 acres, or approximately 59 percent of the planning area) in the planning area that have not been assessed. These allotments are being scheduled for rangeland health assessments.

Range Improvements

On average, the BLM has completed or reconstructed between 8 and 20 new range improvements per year totaling approximately $40,000 to $150,000 annually. The improvement projects are funded through grazing receipts authorized under Section 3 of the Taylor Grazing Act, and primarily consist of fences, reservoirs, springs, water wells, and vegetative treatments. Since 1986, the Lander Field Office has installed 53 stock reservoirs, 38 spring developments, 76 stock water wells, 110 miles of stock water pipeline, and 355 miles of pasture division fence (Table 3.56, "Type and Number of Rangeland Improvements Completed in the Planning Area, 1986-2009" (p. 434)). A full list and breakdown of all range improvements completed in the planning area between 1986 and 2009 is provided in Appendix K (p. 1447).

Table 3.56. Type and Number of Rangeland Improvements Completed in the Planning Area, 1986-2009

Project Type	Quantity
Reservoirs (number)	53
Springs (number)	38
Wells (number)	76
Pipelines (miles)	110
Fences (miles)	355
Land Treatments (number)	315
Vegetation Manipulations (acres)	10,550
Management Facilities (number) (cattleguards, corrals, etc.)	32
Source: BLM 2009b	

Rangeland improvement projects, grazing systems, and other BMPs have been used in rangeland management since the early 1970s. The BMPs have been further improved in recent years through educational workshops and seminars and through federal and private nonprofit cost-sharing programs. These management practices are used independently or cooperatively among livestock lessees, the University of Wyoming Extension Service, state and federal agencies, conservation districts, and interested members of the public. The goal is to allow sustainable livestock use to continue on public lands without damaging the vegetation resource and to maintain healthy watersheds and wildlife habitats.

Management Challenges for Livestock Grazing

Grazing of livestock on public lands receives a high level of public interest, differing opinions, scrutiny, and legal challenges. Many legal challenges have led to policy changes within the BLM since the mid 1970s. The health of the public lands is monitored by public organizations for a variety of reasons. Maintaining successful collaboration and communication with the public, ranchers, private land owners, and other stakeholders is a necessary, but sometimes difficult and lengthy process.

Another management challenge for livestock grazing is meeting the Wyoming Standards for Healthy Rangelands (Appendix J (p. 1437)). There is an identified need to meet the Wyoming Standards for Healthy Rangelands and many allotments are currently not meeting these standards (as identified in Appendix K (p. 1447)). Appendix K (p. 1447) lists the allotments that have been assessed for meeting the Standards: 200,429 acres have been determined to meet the Standards; 584,195 acres have failed assessments with livestock grazing identified as the causal factor; 31,771 acres have failed assessments with the causal factor identified as other than livestock grazing; and 105,291 acres have failed the assessments with no identified

causal factor. Coordinating resource programs and management actions that are related to the Wyoming Standards for Healthy Rangelands (soils, riparian-wetland areas, upland vegetation, rangeland management, water quality, and air quality) and developing management strategies to improve allotments not meeting rangeland health standards is a challenge. The lack of completed rangeland health assessments for all allotments in the planning area (approximately 45 percent of the planning area has been assessed) limits the ability to improve rangeland conditions. The BLM is also constrained in the ability to monitor and implement programs to improve rangeland conditions by limited funds and the availability of personnel.

Balancing management objectives for other resources is another management challenge associated with livestock grazing. Livestock grazing and the construction of range improvements (such as fences and water developments), can potentially impact other resources including special status species such as the grizzly bear, grey wolf, and greater sage-grouse. Recently, habitat fragmentation has caused concern regarding greater sage-grouse and livestock grazing throughout the West. Building wildlife compatible fences and doing so in a manner that prevents habitat fragmentation is a challenge.

The construction of range improvement projects, especially water developments (such as reservoirs), can increase the distribution of livestock and forage availability for livestock grazing across the planning area. However, topography, steepness of slopes, distance from existing water sources, and management for other resource objectives can present management challenges in locating range improvements in areas that would benefit livestock grazing.

From 2000 to 2006, the planning area was in a sustained hydrological drought. Through negotiations and grazing permittee cooperation, range specialists in the Lander Field Office were able to temporarily reduce stocking levels or modify seasons of use on an allotment-by-allotment basis to decrease the impact of drought conditions on soil and vegetation resources. Although the planning area continues to reflect a long-term hydrologic drought, the amount and timing of precipitation through this period were enough for forage growth to support reduced levels of livestock grazing. Adjusting stocking rates to varying climate conditions, including drought, is a normal aspect of annual grazing management; however, extreme periods of drought and fluctuations in precipitation can increase the challenges associated with livestock industry grazing.

Changing weather patterns can affect livestock seasons of use. More precipitation, earlier and warmer spring weather, less frequent but more intense weather systems, and rising CO_2 levels influence vegetative types by favoring some invasive species over native species and possibly affecting seasonal growth patterns for vegetation, which affect livestock seasons of use.

Increases in the price of private rangeland based on nonranching valuation, high operating costs, and fluctuations in precipitation and vegetative condition have lead to uncertainties in livestock industry grazing. These conditions result in a reduction in the availability of water for irrigating hay on private land due to changing precipitation patterns and melting of glaciers in the Wind River Mountains, and the loss of confined feed lots for animal feeding operations (Pew 2008).

Other management challenges associated with the livestock grazing program include assessing the impact of invasive plant species on forage production and addressing long-term monitoring of allotments and management activities.

3.6.6. Recreation

Federal lands within the planning area provide a broad spectrum of outdoor opportunities that afford visitors the freedom of recreational choice with minimal regulatory constraints. Recreational opportunities are offered to the public on all BLM-administered lands within the planning area.

Planning Guidance

The planning guidance for Recreation has substantially changed since the 1987 RMP. The RMP planning process historically identifies areas where recreation is the management focus. These Special Recreation Management Areas (SRMAs) were traditionally areas that had higher recreation use or required extra recreation investment or where more intensive recreation management was needed, whereas Extensive Recreation Management Areas (ERMAs) were established in most cases to facilitate dispersed recreation. The 2011 revision of the Recreation and Visitor Services planning guidance provides a more specific definition of SRMAs and ERMAs. The difference between SRMAs and ERMAs is summarized in Table 3.57, "Extensive Recreation Management Area and Special Recreation Management Area Management and Objectives" (p. 436) below:

Table 3.57. Extensive Recreation Management Area and Special Recreation Management Area Management and Objectives

	SRMA	Distinct ERMA	The Remainder of the Planning Area
Recreation Opportunity Management	Managed to **provide specific opportunities and settings** in response to visitor demand.	Managed to **provide diverse opportunities, as necessary to achieve planning objectives**.	Managed to **provide a diversity of recreation opportunities and settings**.
Allowable Uses and Management Actions	Allowable uses and management actions must **sustain or enhance recreation settings characteristics**.	Allowable uses and management actions **address recreation-tourism issues, activities, conflicts, and/or particular recreation setting**.	Management Actions and allowable uses may be necessary to protect resources or investments.
Management Common To All Areas	All areas are managed to meet statutory requirements to ensure resource protection, human health and safety, reduce conflict as well as achieve other program planning objectives.		
ERMA Extensive Recreation Management Area SRMA Special Recreation Management Area			

Recreation Anticipated Demand

In 1978, Driver and Brown (Driver and Brown 1978) proposed a hierarchical framework that specifies four distinct levels of recreational demands: (1) for activities, (2) settings (situational attributes), (3) for specific psychological outcomes--experiences and satisfactions, and (4) for benefits. This is the framework of recreation demand that will be addressed through the various land use decisions of this planning process.

The following existing sources are incorporated into this affected environment by reference and will assist the BLM in making recreation decisions to address the levels of customer demand discussed above:

- Congressional designations and legislation associated with the NHTs and CDNST.
- The various comprehensive plans for the five Congressionally Designated Trails.
- Surveys conducted locally and nationally (such as those that have been conducted on the National Historic Trails, at developed recreation sites, and by national entities such as the Roper and Starch).
- Scoping comments on this RMP process.
- Information from community Workshops such as those conducted in the Fall of 2007.
- Community planning documents such as the Dubois Gateway Community plan, community assessments by the Wyoming Business Council, and County and City plans.

Visitor Characterization

Based on field observations, discussions with customers, and the sources discussed above, public land visitors are traveling to the planning area from the following primary sources: national and international location, the Casper population center, and locally.

Visitors from outside of Wyoming come to the region from National and international locations. One reason for this widespread visitation is that the area is on a popular route towards two national parks. Additionally, the town of Lander is home to the International Climber's Festival, a privately funded festival where visitors travel to celebrate the sport of climbing. The National Outdoor Leadership School is headquartered in Lander and conducts educational/recreational courses on BLM-administered lands. Many of these students return for additional visits and courses. These are cases where non-agency marketing techniques have increased visitation to the public lands.

Field observations have found that there has been a notable increase in visitation from the adjacent states of Utah, Colorado, Idaho, and Montana. The use demographic change is due to the fact that visitors can escape the developed and sometimes crowded recreation settings of their home states while also enjoying some of the unique setting attributes (NHTs or the Sinks Canyon climbing area) available within the planning area. This trend has been witnessed throughout the planning area, but seems to be strongest along Congressionally Designated Trails and around newly discovered climbing areas. The visitation increase around climbing areas is correlated to the increase in the activity's popularity over the last 20 years. Potential exists to increase this visitor use demographic across several areas of the planning area especially in areas with existing infrastructure and/or in areas where resource conflicts are minimal.

Visitors originating from the Casper population center recreate in all areas of the planning area, however, this user faction typically focuses around the Rattlesnake Hills and Green Mountain areas. This regional-scale demand is generated as a result of the planning area's large acreage of public lands and the accessibility of those lands. In contrast, public lands around these visitors' home area are isolated, often inaccessible tracks of public land encompassing small acreage (USFS 2004a).

Wyoming's population has grown in the past 10 years (Sonoran Institute 2007) and an increasing number of people are living near public lands for a diversity of recreational opportunities characterized by the "mountain resort or outdoor lifestyle." The region is truly a year-round place to live and work; as a result, BLM-administered lands are absorbing increasing recreational demand and use. The towns of Lander, Hudson, Riverton, and Dubois all have public lands

bordering them that are used as "backyard" recreation areas by local residents. Outside of the use season (June-August) of the Congressionally Designated Trails and fall big-game hunting seasons (September-November), when visitation is high everywhere, the greatest number of visitors to public land is on a daily basis near communities.

Activity Demand

Nationally, participation in outdoor recreation activities has increased. Table 3.58, "Outdoor Recreation Survey" (p. 438) is adapted from Moore and Driver (Moore and Driver 2005) and summarizes the results from the 2000 Roper Starch Worldwide Inc Survey (Roper Starch 2000) and the 1994-2001 Cordell, Betz, Green, and Mou National Survey on Recreation and the Environment (NSRE) (Cordell et al. 2004). The table shows the percent of adults participating in predominant planning area outdoor recreation activities and percent change from 1994 to 2001.

Table 3.58. Outdoor Recreation Survey

Activity	Percent participating 2000 (Roper Starch)	Percent participating 2000-2001 (NSRE)	Percent Change 1994-2001 (NSRE)
Kayaking	5	3.46	185.66
Viewing or Photographing Fish	-	24.77	96.79
Snowmobiling	2	5.55	70.22
Viewing Wildlife	16	44.68	55.80
Backpacking	9	10.68	53.78
Day Hiking	19	33.25	51.80
Canoeing	5	9.73	50.65
Bicycling	24	39.49	50.00
Horseback Riding	5	9.68	47.99
Mountain Climbing	-	6.03	46.52
Running or Jogging	18	34.53	43.54
Coldwater fishing	-	13.58	42.77
Developed Camping	26	26.38	38.71
Driving off road	7	17.46	36.50
Walking for pleasure	57	82.97	35.32
Visiting archeological sites	-	20.91	30.71
Bird watching	16	32.38	30.61
Big game hunting	-	8.41	28.92
Cross-country Skiing	2	3.82	27.59
Rock Climbing	4	4.32	26.86
Primitive Camping	8	16.01	24.75
Small Game Hunting	-	7.23	21.43
Picnicking	36	54.49	20.91
Migratory bird hunting	-	2.36	20.05
Visiting historic sites	-	46.20	13.91
Sightseeing	4	8.15	-0.63
Orienteering	-	2.00	-9.36

Source: BLM 2009b; Moore and Driver 2005; Roper Starch 2000; Cordell et al. 2004

NSRE National Survey on Recreation and the Environment

Outcome Demand

BLM will base planning objectives in SRMAs and to a lesser extent in ERMAs around customer demand for Outcomes. Recreational Outcomes are defined as follows: (1) realization of a satisfying recreation experience, (2) An improved change in condition, and (3) maintenance of a

desired condition, prevention of an undesired condition, or reduction of an undesired condition (Hopkins 2008). In general the Roper Starch Survey Outdoor Recreation in America 2000: Addressing Key Societal Concerns (2000) documented some benefits that are important or being realized by national and local customers (Roper Starch 2000). The following statements are directly from the "Study Highlights":

- *Americans continue to ascribe many benefits to participation in recreation. This new research confirms motivations of fun, fitness, and family togetherness, but also shows Americans believe outdoor recreation plays a role in addressing various key social concerns, especially those related to young people. For instance, close to 8 in 10 Americans (79%) believe outdoor recreation can improve education.*
- *Americans also see outdoor recreation playing a role in reducing childhood obesity—a full three quarters of Americans see it as having a role in helping with this problem.*
- *According to most Americans, participating in outdoor recreation also can significantly aid parent—child communication, with three quarters crediting it as playing a role.*
- *Even in the case of tough social problems such as juvenile crime (71%), underage drinking (66%), and illegal drug use (64%), outdoor recreation is viewed by a strong majority as playing positive role.*
- *Overwhelmingly Americans believe that if people participated more in outdoor physical activities, the health effects would be beneficial (93%). Outdoor recreation is seen as the best way to be physically active (90%).*
- *Virtually all Americans agree that outdoor recreation is a good way to increase people's appreciation for nature and the environment (95%). Similarly, more than 9 in 10 agree that if people spent more time outdoors, they would better understand the importance of environmental protections.*

Throughout the RMP revision process BLM will work to further understand customer demand, this continuing input process will allow BLM to develop recreation based objectives and decisions that address customer demand and issues. Furthermore, recreation based decisions will be outcome based which allows BLM to monitor and adjust as social and resource conditions change through the life of the plan.

Existing Recreation Management and Supply

Recreation Management Areas

The 1987 RMP for the Lander Field Office identified 3 SRMAs. These areas included both congressionally and administratively recognized areas. The areas include: South Pass Historic Mining area, the National Historic Trail, and the Continental Divide National Scenic Trail.

South Pass Historic Mining Area: The South Pass Historic Mining Area is a SRMA, with emphasis on recreational opportunities in rustic, open-space settings.

National Historic Trail: The existing plan establishes a SRMA for the NHTs (which in 1987 included only the Oregon/Mormon Pioneer Trail; subsequent action expanded the NHTs to include the California and Pony Express Trails. Together, these four trails are referred to as the NHTs.). The management prescriptions for the NHTs are very general, with particular focus on

preventing over utilization of the NHT and the contributing historic sites, whether by trekkers or hunters. Subsequent actions have refined the kind of BLM monitoring and prescriptions that are required to protect the historic resources. Detailed SRMA plans have not been adopted.

Continental Divide National Scenic Trail: The existing plan recognizes the Continental Divide National Scenic Trail as a SRMA but does not provide detailed management prescriptions.

The 2005 revision of the BLM land use planning handbook also clarified that any area not delineated as a SRMA is an ERMA. In consideration of this update the Lander Field Office manages twelve ERMAs: the Lander Field Office wide ERMA created as a result of the above update, and 11 distinct ERMAs to address local recreation issues including Castle Gardens, Whiskey Mountain/East Fork, Green Mountain, Lander Slope/Red Canyon, Dubois Badlands, Sweetwater Canyon, Sweetwater Rocks, Lysite Badlands, Copper Mountain, Beaver Rim, and Government Draw. The planning method of identifying separate ERMAs allows BLM to recognize areas that required more active management in order to meet our standard ERMA objectives focused on resource protection, human health and safety, and alleviating resource use/user conflicts. Identification of separate ERMAs will be used in this planning process in several circumstances including: to recognize areas that require more active management than the rest of the planning area, to address local planning issues, to recognize an area where customer demand may warrant an SRMA allocation but the various alternatives to management preclude SRMA management, and/or in areas where the potential exists for future consideration of the area for SRMA allocation during a planning amendment process.

General recreation management in the 1987 RMP was not outcome based, causing planning decisions to focus on direct actions rather than minimum actions to produce outcomes. In doing so recreation sections of RMPs provided little to no guidance for the future and were mostly dictated by other program decisions (wildlife) and the existing management situation. The erroneous focus on direct actions also created a situation where SRMAs lacked sufficient allowable use decisions and detail to maintain the areas' recreational values. Finally, recreation management actions were splayed across the planning area usually to address concerns associated with overuse, while the SRMA and ERMA allocations had no bearing or influence on the action. The new land use planning guidance for recreation directs BLM to utilize an outcome based planning system, in turn addressing the shortcomings discussed above.

Developed Site Management

The 1987 RMP directed that management and maintenance will be provided at seven existing developed recreational sites (in both ERMAs and SRMAs), including Atlantic City, Big Atlantic Gulch, and Cottonwood campgrounds; Split Rock and Devil's Gate interpretive sites; and Wild Horse Point overlook and Castle Gardens picnic areas (see Map 120). Since then, the BLM has added several developed sites including: Beaver Creek Nordic ski area, Steamboat Lake interpretive site, and the Martins Cove interpretive trail. The need exists to consider how these various developed sights supply the existing recreation environment and how they can be linked in a more comprehensive fashion.

Recreation Management Actions

Recreation management actions were addressed in each of the management units in the existing plan. All of the units emphasize resolution of competing uses and provide resource protection. All are managed for dispersed recreation. The following list summarizes the management unit specific management actions (other than the SRMAs above):

Green Mountain: The unit is managed as an ERMA with the following specific prescriptions:

- 14-day camping limits
- Safety hazards eliminated
- Aesthetic values improved
- Quotas established for commercial hunting camps

Beaver Creek: The unit is managed as an ERMA with the following specific prescriptions:

- The Split Rock interpretive site is maintained and incorporated in the management plan for the NHT with provisions for use by visitors, resource protection, and interpretative needs.

Lander Slope: The unit is managed as an ERMA with no major recreational developments.

- 14-day camping limits to avoid "homestead" camping and be in conformance with management of the adjoining USFS lands
- Quotas on commercial hunting camps

Red Canyon: The unit is managed to protect wildlife values and geology, particularly as reflected by the NNL. To protect elk winter range, the unit is closed to all winter sport activities.

- 14-day camping limit to eliminate "homestead' camping

Gas Hills: Generally, the unit is managed as an ERMA. However, two intensive managed areas are identified:

- Devil's Gate interpretive site is managed to meet interpretive and visitors' needs coupled with resource protection.
- Castle Gardens management focuses on interpretation and resource protection while allowing for dispersed recreation management.

East Fork: Minimal recreation management is provided. The emphasis is on reducing user conflicts and providing resource protection.

Whiskey Mountain: is managed in cooperation with the WGFD on non-consumptive wildlife visitor use management.

- 14-day camping limit
- Commercial hunting camps not permitted if they are not compatible with bighorn sheep management

Dubois Badlands: This unit is an ERMA that is managed in its "natural state" with a focus on emphasizing resolving competing uses and providing resource protection.

General Lander Field Office Area: The unit is managed as an ERMA with dispersed recreation where visitors will have the freedom of recreational choice with minimal regulation.

Recreation Setting and Foreseeable Development

The recreation setting is an integral supply component of the recreation environment because settings "not only affect the experiences and benefits", but also help to "define what type of activities might occur in an area" (Pierskalla et al. 2004). The setting concept recognizes that visitor attainment of desired recreational experience and benefit outcome opportunities is linked to the physical, social, and operational recreation setting. The range of possible combinations of activities, settings, and experience opportunities can be represented in terms of a spectrum or continuum. This continuum of recreation setting characteristics has historically been referred to as the Recreation Opportunity Spectrum (ROS). The information provided by the ROS is both a descriptive and a land use allocation tool for recreation planning, management, and research (Clark and Stankey 1979). The existing plan used the ROS as a tool to characterize or describe the existing environment. The new RMP will also use recreation settings (in SRMAs) as reasonable foreseeable development scenarios and desired future condition for the recreation resource. In most SRMAs, reaching and maintaining a desired setting condition requires allowable use decisions (such as NSO restrictions) and management actions (Hopkins 2008).

The current BLM-specific methodology for describing the recreation setting builds on the historic ROS concept and has been termed the recreation setting. The BLM now describes the recreational setting across three main factors: the character of the natural landscape (Physical Setting); the character of recreation and tourism use (Social Setting); and how public land agencies, other land managers and private sector service providers manage public use (Operational Setting). These variables combine as descriptors of the recreation environment that can then be placed across a spectrum of six overall recreation settings. The six overall recreation settings moving from least developed to most developed are: Primitive, Back Country, Middle Country, Front Country (or Transition), Rural, and Urban. The BLM typically does not manage for urban settings. This methodology for describing the recreation setting builds on the historic ROS concept and is here by referred to as recreation settings.

The existing 1985 ROS map (Map 86) utilized a mapping technique in which all three setting attributes were combined to form one recreation setting map. This technique resulted in a map that was weighted heavily toward the physical setting and less towards addressing the recreational expectation of visitors. This technique yielded accurate setting capacity descriptions; however, it does not lend itself to setting allocations or prescriptions. Moreover, it is a top-down management approach that fails to be responsive to the different populations utilizing the public lands. The new recreation setting inventory for the Physical, Social, and Operational settings is depicted on Maps 87–89. Trends in recreation setting can be garnered by comparing the new physical setting map with the existing ROS map. Recreational management recognizes four key issues when forecasting the setting changes over time:

- Population growth
- Changing public expectations and demand for outdoor recreation opportunities
- Increased energy development/exploration
- Increased occurrences of large ranches being subdivided to accommodate non-agricultural uses

Overall Physical, Social, and Operations settings are demonstrating an urbanizing trend, which is likely to continue. At the broadest level, the physical, social, and operational recreation character of BLM public lands is quickly changing from less natural to more developed, from less crowded to more contacts with others, from less restrictive to more rules and regulations. These changes

will impact the activity opportunities that can be offered and the recreation experience and benefit opportunities that can be produced by land managers and partners.

Existing Use Levels and Forecasts

Visitor Use Figures

By 2000, 78 percent of Americans participated at least monthly in outdoor recreation activities, up 50 percent from 1994 (Cordell 1999). Most public land use estimates and activity participation estimates depend entirely on field observations and professional judgment of the recreation staff and hence are not scientifically based. Recreation use figures are tracked in the Recreation Management Information System and are available at the Lander Field Office. In addition, several other entities such as the Wyoming Game and Fish Department, County Governments, and the Wyoming State Trails program collect use figure information. These sources also indicate an overall increase in outdoor recreation participation across the planning area.

While visitor use figures are critical to an input/output (or IO model) economic analysis, these figures are not an indicator of recreational quality.

One example of this phenomenon is in areas enjoyed for solitude or naturalness, in these areas increases in visitor use can degrade the quality of recreation environment.

Another problem with visitor use figures as a recreation indicator lie in the simple fact that these figures do not provide any indication of customer demand, instead they simply reflect where people are going based on current management.

Finally, a limitation of input/output economic analysis and visitor use figures lies in the simple fact that the IO model is only concerned with use figures of nonresidents. The BLM recreation program is often geared to supply local customer demand whereas an IO model and the visitor use data supporting it does not recognize economic benefits accrued as a result of recreation enhancements to support local community residents. A non-market analysis technique (such as Contingent Valuation Method) is far superior to capturing the true economic contribution of recreation management. Based on time and data constraints this plan will use an IO model to calculate the economic benefits of recreation, therefore visitor use data in support of this analysis will only be compiled for nonresident visitors.

Special Recreation Permits

The amount and type of Special Recreation Permits (SRP) are indicators of the current level of use and in some case reflect the activity demand of the public. There are four types of uses for which SRPs are required: commercial use, competitive events, organized groups, and recreation use in special areas. Most SRPs are related to hunting outfitting; however the Lander Field Office does have a very diverse SRP program.

There has been increased demand for SRPs over the past 20 years. Currently BLM administers 30 SRPs as multi-year permits. In addition, the office typically authorizes another 10 one-time events and organized groups.

No limits on the number or type of SRP exists however, authorized activities along the NHTs are managed closely in order to maintain the areas cultural resources. Conflicts have arisen when SRPs are issued for activities that are out of character with the existing recreation setting such as

large group use in an area with Back Country characteristics, and conflict with other resource values, such as in an area containing threatened and endangered species.

Since SRPs are a manner by which the agency delivers recreational outcomes to visitors it is important that the BLM issue SRPs to complement existing land use plan objectives. The RMP will establish broad objectives across the entire planning area that will provide a guide to administer the SRP program in a way that ensures a healthy outfitter and guide service sector, while also ensuring permitted activities extend the agency's ability to deliver targeted outcomes to visitors.

Recreation Use Forecasts

It is anticipated that recreational use will increase in the next 20 years. The factors influencing this trend include: a projected moderately heavy population pressure, a projected moderately heavy recreation demand pressure, and the planning area's total land area in public land ownership in comparison to eastern Wyoming (Moore and Driver 2005). The increase in recreational use will necessitate an outcome based approach to recreation management. Such an approach provides land managers enough flexibility to adapt with the dynamic nature of the use, while also ensuring the use is guided by planning instead of the agency constantly reacting to the use. In addition, an outcome based approach will allow the agency to encourage increased use in areas where such increases will be environmentally sustainable and minimize conflict among users.

Management Challenges for Recreation

Simultaneously managing lands in the planning area for recreational use and other forms of development is the greatest recreation management challenge. Modifications to the environment as a result of energy and minerals development have the potential to alter recreational settings and shift the types of recreation experiences possible. In the case of SRMAs, reaching and maintaining a desired setting condition could require management actions to establish allowable uses and development requirements (e.g., NSO restrictions) (Hopkins 2008).

3.7. Special Designations

This section describes ACECs, Congressionally Designated Trails (NHTs and National Scenic Trails [NSTs]), Wild and Scenic Rivers (WSRs), and WSAs. Special designations are areas that have either been administratively or Congressionally designated where specific management is required to meet resource goals and objectives. These areas often include important biological (or other natural system), historic, cultural, scenic, or other resource values.

3.7.1. Congressionally Designated Trails

BLM land use planning guidance requires special management for Congressional designations (BLM Land Use Planning Handbook H-1601-1). Congressionally Designated Trails in the planning area include the CDNST and the Oregon, Mormon Pioneer, California, and Pony Express NHTs.

Additionally, management of Congressionally Designated Trails is guided by IM 2009-215 (Planning for Special Designations within the National System of Public Lands). Under IM 2009-215:

> A presidential proclamation or act of Congress that designates an area within the National System of Public Land supersedes conflicting direction by the FLPMA. Specifically the land use plan and management direction for such a designation must comply with the purposes and objectives of the proclamation or act of Congress regardless of any conflicts with the FLPMA' multiple use mission...
>
> When integrating planning for a special designation created by presidential proclamation or act of Congress with a general RMP planning process, the Field Office should ensure that the RMP identifies the objects or resources for which the area was designated and illustrates how those objects or resources are protected by the plan. The RMP must also clearly distinguish between the planning area for the RMP and the planning area for the special designation. The existence of multiple decision areas necessitates a plan distinction between the decision and analysis for each area. Additionally, an integrated planning process should conclude with an independent Record of Decision for both the RMP planning area and the special designation planning area.

In 1968, the National Trails System Act (NTSA; Public Law 90-543) provided for the development of a national system of trails in urban, rural, and wilderness settings. Originally, the NTSA specified three categories of national trails: NSTs, recreation trails, and connecting or side trails. In 1978, historic trails were added as another category. Today, only Congress can designate NHTs and NSTs.

3.7.1.1. National Scenic Trails

The NTSA provides for the designation of NSTs "so located as to provide for maximum outdoor recreation potential and for the conservation and enjoyment of the nationally significant scenic, historic, natural, or cultural qualities of the areas through which such trails may pass" (Section 3(a)(2)). After passage of the NTSA, the Bureau of Outdoor Recreation (in accordance with the NTSA) performed a study that endorsed designation of the Continental Divide Trail as an NST.

Continental Divide National Scenic Trail

The National Trails System Act (Public Law 90-543) provides for the designation of national scenic trails "so located as to provide for maximum outdoor recreation potential and for the conservation and enjoyment of the nationally significant scenic, historic, natural, or cultural qualities of the areas through which such trails may pass" (Section 3(a)(2)).

The CDNST is a 3,100-mile trail extending from Canada to Mexico and passing through the Rocky Mountain States of Montana, Idaho, Wyoming, Colorado, and New Mexico. An 89-mile on-the-ground route of the CDNST was designated through the planning area in 1999, followed by an additional 3 miles of route in 2001. These 92 miles of the CDNST include 2 miles of hiking trail, 10 miles of cross-country travel, 4 miles of gravel roads, and 76 miles of primitive two-track roads (Map 121). A cooperative agreement with the Wyoming State Lands & Investment office provides for joint management of approximately 3 miles of scattered state lands in the 92 miles of route.

After the passage of the National Trails System Act, the Bureau of Outdoor Recreation (in accordance with the Act) conducted a study that endorsed designation of the Continental Divide Trail as a national scenic trail (Bureau of Outdoor Recreation 1976). The overall vision for the CDNST, as stated in the 1976 Study Report follows:

> The primary purpose of this trail is to provide a continuous, appealing trail route, designed for the hiker and horseman, but compatible with other land uses…To provide hiking and horseback access to those lands where man's impact on the environment has not been adverse to a substantial degree and where the environment remains relatively unaltered. Therefore, the protection of the land resource must remain a paramount consideration in establishing and managing the trail. There must be sufficient environmental controls to assure that the values for which the trail is established are not jeopardized….The basic goal of the trail is to provide the hiker and rider an entrée to the diverse country along the Continental Divide in a manner which will assure a high quality recreation experience while maintaining a constant respect for the natural environment.

Similarly, the Comprehensive Management Plan for the CDNST (USFS 1985) established the following goal:

> Provide users with opportunities to view, experience, and appreciate examples of prehistoric and historic human use of the resources along the Continental Divide; examples of the ways these resources on public lands are being managed in harmony with the environment, as an asset to the existing character of the Continental Divide, and which will not detract from the overall experience of the trail.

In recognition of the above, the Comprehensive Management Plan emphasized the importance of visual management as a key factor to ensure user enjoyment of the CDNST. The plan directed the BLM to consider the trail a high sensitivity travel route. Importantly, the trail corridor across the planning area encompasses diverse landscapes. A portion of the trail landscape encompasses areas of "high absorption capacity," meaning activities along these could be easily located out of view. Conversely, another portion of the trail crosses a landscape that does not readily absorb contrasting activities, that is observers traveling along this section of trail would be particularly sensitive to activities that altered the characteristic landscape.

The portion of the CDNST in the planning areas travels through numerous differing landscapes. The trail enters south of Green Mountain and travels northwest towards Crooks Gap. In the Crooks Gap area the trail travels through a more industrialized zone with many resource uses including major pipeline ROWs, reclaimed uranium mining, major motorized travel routes, and an oil field on top of Crooks Mountain. Continuing in a northwesterly direction, the trail travels into a zone with very little development or resource use. This zone contains some of the most wide-open and undeveloped landscapes available on the entire CDNST. After crossing the Bison Basin Road, the trail connects to the NHTs and travels across an area known as the Antelope Hills. Within the Antelope Hills landscape are numerous granite outcrops and features that draw the observer's attention. The trail eventually crosses the Sweetwater River at the Phelps Dodge Bridge; here the trail travels toward South Pass City State Historic Park and the South Pass Mining ACEC. This section contains numerous cross-country sections and eventually drops the user into South Pass City. Continuing on from the Willow Creek trailhead, the trail heads cross-country for some time before returning to a primitive two-track and eventually encountering Wyoming Highway 28.

The diversity of landscapes and features encountered on each section of the trail has corresponding different visual resource classes. The existing plan visual resource designation for the trail is Class II-IV. These were established several years before the trail was designated; as a result, most of the visual resource classes do not consider the trail corridor. The most recent VRI was conducted in partnership with the University of Wyoming and considered the trail designation; as

a result, inventory classes displayed a higher visual value then those considered in 1987. The new inventory found that the trail travels through VRI Classes II-IV, with a very high amount in Class III or higher.

Visitor use by through-hikers is on a slight upward trend. Use in both 2003 and 2004 was in the range of 40 to 60 through-hikers from May through September (BLM 2009h). Non-through-hiker day-use and multiple-day use of the trail is low. Other recreational uses on the designated route include hiking, hunting, mountain biking, and driving for pleasure, but are not considered uses tied directly to the trail.

A trailhead was developed in the parking area of the South Pass City State Historic Site in 2002. The trail uses the main site roadway before entering public land to follow the Volksmarch Trail for approximately 2 miles. It then follows a series of two-track roads and cross-country travel toward the Sweetwater River and beyond.

Further analysis of the recreation and visual trends of the trail are contained in the *Visual Resources* and *Recreation* sections. Currently, no allowable use decisions exist on or adjacent to the CDNST; this situation creates conflicting mandates for managers and members of the public. A change in management is needed in order to provide a diversity of trail landscapes that meet the demands of the National Trails System Act, the Comprehensive Report, and the subsequent Comprehensive Management Plan. This National Conservation System landscape is not currently protected under standard mitigation guidelines or other planning decisions. Prescriptions to maintain this Congressionally designated resource need to address the following: activities under the 1872 Mining Law, management of ROWs, oil and gas development, management of OHVs, historical resource protection, as well as the management of recreational use and enjoyment of the trail.

Management Challenges for the Continental Divide National Scenic Trail

At present, there are no allowable use decisions on or adjacent to the CDNST. This creates one of the major management challenges for the CDNST: how to manage for multiple use while maintaining the CDNST's scenic value. For example, as the technology for wind-energy development changes, the increased height of wind turbines increases the potential for a visual impact to the CDNST.

To provide a diversity of trail landscapes that meet the demands of the NTSA, the Comprehensive Report and the subsequent Comprehensive Management Plan require a change in management. This National Conservation System landscape is currently unprotected under standard mitigation guidelines or other planning decisions. Prescriptions to maintain this Congressionally designated resource would need to address the following: activities under the 1872 General Mining Law, ROW management, oil and gas development, management of motorized vehicles, and historical resource protection, along with management of recreational use and enjoyment of the trail.

Refer to the *Visual Resources* section of this chapter for additional information on management challenges for the CDNST related to visual resources.

3.7.1.2. National Historic Trails

The Oregon, Mormon Pioneer, California, and Pony Express NHTs are four nationally significant historic trails that traverse the southern portion of the planning area. These trails mark the mid-1800s period of mass migration for pioneering Americans who headed West (Map 123). The

Congressional designation of these trails as NHTs reflects their nationally recognized status as symbols of one of the most important and influential movements of people in United States history.

The four routes converge onto one general route and are managed as a unit through much of Wyoming. The National Park Service and the BLM have long described the Oregon, Mormon Pioneer, California, and Pony Express Trails and its variants in central and western Wyoming as some of the best remains of these NHTs left in the United States. These trails include long stretches of well-preserved ruts, swales, and mostly intact historical settings. In fact, the entire section of the four NHTs within the planning area was designated as a High Potential Segment, which deserves the highest level of protection and preservation. The following sections describe the four NHTs and the Seminoe Cutoff.

The Oregon National Historic Trail

The Oregon NHT is a portion of the transcontinental route that was a migration route for prehistoric and early historic groups, and later became the main highway for European-American emigrants looking for new land and a new beginning in the largely unsettled western territories. This westward movement occurred primarily from the 1840s through the 1860s, but the Oregon Trail remained in use as a wagon trail as late as 1912. Estimates claim the number of pioneers who used the trail range from 350,000 to 500,000. Most of the emigrants traveled with wagon trains, spending an average of 6 months walking and riding over the arduous route. At least 20,000 died along the various emigrant trails during this period.

A large number of Oregon Trail emigrants settled the widely available lands in Oregon and Washington or set up commercial pursuits to serve the settlements. Later, discoveries of precious minerals became an impetus for migrations to different parts of the West and provided the basis for settlement of lands previously bypassed by the emigrants.

In the 1850s and 1860s, military and commercial interests used the Oregon Trail extensively. The supply needs of settlements, travelers, and Native American tribes under treaty enabled freighting companies to operate, while military garrisons were assigned to posts along the trail to protect the emigrants and freighters. Communications services also developed along the Oregon Trail, the most famous was the Pony Express. Stage lines also operated on the Oregon Trail, but some were forced to move to the more southern Overland Trail because of Indian attacks.

The use of the Oregon Trail and its contribution to settlement and development in the west are an important part of American history. Congress recognized this in 1978 by designating the Oregon Trail an NHT. Under this status, the federally administered portions of the Oregon NHT are protected from unwarranted impacts and are maintained for public enjoyment and use. The entire section of the Oregon Trail within the planning area is designated as a High Potential Segment, which deserves the highest level of protection and preservation.

The Mormon Pioneer National Historic Trail

In the midst of the migration to Oregon and California, there was a smaller migration headed toward Utah. Most of these emigrants were Mormons (members of the Church of Jesus Christ of Latter-Day Saints), which was founded in 1830. The Mormon emigrants' goal was to get to the Great Salt Lake Valley where the new center of the Mormon Church had been established.

In 1846/1847, an advance party led by church leader Brigham Young headed west from Illinois and chose their new home in the Great Salt Lake Valley. The route these first pioneer Mormons

used is the Mormon Pioneer NHT. In the two decades following their pioneering trek, thousands of Mormons from the eastern United States and Europe traveled to Utah to live in the Great Salt Lake Valley.

The route the Mormons used to get as far as mid-Nebraska differed from the Oregon Trail, but when the two trails met on the Platte River they basically followed the same route from there to Fort Bridger in southwest Wyoming. The Mormon Pioneer Trail complements the Oregon Trail as a major symbol of the nation's expansion. Whereas the Oregon Trail contributed to development in the far western states, the Mormon Pioneer Trail was one of the major factors in the initial development of the interior West. Congress observed the importance of the Mormon Pioneer Trail by designating it as an NHT in 1978. As with the Oregon Trail, the Mormon Pioneer Trail is now afforded protection from unwarranted disturbances and is maintained for public enjoyment and use. The entire section of Mormon Pioneer Trail within the planning area is designated as a High Potential Segment, which deserves the highest level of protection and preservation.

The California National Historic Trail

Following the Oregon Trail to Fort Bridger, and then continuing west through Utah and Nevada, a small number of emigrants blazed trails into California as early as 1841. In 1846, the number of people headed to California is estimated to have been about 1,500. In 1848, gold was discovered in the Sierra Nevada Mountains of California, and by 1849, those moving to California exceeded those headed for Oregon. In 1850 alone, an estimated 44,000 emigrants arrived in California, and as many as 250,000 people traveled the California Trail from 1841 through 1868.

Some segments of the California Trail followed slightly different routes in Wyoming than the Oregon or Mormon Pioneer Trails. These cut-offs and short cuts were generally blazed to enable hurried travelers to bypass the slow wagon trains prevalent on the other trails.

The California Trail complements the Oregon Trail as a symbol of our nation's expansion. Emigration along the California Trail established a 2,400-mile transportation, commerce and communications route and helped secure the West for the United States. Therefore the trail's social, political, and economic contributions to the fledgling United States are highly significant. Congress observed the importance of the California Trail by designating it an NHT in 1999. As with the Oregon and Mormon Pioneer Trails, the California Trail is now afforded protection from unwarranted disturbances and is maintained for public enjoyment and use. The entire section of the California Trail within the planning area is designated as a High Potential Segment, which deserves the highest level of protection and preservation.

The Pony Express National Historic Trail

By 1860, the population and commerce of the West had grown, civil war loomed, and fast, reliable communications between East and West became critical. The freighting firm of Russell, Majors & Waddell, hoping for a profitable federal postal contract, devised a relay system of riders, stations, and stock handlers to move light mail quickly between St. Joseph, Missouri, and San Francisco. This system, popularly known as the Pony Express, launched on April 3, 1860.

Although the Pony Express was efficient and popular, it was not profitable due to high overhead costs, and the enterprise never secured a government contract. It was also not competitive with transcontinental telegraph route, which was substantially completed in 1861. The Pony Express was forced to discontinue service in November 1861, after operating for only a year and a half.

Nevertheless, the Pony Express is significant in American history because it proved the viability of an all-season, central overland route for fast communications between East and West; played a vital role in aligning California with the Union; and ensured timely transcontinental communications during the first year of the Civil War before completion of the transcontinental telegraph (NPS 1999).

The Pony Express Trail follows the Oregon Trail through the planning area. Although driven out of business by the transcontinental telegraph after a year and a half, it remains part of national history as an important American achievement. Congress observed the importance of the Pony Express Trail by designating it an NHT in 1999. As with the other NHTs, the Pony Express NHT is now afforded protection from unwarranted disturbances and is maintained for public enjoyment and use. The entire section of the Pony Express Trail within the planning area is designated as a High Potential Segment, which deserves the highest level of protection and preservation.

The Seminoe Cutoff of the Oregon, Mormon Pioneer, California, and Pony Express Trail

The Seminoe Cutoff of the Oregon, Mormon Pioneer, California, and Pony Express Trail begins in the southeastern portion of the planning area where it cuts off from the main Oregon, Mormon Pioneer, California, and Pony Express Trail. Probably named for Basil LaJeuness, a trapper known as Seminoe, this route remains south of the Sweetwater River and was used by freighters and travelers seeking a speedier trip. Although it avoids a number of river crossings, it was also relatively dry and longer than the main Oregon, Mormon Pioneer, California, and Pony Express Trail. The Seminoe Cutoff leaves the main Oregon, Mormon Pioneer, California, and Pony Express Trail at Warm Springs and rejoins the main trail west of the Ninth Crossing and a few miles east of South Pass (Wyoming SHPO 2009). As part of the California Trail, the Seminoe Cutoff is afforded protection from unwarranted disturbances and is maintained for public enjoyment and use. The entire section of the Seminoe Cutoff within the planning area is designated as a High Potential Segment, which deserves the highest level of protection and preservation.

Location and Geography of the NHTs

The four NHTs share a mostly common corridor from Horse Creek, east of Independence Rock, to Burnt Ranch, south of Atlantic City. Some individual sites identified on Map 123 are depicted because they are associated with mineral withdrawals. It is a route considered to be one of the most pristine segments of these trails in the entire nation. The overall good-to-excellent condition of the trail corridor is due to a lack of effects on the trails themselves, and to the mostly intact historic setting around the trails. For this reason, the BLM and the National Park Service have designated this stretch of NHTs as a High Potential Route Segment, a designation that carries the highest priority for protection and management in the National Trails System. Map 123 shows the locations of the NHTs in Wyoming.

Physical Condition and Use

After heavy use of the NHTs' near the mid- to late- 19th Century, most of the trail corridor reverted to minimal use by ranchers, recreationists, hunters, and other casual users. However, commemorative anniversary wagon trains in the 1990s increased the popularity of the NHTs, and use began to increase. By 2000, use in the western part of the planning area (especially by Mormon groups) had increased dramatically, and the trails there began to be adversely affected. By 2005, the BLM developed better management strategies to protect the historical values of the

NHTs. At present, most of the Oregon, Mormon Pioneer, California, and Pony Express Trails are still in good-to-excellent condition, and the affected parts are likely starting to recover. See Map 122 for condition class ratings associated with the NHTs.

Special Sites Associated with the NHTs

Associated with the NHTs are a number of sites on BLM-administered surface that figured prominently in the combined history of the NHTs. These sites sometimes occur outside of the current NHT corridor, but are included in this section because they are integral parts of the NHT system. The sites are shown on Map 123, and include Martin's Cove, Devil's Gate, Split Rock, Ice Slough, Rocky Ridge, Rock Creek Hollow, and Gilespie Place, all described below.

Martin's Cove

Martin's Cove is a historic site associated with the Mormon Pioneer NHT in the southeastern part of the planning area (603 acres of BLM-administered surface) (Map 123). The Cove is a sheltered recess among the Sweetwater Rocks where Mormon emigrants took refuge from a winter storm in 1856. The cove is next to the bare granitic hills of the Sweetwater Rocks, just north of the Sweetwater River, about 2 miles west of Devil's Gate and 1 mile north of the Oregon/Mormon Pioneer Trail.

The setting of this disaster involved Captain Edward Martin's 6th Handcart Company, a large group of Mormon converts who were headed to the Salt Lake Valley of Utah. The company originated in England, and they planned to walk across the interior of the United States pulling two-wheeled handcarts. A winter storm caught them weak and unprepared, and the emigrants took refuge in Martin's Cove. The company was eventually rescued and brought to Salt Lake City, but not before 145 people in the company died from exposure and starvation.

Until recently, the site was only casually used by local ranchers and occasional history buffs. However, in the 1990s, the Mormon Church purchased the ranch that controlled access into the Cove. Visitation immediately increased, and the BLM and the Church jointly developed a walking path, interpretive stations, and other facilities to handle the surge of visitors. Although these modern facilities diminished the historical integrity of the Cove, they have kept the effects from an estimated 40,000 visitors per year to an acceptable level.

Devil's Gate

Devil's Gate (395 acres of BLM-administered surface) is a historic site associated with the NHTs just east of Martin's Cove (Map 123). Devil's Gate is a unique geological feature where the Sweetwater River has cut through the Sweetwater Rocks leaving a narrow cleft measuring approximately 370 feet deep, 2,500 feet long, and less than 50 feet wide in places. This site is 5 miles southwest of Independence Rock near the point where the NHTs begin to parallel the Sweetwater River. Many pioneer diaries include remarks about Devil's Gate, and some of the emigrants wrote or carved their names on the cliffs around this landmark. Devil's Gate appears mostly as it did in the mid-1800s, except for an irrigation canal built along the river cut, and some modern ranching developments near it. For more than a century, use of Devil's Gate was minimal. The site is accessible from the Martin's Cove complex, and there has been increased use in recent years without much of an effect on the site.

Split Rock

Split Rock is a geologic feature with historical associations to all four of the NHTs. The Split Rock area includes an interpretive site (242 acres of BLM-administered surface) and the Split Rock/Twin Peaks NRHP site (645 acres of BLM-administered surface). Approximately 15 miles west of Martin's Cove and Devil's Gate, Split Rock is a prominent and highly visible landmark and served as a geographical guide for Native Americans, fur traders, and emigrants. This high cleft in the granite of the Sweetwater Rocks could be seen soon after the emigrants left Devil's Gate, and the area near Split Rock was a favorite camping spot. During the 1860s, the Pony Express, Overland Stage Line, and the Eleventh Ohio Cavalry maintained a post in the local area. Although there has been some agricultural development near the Sweetwater River, the general area is little changed from its 19th Century historical setting.

Ice Slough

Ice Slough is another historic site associated with the four NHTs (1,345 acres of BLM-administered surface) (Map 123). Ice Slough is a wide, shallow, swampy drainage that was often mentioned by the emigrant travelers on the Oregon, Mormon Pioneer, and California Trail. This spring-fed boggy area, approximately 23 miles west of the Split Rock landmark, is paralleled by the trail for several miles before the trail crosses it. The emigrants used the slough for grass, water, camping, and reportedly as a source of summertime ice. The ice, found under peat and water layers, could be obtained even in the hot summer months, and this oddity was a constant and welcome surprise to the pioneers. Along the banks of the slough was a Pony Express station, which operated in the 1860s. U.S. Highway 287 crosses the slough, and ditches have been cut into it in places, but otherwise the site still appears mostly as it did in the 19th century. Heavy grazing in Ice Slough was recently controlled by the installation of an electric fence, which was designed to be minimally visible from the NHT.

Rocky Ridge

Rocky Ridge is a historic site associated with all four of the NHTs, and is in the southwestern part of the planning area (833 acres of BLM-administered surface) (Map 123). Rocky Ridge was a landmark of a different sort for the emigrants. This area, approximately 19 miles west of Ice Slough, was a spot where the emigrants were forced to leave the lowlands along the Sweetwater River and cross a high, barren and rocky ridgeline north of the river. Many of the pioneers' diaries speak of the rough, jarring ride they endured and the difficulty of the steep climb over the ridge. The area today still exhibits rust stains on the rocks from the iron-tire wheels of the early wagons. The Rocky Ridge area is isolated and retains much of its historical and natural character.

After the 1870s, Rocky Ridge reverted to minimal use by ranchers, hunters, and trail enthusiasts. However, in the 1990s, commemorative anniversary wagon trains increased the popularity of the NHT and Rocky Ridge, and use began to increase. By 2000, use of Rocky Ridge (especially by Mormon groups) had increased dramatically, and the site began to be adversely affected. By 2005, vehicle use over Rocky Ridge had been prohibited, and non-vehicular use was beginning to be better managed to protect the historical character of Rocky Ridge. At present, use is being carefully monitored, and the site might be starting to heal. Part of Rocky Ridge is within the current NHT ACEC and part is not.

Rock Creek Hollow

Rock Creek Hollow is a historic site associated with the Mormon Pioneer NHT (94 acres of BLM-administered surface) (Map 123). This site (formerly known as Willie's Handcart Rescue Site) was one of the locations where the Willie's Handcart Company took shelter after being

rescued in the fall/winter of 1856. The hollow, located approximately 6 miles west of Gilespie Place, lies in the narrow floodplain of Rock Creek near the spot where the Oregon Trail crosses the creek.

Rock Creek Hollow commemorates the disaster to Willie's Handcart Company in October and November of 1856. The same storm that trapped Martin's Handcart Company also overtook Willie's Handcart Company. The Willie's Company, was overtaken by the storm and took shelter in several different areas, including Rock Creek. More than 70 people from this company died during the disaster, including several people at Rock Creek. The Mormon Church has developed the private land at this site, but the BLM portion to the south is mostly untouched and appears much as it did in the 1850s. Under the existing plan, mining activities within one-eighth of a mile of Rock Creek Hollow are required to have a Plan of Operations, and part of the site is within the NHT ACEC.

Gilespie Place

Gilespie Place is a historic site associated with the four NHTs and later mining and settlement history of the area (240 acres of BLM-administered surface) (Map 123). This site is along the Oregon/Mormon/California Trail, just east of the historical mining camp of Lewiston. Gilespie Place consists of two standing structures, several foundations with wall remains, and a flowing spring. The site, located along a major transportation route, was associated with several historical events of Wyoming's early territorial and state history.

The earliest historical use of the site probably occurred during the Oregon/Mormon Pioneer Trail era, when early emigrants passed through the region in the 1840s. Although there are no known emigrant-diary accounts of this site, the site's spring (Radium Spring) was probably often used as a convenient water source. In addition, there was probably some overnight emigrant camping at the site.

Radium Spring probably continued to be used by travelers over the entire emigrant trail era. In the 1880s, mineral exploration began in earnest in the Lewiston Mining District, which included the Radium Spring area. Although no records are available, there was probably some small-scale exploration in the local area.

Structures were built on the site after the turn of the 20th Century, but there is no record of exactly when sites were constructed. Artifactual evidence points to pre-1920s dates of occupation for at least some of the structures. This evidence corresponds to newspaper accounts of a Mrs. S. F. Gilespie having settled on 160 acres in the immediate area sometime around 1910 (BLM 2009b). Touted as "Wyoming's Copper Queen," Mrs. Gilespie seems to have been heavily involved in mining ventures in the local area around Lewiston. During this period, the spring was claimed to have radium in its waters and was advertised to have healthful properties.

Several structures in fair-to-good condition still exist at the site. Under the existing plan, mining activities within one-eighth of a mile of Gilespie Place are required to have a Plan of Operations.

Current Management of the NHTs

Guidelines, Management Plans, and Other Current Management Specific to NHTs

Specific to the Oregon, Mormon Pioneer, California, and Pony Express Trails, the BLM Wyoming Oregon/Mormon Pioneer National Historic Trails Management Plan (BLM 1986) states:

> Because of the Trails' status as congressionally designated components of the National Trails System, management decisions have been made that significant segments of the Oregon and Mormon Pioneer Trails are to be protected. It is incumbent on BLM managers to maintain the scenic/historic integrity of historic sites and cross-country segments on the public, to avoid destruction of trail resources, to mitigate unavoidable impacts, to accord the trails a priority status in the land use planning process, and generally extend to the trails the type of protection afforded to other nationally significant historic sites. (Oregon/Mormon Pioneer National Historic Trails Management Plan: Part I, Bureau of Land Management Responsibilities, Section 3).
>
> All historic sites and cross-country segments of the trails on federal lands should be managed to protect and interpret their historic values. (Oregon/Mormon Pioneer National Historic Trails Management Plan: Part II, General Management Objectives, Section 3).
>
> New fencing projects will cross the trail corridor at right angles to minimize the number of feet per miles of fence within the corridor. Gates, and in some cases, cattleguards will be installed in the fence at trail crossings. Fragile or pristine trail ruts will be avoided with fence crossings. (Oregon/Mormon Pioneer National Historic Trails Management Plan: Part III, Oregon/Mormon Trail General Management Policy, Fencing section).

The existing plan focuses on general methods of management that protect and maintain important trail values while allowing public use and enjoyment of the NHTs. Important segments of the trails and trail-related sites are recommended for special protection, interpretation, use, or other management measures. The management decisions outlined in the Oregon/Mormon Pioneer Trails Management Plan are consistent with the decisions in the RMP (BLM 1987b).

The NHTs are managed for cultural and recreational values. The National Park Service and the BLM have designated the portions of the NHTs in the planning area as a High Potential Route Segment. Under current management, a corridor one-quarter mile on each side of the NHTs has an NSO restriction for leasable minerals, locatable mineral exploration (occasional withdrawals and plans of operations requirements), utility systems (avoided), wind development and other ROWs (avoided), and motorized travel use (limited and closed at Rocky Ridge).

National Historic Trails ACEC

The current National Historic Trails ACEC consists of approximately 27,728 acres of BLM-administered surface along the Oregon, Mormon Pioneer, California, and Pony Express NHTs, all of which follow essentially the same east-west route through southwestern Natrona County and southern Fremont County (Map 130). This trails corridor follows the Sweetwater River for most of its length. Resources that met the ACEC importance and relevance criteria in the 1987 RMP included cultural and scenic values. Those resources continue to meet the criteria for this RMP revision. The ACEC includes several other significant historical sites (e.g., Independence Rock, Devil's Gate, Martin's Cove, Split Rock, Ice Slough, Sixth Crossing, Rocky Ridge, and Burnt Ranch) that are associated with the NHTs. One-quarter mile on either side of the trails is designated as VRM Classes I or II.

Proposed Expansion

The proposed expansion of the National Historic Trails ACEC is on either side of the existing ACEC and would expand the ACEC to 468,183 acres of BLM-administered surface. As with the existing ACEC, the proposed expansion area contains scenic values and historic resources. This expansion is proposed to address visual sensitivity within 5 miles of the trail (or the foreground/middleground zone). Public interest and visual sensitivity in the viewshed along these trails in the area encompassed by this proposed expansion has increased since publication of the existing plan. Management challenges for the existing ACEC also apply to the expansion.

Refer to Chapter 2 of this document for detailed management prescriptions for the NHTs (Special Designations – Congressionally Designated Trails).

National Register of Historic Places and National Historic Landmark

Specific sites along the NHTs require special management. One site along the NHTs is part of a National Historic Landmark (NHL) (Devil's Gate), two sites are listed on the NRHP (Martin's Cove and Split Rock), and four are eligible for listing on the NRHP (Ice Slough, Rocky Ridge, Rock Creek Hollow and Gilespie Place).

Devil's Gate

Devils Gate is part of the Tom Sun National Historic Landmark and is managed for cultural and recreational values. The National Park Service and the BLM have designated this site as a High Potential Historic Site. The site has an NSO restriction for leasable minerals; is withdrawn from locatable mineral entry; avoided for utility systems, wind development, and other ROWs; and open to limited motorized travel. Devil's Gate is only partly within the current NHT ACEC, but is within the area nominated to become part of an expanded NHT ACEC. The condition trend for Devil's Gate is stable; surprisingly, heavy use at nearby Martin's Cove has not caused an increase in impacts to Devil's Gate.

Martin's Cove

Martins Cove is listed on the NRHP and is managed for cultural and recreational values. The National Park Service and the BLM have designated this site as a High Potential Historic Site. The BLM and the Mormon Church jointly manage Martin's Cove. The site has an NSO restriction for leasable minerals; is withdrawn from locatable minerals; avoided for utility systems, wind development, and other ROWs; is fenced from grazing; and is open to limited motorized travel. Martin's Cove is not part of an ACEC, but is within the area nominated to become part of an expanded NHT ACEC.

The condition trend for Martin's Cove was down, but has now stabilized. Martin's Cove is one of several sites associated with the NHTs where heavy use has caused measurable damage. Intensive management has stopped the downward trend, with improvement of previous damage occurring.

Split Rock

Split Rock is listed on the NRHP and is managed for cultural and recreational values. The National Park Service has designated this site as a High Potential Historic Site. The site has an NSO restriction for leasable mineral; is withdrawn from locatable minerals; avoided for utility systems, wind development, and other ROWs; and is closed or open to limited motorized travel. Split Rock is only partly within the current NHT ACEC, but is within the area nominated to become part of an expanded NHT ACEC. The condition trend for Split Rock is stable because it is not easy to access and does not receive heavy use.

Ice Slough

Ice Slough is eligible for listing on the NRHP and is managed for cultural, recreational, and grazing values. The National Park Service and the BLM have designated this site as a High Potential Historic Site. The site has an NSO restriction for leasable minerals; requires a Plan of Operations for locatable mineral entry; is avoided for utility systems, wind development, and other ROWs; and closed or open to limited motorized travel. Ice Slough is only partly within the current NHT ACEC, but is within the proposed NHT expansion ACEC. The condition trend for Ice Slough was down, but has now stabilized. A riparian-wetland fence was built several years ago to relieve grazing pressure on the Slough, and this has markedly improved the site's condition.

Rocky Ridge

Rocky Ridge is eligible for listing on the NRHP and is managed for cultural and recreational values. The National Park Service and the BLM have designated this site as a High Potential Historic Site. The site has an NSO restriction for leasable minerals; is withdrawn from locatable mineral exploration; avoided for utility systems, wind development, and other ROWs; and is open to limited motorized travel. Rocky Ridge is only partly within the current NHT ACEC, but is within the area nominated to become part of an expanded NHT ACEC. The condition trend for Rocky Ridge was down, but has now stabilized. Rocky Ridge is one of several sites associated with the NHTs where heavy use has caused measurable damage. Intensive management has stopped the downward trend, with some healing of earlier damage being observed.

Rock Creek Hollow

Rock Creek Hollow is eligible for listing on the NRHP and is managed for cultural and recreational values. The site has an NSO restriction for oil and gas leasing; is withdrawn for locatable mineral exploration; avoided for utility systems, wind development, and other ROWs; and is open to limited motorized travel. Rock Creek Hollow is only partly within the current NHT ACEC, but is within the area nominated to become part of an expanded NHT ACEC.

The condition trend for Rock Creek Hollow is down, mostly due to over-development. Rock Creek Hollow is one of several sites associated with the NHT where excessive development and use has caused measurable damage. However, the BLM-administered portion of the site remains in stable to only slightly down condition due to restrictions on its use.

Gilespie Place

This site is eligible for listing on the NRHP and is managed for cultural and recreational values. The site has an NSO restriction for oil and gas development; is withdrawn for locatable mineral exploration; avoided for utility systems, wind development, and other ROWs; and is open to limited motorized travel and grazing use. Gilespie Place is only partly within the current ACEC, but is within the area nominated to become part of an expanded NHT ACEC. The condition trend for Gilespie Place was down; however, stabilization of the standing structures at the site has stopped the downward trend.

Oregon Trail Withdrawals

There are several existing Oregon Trail withdrawals along the NHTs that were approved in the 1970s when the Oregon Trail was established as a NHT. These mineral withdrawal areas were chosen because they included emigrant inscriptions and campsites, or were the locations of NHT related historical events. They comprise three separate parcels that cover 315 acres

of BLM-administered surface. They were carried forward in the existing plan and are still applicable. These withdrawals are managed for cultural and recreational values. The sites have an NSO restriction for oil and gas development; are avoided for utility systems, wind development, and other ROWs; and are open to limited motorized travel. The Oregon Trail withdrawals are only partly within the current NHT ACEC, but are within the area nominated to become part of an expanded NHT ACEC.

The condition of the NHTs in the withdrawal areas varies from stable to deteriorating, depending on the location. The portion of the NHTs between 6th Crossing (of the Sweetwater River) and Rock Creek Hollow has experienced heavy use and measurable damage. More intensive management on the part of the BLM has slowed the downward trend, with some healing of earlier damage being observed.

Management Challenges for National Historic Trails

As with other nonrenewable resources, balancing the BLM's commitment to multiple-use with the preservation needs of NHTs presents a management challenge. Pressures on NHTs would likely increase from continued development. Indirect and cumulative effects degrade the trails' historic and natural landscape.

Issues related to preservation of the viewshed are particularly complicated due to wind-energy development, potential location of transmission lines, and other development. The setting is an essential component in determining whether a particular trail segment contributes to the trail's overall significance and in maintaining the historic setting that is critical to providing a quality experience for visitors. The *Visual Resources* section of this chapter provides additional information regarding visual resources along NHTs.

The demand for consumptive use of NHT resources through tourism is relatively high in the planning area and is anticipated to increase over time, reflecting an increasing interest in history and heritage tourism. However, due to the growing interest in the trails, impacts to NHT resources would have to be managed to avoid adverse effects to them. Visitor use of the NHTs is an indicator of public interest in and regard for these traces of the westward emigration, a highly significant trend in our nation's history. Lower visitation might therefore benefit the physical resources, but would imply that the public does not place much value in them. Therefore, visitation should not be discouraged, but managed so as to minimize physical impacts while encouraging visitor use and appreciation of the resource.

In addition to programmed uses in the planning context, collecting, looting, and vandalism of NHT historic sites are forecast to continue to be a problem in the planning area. Some of these unlawful activities are attributable to new types of motorized and nonmotorized vehicles, which have increased the utilization of more remote parts of the NHTs. This factor has also increased the potential for degradation in remote NHT segments and sites due to human-caused activities and impacts. This type of impact is difficult to quantify, but certain types of sites, especially historic station locations and structures, would continue to suffer damage from these kinds of activities.

3.7.2. Wilderness Study Areas

The Wilderness Act of 1964 established a national system of lands designed to preserve a representative sample of ecosystems in a natural condition for the benefit of future generations. With the passage of FLPMA in 1976, Congress directed the BLM to inventory, study, and

recommend which public lands under its administration should be designated as wilderness. Areas identified under this direction are WSAs. To be designated as wilderness, an area must have the following characteristics:

- *Size:* roadless areas of at least 5,000 acres of public lands or of a manageable size
- *Naturalness:* generally appears to have been affected primarily by the forces of nature
- *Opportunities:* provides outstanding opportunities for solitude or primitive and unconfined types of recreation

There are no Congressionally designated wilderness areas in the planning area; however, there are eight WSAs (see Table 3.59, "Current WSA Acreage in the Planning Area and BLM-Recommended Acreage for Wilderness Areas" (p. 458) and Map 128). The BLM's authority to establish new WSAs expired on October 21, 1993 (BLM 2003). With the increase in demand for consumptive and non-consumptive resources, and with increased housing and subdivision development near natural and primitive areas, the WSAs preserve unique ecosystem niches that can support desired outcomes.

The BLM is required by Congress to manage WSAs to preserve the wilderness characteristics under the non-impairment standard until Congress designates the lands under wilderness review as wilderness, or releases the lands to uses other than wilderness. The BLM performs inventories of these areas and makes recommendations regarding the areas and acreage that it recommends for designation as wilderness. These recommendations are based on factors such as the manageability of the area, how well it meets the characteristic of wilderness, conflicts or potential for conflicts with other users and uses, and other relevant factors. Table 3.59, "Current WSA Acreage in the Planning Area and BLM-Recommended Acreage for Wilderness Areas" (p. 458) shows the current acreage for WSAs in the planning area and the BLM's recommendations for the number of acres that should be designated as wilderness.

Table 3.59. Current WSA Acreage in the Planning Area and BLM-Recommended Acreage for Wilderness Areas

Area Managed as Wilderness	Wilderness Study Areas (BLM-administered surface acres)	Recommended for Wilderness (BLM-administered surface acres)
Whiskey Mountain	519	0
Dubois Badlands	4,561	0
Sweetwater Canyon	9,135	5,538
Lankin Dome	6,347	0
Split Rock	13,964	0
Savage Peak	7,178	0
Miller Springs	6,697	0
Copper Mountain	6,936	0
Total	**55,337**	**5,538**

Source: BLM 1991

BLM Bureau of Land Management
WSA Wilderness Study Area

An important distinction between WSAs and Wilderness areas lies in the fact that WSAs are areas that have been found to possess wilderness characteristics. The Wyoming BLM made recommendations to Congress (1991) in regards to which areas met the criteria to be managed as Wilderness. To date, no WSAs managed by the BLM in Wyoming has been designated or released from the wilderness system by Congress. For a WSA to become Wilderness, Congress must so

designate those lands; until Congress acts on these areas BLM is obligated to manage these lands so as not to impair Congress' ability to designate the area as Wilderness. See the Interim Management Policy (IMP) for Lands Under Wilderness Review (H-8550-1).

Whiskey Mountain WSA (WY-030-110)

The Whiskey Mountain WSA includes 519 acres of BLM-administered surface approximately 5 miles south of Dubois bordering the USFS Fitzpatrick Wilderness Area (Map 128). The Whiskey Mountain WSA is bounded by the Ross Lake trail on the east, the Fitzpatrick Wilderness Area on the south and west, and private lands to the north. The WSA is on the northern slope of Whiskey Mountain in the Wind River Mountains. In 1931, a fire burned a large portion of the Wind River Mountains, including the WSA, and the area is currently not distinguishable from the surrounding areas. The terrain is rough and mountainous, and the dominant vegetation is limber pine and Douglas fir, interspersed with burnt snags. The area possesses scenic qualities and provides opportunities for solitude and primitive recreation. The area is used for a variety of recreational activities. Primary factors that attract visitors are the areas' topography, scenic vistas, and wildlife resources.

Dubois Badlands WSA (WY-030-109)

The Dubois Badlands WSA contains 4,561 acres of BLM-administered surface just north of the Wind River and 2 miles east of the town of Dubois (Map 128). The WSA is approximately 4 miles long and between 1 and 2 miles wide. The area can be seen by motorists on U.S. Highway 287 south of Dubois. The WSA's topography consists of badlands and flat-topped hills that are extensively eroded and separated by drainage patterns. The red and tan sedimentary rock bandings in the WSA are particularly noticeable when the vegetation along the Wind River is a contrasting green. The total relief above the Wind River is approximately 400 feet, with notable topographic features, including eroded pinnacles and spires.

Sweetwater Canyon WSA (WY-030-101)

The Sweetwater Canyon WSA contains 9,135 acres of BLM-administered surface in Fremont County, approximately 15 miles east of South Pass City (Map 128). The boundary of the WSA is defined by roads and state and private lands, but does not include private or state in-holdings.

The two basic types of topography in the WSA are the Sweetwater Canyon and its tributary draws and the rolling hills that surround the canyon. Sweetwater Canyon is a water-carved gorge almost 500 feet deep and between 6 and 7 miles long. The walls are almost vertical in places along the canyon. There are bare rock outcrops throughout the canyon interspersed with a variety of vegetation, including sagebrush, grasses, other shrubs, and pockets of aspen and willow. The topography and vegetative features of the canyon contrast strongly with the surrounding hills.

In addition to topography, the river that runs through Sweetwater Canyon offers high-quality brown and rainbow trout fishing. The WGFD has classified this waterway a trout water of regional importance. Recreational visitors from Wyoming and nearby states fish and float the waterway.

The primary management challenge for the WSA is conflict with livestock grazing, which is currently allowed in the Sweetwater Canyon WSA, and recreational uses of the area. The BLM fenced the canyon in the mid 1990s and local grazing permittees agreed to suspend grazing for five years following this action. This management change has resulted in an overall trend of improved range condition and improved recreation experiences. However, since the reinstitution

of grazing, the BLM has received input from recreationists indicating that their wilderness experience was affected by livestock grazing. Visitors have reported encountering livestock in or near dispersed camps, in riparian-wetland areas, and in meadows, and manure in camp sites, livestock tracks in riparian-wetland areas, and odors (BLM 2009b). Research supports the position that livestock grazing can detract from wilderness experiences (Johnson et al. 1997) and indicates that certain groups of recreationists, such as fishermen, are more sensitive to the presence of livestock (Sanderson et al. 1986).

Lankin Dome WSA (WY-030-120)

The Lankin Dome WSA contains 6,347 acres of BLM-administered surface in the eastern portion of the planning area (Map 128). Elevations in the area range from approximately 6,200 feet at the western boundary road to 7,700 feet on Lankin Dome. The primary topographic features of the WSA are uplifted mountains of reddish granite rocks, slabs, and exfoliating domes, and the flats of Noel Pocket. Vegetation cover varies between the two different topographic forms. The mountainous rocky topography supports little vegetation except along drainages where pockets of limber pine, juniper, aspen, and sagebrush can be found. These green vegetation pockets contrast with the reddish granite rocks and add visual interest.

The primary management challenge for the Lankin Dome WSA is recreational access. The BLM has received comments on the recreational value of the Sweetwater Rocks and Granite Mountains within the WSA, and on the need for better access throughout the Granite Mountains area. Any action to improve public access in the areas surrounding the WSAs would need to be developed to ensure any increase in visitation did not conflict with the IMP and travel management designations for the WSA. Inadvertent trespass by public lands users is also an issue of concern in this area due to adjacent private land.

Split Rock WSA (WY-030-122)

The Split Rock WSA contains 13,964 acres of BLM-administered surface (Map 128). The WSA is part of the Granite Mountain Uplift, a large east-west uplift that separates the greater Green River Basin from the Wind River Basin. The area is composed of reddish eroding granite divided by numerous small drainages or pockets. Many of the granite uplifts form large slabs, domes, piles of broken rocks, and slope exceeding 100 percent in places. Elevations range from approximately 6,200 feet in Beaton Pocket to above 8,500 feet on McIntosh Peak. The total relief in the WSA is approximately 1,800 feet.

In addition to scenic resources created by the areas' topography, the WSA contains cultural and recreation resources. Historic features in the area include Miller Cabin, archeological sites containing arrowhead and thumb scraper chippings, and a buffalo jump used by prehistoric hunters. Within the drainage, small wooded patches allow visitors to experience solitude near the access points to the WSA. The contrast between the green vegetation in these drainages and the red granite rocks adds visual interest.

Savage Peak WSA (WY-030-123a)

The Savage Peak WSA contains 7,178 acres of BLM-administered surface near Savage Peak (Map 128). Most of the WSA consists of rugged and mountainous terrain with large vertical relief. Large expanses of bare granite are not found elsewhere in central Wyoming, and these rocks form a scenic backdrop for the Sweetwater River Valley. Bare rock predominates and vegetation is generally sparse, except in small stands of Douglas fir, limber pine, aspen, and

cottonwood along drainages. Outside of the drainages, scattered juniper trees are the primary vegetation in rocky areas. Steeply rising slopes surround large areas of open grass and sagebrush on the western portion of the WSA.

Miller Springs WSA (WY-030-123b)

The Miller Springs WSA contains 6,697 acres of BLM-administered surface (Map 128). The WSA is part of the Sweetwater Rocks complex, and is characterized almost entirely by rough, broken granite domes and outcrops. Parts of the unit resemble piles of monolithic rock. Vegetation in the area is composed of juniper and scattered limber pine along the rocky slopes, and aspen along the base of the rocks. The remaining area is composed of sagebrush flats, which make up between 10 and 15 percent of the WSA.

Copper Mountain WSA (WY-030-111)

The Copper Mountain WSA contains 6,936 acres of BLM-administered surface in Fremont County approximately 10 miles north of Shoshoni and east of the Boysen Dam at the upper end of the Wind River Canyon (Map 128). Steep canyons and rocky slopes dominate the area. Rugged mountains in the WSA rise from between 5,000 feet and 6,400 feet. Total relief in the unit is 1,400 feet. Scenic vistas from the WSA include the Wind River Basin and Boysen Reservoir south and west of the WSA, and the Wind River Mountains and Beaver Rim.

Management Challenges for Wilderness Study Areas

Overall management of WSAs is in compliance with the IMP, and the Lander Field Office has no documented IMP violations on file. The IMP has been adequate to protect the wilderness characteristics in the WSAs. Continuing challenges to WSA management include motorized vehicle management and the enhancement of wilderness experience for visitors to these areas. Motorized vehicle management limitations apply to all WSAs and are directed by the IMP and the BLM Land Use Planning Handbook (H-1610-1). The Land Use Planning Handbook states that travel management designation for WSAs must be at least limited to roads and trails in existence at the time of WSA designation, with open areas only appropriate for sand dunes and over-the-snow travel. Refer to the *Comprehensive Trails and Travel Management* section of this document for additional information on travel management designations.

The BLM separately manages lands found to contain wilderness characteristics that were identified after the BLM's authority to establish WSAs expired. The discussion of these areas is found in the *Lands with Wilderness Characteristics* section of this chapter.

3.7.3. Wild and Scenic Rivers

The National Wild and Scenic River System (NWSRS) is a system of nationally designated rivers preserved in a free-flowing condition; their immediate environments are recognized for outstanding scenic, recreational, geologic, fish and wildlife, historic, cultural, and other similar values. The system consists of three types of rivers:

1. *Recreation* – rivers or sections of rivers that are readily accessible by road or railroad, that might have some development along their shorelines, and that might have undergone some impoundments or diversion in the past.

2. *Scenic* – rivers or sections of rivers free of impoundments with shorelines or watersheds still largely undeveloped, but accessible in places by roads.

3. *Wild* – rivers or sections of rivers free of impoundments and generally inaccessible, except by trails, with essentially primitive watersheds or shorelines, and unpolluted waters.

The BLM is responsible for evaluating all rivers on BLM-administered land to determine if they are appropriate for addition to the NWSRS. The BLM also makes, as appropriate, recommendations for legislative actions to accomplish such additions. Congress ultimately decides whether to include a waterway segment in the NWSRS.

In accordance with the Wild and Scenic Rivers Manual (8351), the BLM evaluates identified river segments for their eligibility and suitability for WSR river designation through its RMP process. BLM shall afford protective management to all eligible river segments as necessary to ensure that the existing qualities upon which their eligibility is based are not degraded. All eligible river segments are tentatively classified and management measures instituted as necessary to ensure appropriate protection of the values supporting the eligibility and classification determination. Actual classification is a Congressional legislative determination; BLM's classification is a planning determination and is only tentative prior to congressional action. Each eligible river segment is further evaluated in the RMP process to asses whether or not it would be suitable for inclusion in the NWSRS. The planning determination of suitability provides the basis for any decision to recommend legislation. The Wild and Scenic River review (BLM 2002a) will be reviewed and revisited through this Land Use Planning process. At the conclusion of this land use planning process the BLM (through public involvement) will make final: tentative classification for eligible waterways, develop interim management prescriptions for these waterways, and conclude with determinations of suitability.

At present, there are no Congressionally designated WSRs in the planning area; however, nine waterways have been found to meet the eligibility criteria for WSR designation, and two of these waterways have been preliminary determined to meet suitability factors. The Lander Field Office Review of Potential Wild and Scenic Rivers in the Lander Planning Area (BLM 2002a) documents these findings. The BLM is seeking public comment on the Wild and Scenic River Report (BLM 2002a). Comments received during this RMP Revision will be incorporated into the Final Wild and Scenic River Report. Recommendations to Congress for inclusion of BLM-administered land and waterways in the NWSRS will consider public comments.

Step I – Eligibility Criteria

The Lander Field Office reviewed a total of 157 waterways in the planning area for eligibility as part of its 2002 WSR review (BLM 2002a). The Lander Field Office Review of Potential Wild and Scenic Rivers in the Lander Resource Management Plan Planning Area contains detailed descriptions of the waterway identification and review processes. To begin these reviews, the BLM identified natural waterways (including both perennial and non-perennial rivers and streams) in the planning area based on a broad definition of free-flowing that included all waterways on BLM-administered land. Following this initial inventory, the BLM Interdisciplinary Team members reviewed the waterways to determine if they met eligibility criteria of containing at least one of the outstandingly remarkable values described in BLM Manual 8351. These outstandingly remarkable values include scenic, recreational, geologic, fish, wildlife, cultural, historic, and other similar values (e.g., ecologic/biologic diversity, paleontologic, or botanic values). Of the 157 waterways reviewed, 148 were found not to possess outstandingly remarkable values. These 148 waterways were subsequently dismissed from further consideration.

Nine waterways were determined to meet the WSR eligibility criteria. Two of these nine waterway review segments include a main waterway segment and one or more tributaries that have been grouped together for review as "waterway units." The BLM gave all eligible waterway segments a tentative classification of either wild, scenic, or recreational. The BLM determined tentative classifications based on the degree of development along the waterway and on adjacent lands at the time of the evaluation. Table 3.60, "Characteristics for Wild and Scenic River-Eligible Waterways in the Planning Area" (p. 463) lists these nine waterways and waterway units, their total lengths, their outstandingly remarkable values, and their tentative classifications (segments found suitable for listing are identified on Map 129).

On review of the original inventory in preparation for the RMP revision, the Lander Field Office initially identified a few reaches of the Upper Willow Creek area in the Sweetwater drainage as potentially having been not reviewed. Subsequent evaluation determined that these reaches had been properly reviewed.

Table 3.60. Characteristics for Wild and Scenic River-Eligible Waterways in the Planning Area

Waterway Reviewed	Segment and Length (miles)	Free Flowing	Outstandingly Remarkable Values on Public Lands	Tentative Classification
Baldwin Creek (includes Upper Baldwin Creek and Lower Baldwin Creek)	8.1	Yes	Scenic, Recreational, Wildlife	Wild/Scenic
Ice Slough	1.6	Yes	Historical	Wild
Little Popo Agie River	1.5	Yes	Scenic, Recreational, Cultural	Wild
North Popo Agie River	0.7	Yes	Scenic, Recreational, Cultural	Wild
Rock Creek	4.0	Yes	Historical	Scenic
Sweetwater River (includes Granite, Mormon, Strawberry, and Willow Creeks)	12.9	Yes	Scenic, Recreational, Historical, Other - Ecological	Wild
Warm Springs Creek	1.3	Yes	Geological, Historical	Recreational/Scenic
Willow Creek	1.3	Yes	Recreational, Historical	Scenic
Wind River	0.5	Yes	Scenic, Geological	Scenic
Source: BLM 2002a				

Step II – Suitability Factors

All waterway segments that met the eligibility criteria were reviewed to determine if they were also suitable for inclusion in the NWSRS. The Wild and Scenic River Act and BLM Manual 8351 list a number of factors that should be considered when assessing the suitability of waterways for inclusion in the NWSRS. Of the nine eligible waterway segments and waterway units, two were also found to be suitable for designation: the Baldwin Creek and the Sweetwater River segments.

Several factors caused eligible waterways to be recommended as not suitable for inclusion in the NWSRS. These factors included management conflicts and/or challenges due to adjacent non-BLM-administered land, use conflicts on private and/or public lands in the waterway corridor that could be incompatible with inclusion in the NWSRS, the effectiveness of current non-WSR management in protecting the identified outstandingly remarkable values, and determinations

that the segments were not worthy of WSR designation. Refer to the Lander Field Office Review of Potential Wild and Scenic Rivers in the Lander Resource Management Plan Planning Area (BLM 2002a) for additional detail on the suitability determinations. The BLM is evaluating the constraints that lead to the determination that the Warm Springs Creek did not meet the "suitable" criteria. A withdrawal for power that appeared to conflict with WSR suitability is being re-considered because of the change in management approaches since the withdrawal in 1910.

The interim management prescriptions are designed to protect or enhance the identified outstandingly remarkable values and maintain the tentative classifications assigned to these waterways. The BLM has determined that the management associated with these existing special designations is sufficient to protect these waterways; therefore, the BLM has developed no additional interim management prescriptions. Chapter 2 of this document identifies the current management of these waterways.

3.7.4. Areas of Critical Environmental Concern

An ACEC is defined in FLPMA, Section 103(a) as an area within public lands where special management attention is required to protect and prevent irreparable damage to important historic, cultural, and scenic values, fish and wildlife, and other natural systems or processes. ACECs are also designated to protect life and ensure safety from natural hazards. Designation of ACECs during revisions of land use plans is mandatory under FLPMA: "In the development and revision of land use plans, the Secretary shall … give priority to the designation and protection of areas of critical environmental concern …" FLPMA, Section 202(c)(3). BLM regulations for implementing the ACEC provisions of FLPMA are found at 43 CFR 1610.7-2(b).

As per 3809.11(c), an ACEC designation carries the following management prescription: a 3809-Plan of Operations is required for operations causing surface disturbance greater than casual use. Without ACEC designation, a Plan of Operations is required only for locatable mineral mining activities, exploration causing more than 5 acres of disturbance, and bulk sampling of 1,000 tons or more. All other management prescriptions are developed on a site-specific basis, depending on the resources to be protected and the identified threats to those resources.

The Lander Field Office currently manages nine ACECs in the planning area (Map 130):

- Lander Slope
- Red Canyon
- Dubois Badlands
- Whiskey Mountain
- East Fork
- Beaver Rim
- Green Mountain
- South Pass Historic Mining District
- National Historic Trails

In addition to these existing ACECs, the BLM received a number of recommendations for expanding existing ACECs and for new ACECs through public and internal scoping processes. The BLM reviewed all such recommendations to determine if they met the importance and relevance criteria required for consideration as an ACEC. Of the nominations received, four new proposed ACECs met the criteria, as did expansion areas adjacent to five existing ACECs.

Table 3.61, "Existing and Proposed ACECs in the Planning Area" (p. 465) lists the existing and proposed ACECs, their acreage, and the value(s) of concern that justify their consideration as ACECs.

Table 3.61. Existing and Proposed ACECs in the Planning Area

Area	Acreage (BLM-administered surface)		Value(s) of Concern
	Existing	Proposed	
Existing ACECs (no expansion proposed)			
Lander Slope	25,065	N/A	Fish and wildlife, scenic values, natural processes
Red Canyon	15,109	N/A	Wildlife, special status species, scenic values, geologic features
Dubois Badlands	4,903	N/A	Wildlife, soils, scenic values
Whiskey Mountain	8,776	N/A	Wildlife, scenic values
Existing ACECs (and proposed expansion)			
East Fork	4,431	7,744	Wildlife
Beaver Rim	6,421	20,532	Fish and wildlife, plant communities, scenic values, geologic features, paleontological
Green Mountain	14,612	24,860	Wildlife, plant communities
South Pass Historic Mining Area	12,576	23,439	Hazards, cultural
South Pass Historical Landscape [1]	N/A	124,229	Hazards, cultural
National Historic Trails	27,728	468,183	Scenic values, cultural
Proposed ACECs			
Continental Divide Scenic Trail	N/A	259,380	Scenic
Cedar Ridge	N/A	7,039	Cultural
Castle Gardens	N/A	8,469	Cultural
Sweetwater Rocks	N/A	152,347	Scenic values, geologic features, cultural
Regional Historic Trails and Early Highways	N/A	89,016	Cultural
Government Draw/Upper Sweetwater Sage-Grouse	N/A	1,246,791	Wildlife
Twin Creek [2]	N/A	36,302	Wildlife

Source: BLM 2009i
[1] The proposed South Pass Historical Landscape ACEC is designated under Alternative D. The existing South Pass Historic Mining Area ACEC is contained within the boundaries of the proposed South Pass Historical Landscape ACEC.
[2] The proposed Twin Creek ACEC is designated under Alternative D and is contained within the area proposed as the Government Draw/Upper Sweetwater Sage-Grouse ACEC under Alternative B.

ACEC Area of Critical Environmental Concern
BLM Bureau of Land Management
N/A Not Applicable

3.7.4.1. Existing ACECs

This section describes the existing ACECs in the planning area (Map 130). Chapter 2 of this document provides specific management prescriptions for existing ACECs.

Lander Slope

The Lander Slope ACEC consists of 25,065 acres of BLM-administered surface of high-elevation slopes and drainages south and west of Lander (Map 130). Most of the area consists of high-elevation slopes and drainages covered by mountain shrub communities, with smaller areas of forest and wet meadow communities. Resources that met the ACEC importance and relevance criteria in the 1987 RMP were fish and wildlife, scenic values, and natural processes. Those resources continue to meet the criteria for this RMP revision. The ACEC provides crucial winter range for elk and mule deer, and supports a large percentage of the South Wind River elk herd. This elk herd provides hunting opportunities for both resident and nonresident hunters and revenue to local economies. Several of the steep canyons provide habitat for bighorn sheep and peregrine falcons, a BLM sensitive species. The Lander Slope is visible from Lander and Sinks Canyon State Park and its prominence from these vantage points makes it a visually sensitive area. The ACEC is also an important component of the watershed that supplies water to Lander; a potential for flooding in Lander from the Popo Agie River makes watershed management in this area important.

Management challenges for this area include development pressure and impacts from surface-disturbing activities. The area is important winter wildlife habitat and contains scenic vistas susceptible to the impacts of development, mining, ROWs, habitat fragmentation, motorized vehicle use, and the expansion of existing invasive plant species infestations. In addition, the ACEC has WUI issues related to fire and fuels management and steep slopes sensitive to erosion. At present, the BLM manages the area as VRM Classes II and III; mineral and realty actions in the ACEC are open with major constraints, and travel is limited to designated roads and trails with seasonal limitations.

Red Canyon

The Red Canyon ACEC consists of 15,109 acres of BLM-administered surface of high-elevation slopes and drainage in the foothills of the Wind River Mountains south and west of Lander (Map 130). Resources that met the ACEC importance and relevance criteria in the 1987 RMP were wildlife, special status species, scenic values, and geologic features. Those resources continue to meet the criteria for this RMP revision. The ACEC, which is part of the WGFD Red Canyon Habitat Management Unit, contains crucial winter range for elk and mule deer and supports a large percentage of the South Wind River elk herd. This elk herd provides hunting opportunities for both resident and nonresident hunters and revenue to the local economy. There are five sensitive plant species in the area, including one known to occur only in this area (Barneby's clover). Red Canyon has the highest visual sensitivity of any landscape in the planning area and is a draw for visitors, artists, and photographers. The geology of the ACEC provides an example of differential erosion of sedimentary layers, with the harder layers of sandstone and limestone forming cliffs and benches and the easily eroded shales and siltstones forming valleys and gulches. Color variation between the rock layers allows non-geologists a chance to understand the stratigraphy and structure of the canyon. The southern portion of the Red Canyon ACEC was designated a NNL in recognition of these geologic values.

Management challenges for this area include development pressure and impacts from surface-disturbing activities (e.g., phosphate mining), motorized vehicle use, and invasive plant species. The area contains nationally recognized visual resources and important wildlife habitat (corridors and crucial winter range) threatened by visual intrusions from development and habitat fragmentation. Much of the private land adjoining the ACEC has been subdivided, increasing

pressure on these public lands to meet wildlife needs. The expansion of existing invasive plant infestations in the area could affect sensitive plant species, potentially leading to ESA listing. The ACEC also has steep slopes sensitive to erosion. At present, the BLM manages the area as VRM Classes I and II; mineral and realty actions in the ACEC are open with major constraints (except the NNL and crucial winter range, which are closed to phosphate leasing); and travel is limited to designated roads and trails with seasonal limitations.

Dubois Badlands

The Dubois Badlands ACEC consists of 4,903 acres of BLM-administered surface at the northwest corner of the planning area bordering the WRIR along the north bank of the Wind River to 2 miles west of Dubois (Map 130). The area consists of badlands characterized by extensive erosion patterns and colorful soil banding. Resources that met the ACEC importance and relevance criteria in the 1987 RMP were wildlife, soils, and scenic values. Those resources continue to meet the criteria for this RMP revision. The area provides year-round habitat for a resident herd of bighorn sheep and hunting opportunities. The Dubois Badlands are highly visible from the town of Dubois and along an important travel route to Yellowstone and Grand Teton National Parks. The badland soils (variegated claystones, silt stones, and sandstones from the Wind River and Indian Meadows Formations) in the ACEC are highly erosive and scenic due to their red, gray, and purple banding.

Management challenges for this area include impacts of motorized vehicle use on soil, and bighorn sheep. Additionally, due to its location, any activity that would change the characteristic landscape of this area would be highly visible and could affect scenic values. At present, the BLM manages the area as VRM Classes I and II; mineral and realty actions in the ACEC are open with major constraints; and travel is limited to designated roads and trails with seasonal limitations.

Whiskey Mountain

The Whiskey Mountain ACEC consists of 8,776 acres of BLM-administered surface on Whiskey Mountain south and southeast of Dubois (Map 130). The ACEC contains high-elevation, wind-swept slopes and rocky cliffs. Resources that met the ACEC importance and relevance criteria in the 1987 RMP were wildlife and scenic values. Those resources continue to meet the criteria for this RMP revision. The area provides crucial winter range for the Whiskey Mountain bighorn sheep herd (managed as the WGFD Whiskey Mountain Wildlife Habitat Management Unit), one of the largest and most visible herds in North America. The area has been the site of active land acquisition by the BLM and a conservation easement by The Nature Conservancy to protect this herd.

The Whiskey Mountain ACEC is an economic driver for Dubois, making it not just a gateway to Yellowstone and Grand Teton National Parks but also a tourism destination. In the period following the initial ACEC designation, there has been substantial economic investment in the town of Dubois focusing on bighorn sheep. Perhaps the most important of these, but not the only example, is the establishment of the National Bighorn Sheep Center on the main street through Dubois heading towards the national parks.

Management challenges for this area include stresses on bighorn sheep and development activities. The resident bighorn sheep herd is recovering from a decline in the 1990s due to extreme winter conditions and remains vulnerable to additional stresses, (e.g., human disturbance, disruptions in forage supply, diseases from domestic sheep and goats, and predation). To ensure adequate forage is available for wintering bighorn sheep and to minimize disturbances, most of the ACEC

is currently closed to domestic livestock grazing and is closed to motorized vehicle use during the winter. The area is within view of the Fitzpatrick Wilderness Area (USFS), and visitors to that area might be sensitive to visual changes in the ACEC. At present, the BLM manages the area as VRM Classes I and II; mineral and realty actions in the ACEC are closed and predominantly withdrawn; and travel is limited to designated roads and trails with seasonal limitations.

3.7.4.2. Existing ACECs with Proposed Expansions

This section describes existing ACECs in the planning area that have proposed expansion areas. Chapter 2 of this document provides specific management prescriptions for existing ACECs and proposed expansions.

East Fork

The East Fork ACEC consists of 4,431 acres of BLM-administered surface in the drainages of the East Fork of the Wind River, Wiggins Fork, Bear Creek, and Alkali Creek 5 miles northeast of Dubois (Map 130). The area consists of high elevation, wind-swept slopes and sagebrush draws near timber patches. The resource that met the ACEC importance and relevance criteria in the 1987 RMP was wildlife. This resource continues to meet the criteria for this RMP revision. The area is crucial winter habitat for elk and is managed as part of the Inberg/Roy Wildlife Habitat Management Area, which contains interspersed BLM- and WGFD-administered lands. This elk herd is one of the largest not supported by a state or federal feed ground.

The primary management challenge for this area is habitat fragmentation. Development in the Dubois area on private lands and pine beetle infestation in surrounding areas are the primary causes of fragmentation. The area is currently closed to livestock grazing to allow sufficient forage for big game. At present, the BLM manages mining and leasing actions in the ACEC as closed/withdrawn and avoided, and travel is limited to existing roads and trails.

Proposed Expansion

The proposed expansion of the East Fork ACEC would include land in the Spence/Moriarity Wildlife Management Area and areas adjacent to the USFS and WRIR boundaries northeast of the Spence/Moriarity Wildlife Management Area and would expand the ACEC to 7,745 acres of BLM-administered surface (Map 131). As with the existing ACEC, the proposed expansion contains wildlife resources related to elk winter habitat. Management challenges for the existing ACEC also apply to the expansion. At present, BLM-administered lands in the proposed expansion area are open to livestock grazing.

Beaver Rim

The Beaver Rim ACEC consists of 6,421 acres of BLM-administered surface in south-central Fremont County, north and west of Sweetwater Station (Map 130). The Beaver Rim ACEC is an east-west trending escarpment that separates the Sweetwater River drainage basin from the Wind River drainage basin. Resources that met the ACEC importance and relevance criteria in the 1987 RMP were fish and wildlife, geologic features, paleontological values, plant communities, and scenic values. Those resources continue to meet the criteria for this RMP revision. Beaver Rim provides nesting habitat and hunting perches for many raptor species, with rock wall cavities, rock ledges, and trees located above, below, or within the rim typically used for nesting. Several Wyoming BLM sensitive plant species are found on the shallow soils and rocky slopes along the rim. The topographical and soil characteristics in the area also create a micro-climate in

isolated pockets along the rim, which contain plant communities typical of a moister climate (e.g., Douglas fir stands and riparian-wetland areas). Geologically, the area contains an unusually complete sequence of Tertiary deposits representative of the Early Eocene Epoch (about 53 million years BP) through the Middle Miocene Epoch (about 10 million years BP). The ACEC is also representative of the deflational and erosional boundary between the degrading Wind River Basin to the north and west, and the stable upland Sweetwater Plateau. Fossil remains occur in the exposed stratigraphy along Beaver Rim. Although not found to meet importance and relevance criteria, the ACEC area also contains numerous archeological sites, some of which are important to local tribes.

Management challenges for this area include ROW development, particularly wind-energy development, and other disturbances. The scenic horizontal feature of the rim is vulnerable to visual disturbances from vertical developments and erosion due to surface disturbance. Because of their fragile nature, the geologic features in the ACEC are also vulnerable to degradation. At present, the BLM manages the area as VRM Classes II through IV; mineral and realty actions in the ACEC are open with moderate or no constraints and restrictions; and travel is limited to existing roads and trails.

Proposed Expansion

The proposed expansion of the Beaver Rim ACEC would encompass a larger portion of the Beaver Rim and would expand the ACEC to 20,532 acres of BLM-administered surface (Map 131). As with the existing ACEC, the proposed expansion area contains fish and wildlife, geological and paleontological resources, plant communities, and scenic values. The proposed expansion would include the entire portion of this scenic feature as viewed from U.S. Highway 287, a sensitive observation route. The proposed ACEC expansion area is also important for the preservation of volcanic deposits derived from the Yellowstone-Absaroka volcanic field to the northwest, and the Rattlesnake volcanic field to the east. Management challenges for the existing ACEC also apply to the expansion area.

Green Mountain

The Green Mountain ACEC consists of 14,612 acres of BLM-administered surface on the north slopes of Green Mountain and Crooks Mountain in southeast Fremont County, south of Jeffrey City (Map 130). The area is characterized by sagebrush grasslands at the lower elevations and conifers at the mid to higher elevations. Resources that met the ACEC importance and relevance criteria in the 1987 RMP were wildlife and plant communities. Those resources continue to meet the criteria for this RMP revision. The area contains important elk winter range and constitutes almost all of the winter range for the Green Mountain elk herd. The important plant communities in this area are the riparian-wetland systems scattered throughout the ACEC, including wet meadow complexes formed by beaver dams. Though it did not meet the importance and relevance criteria, the ACEC also contains the locally important Sparhawk Cabin, which F.O. Sparhawk, the first USFS ranger on the Shoshone National Forest, built in the 1930s. The ACEC receives public use in the form of hunting, fishing, camping, and firewood gathering.

The primary management challenge for this area is energy development. Energy development activity could result in the loss or alteration of the elk crucial winter range, which could threaten the viability of the Green Mountain herd. The area has historically undergone intensive exploration and development for uranium and, to a lesser degree, oil and gas. The resurgence of the uranium market has resulted in renewed mining activity in the area. There has also been increased interest in wind-energy development and drilling for oil and gas in and surrounding

the ACEC. In addition to energy development, vegetation in the area is vulnerable to recreation, livestock grazing, and wild horse grazing. At present, the BLM manages the area as VRM Classes II and III; mineral and realty actions in the ACEC are open with major constraints (except around campgrounds and picnic sites, which are withdrawn); and travel is limited to designated roads and trails.

Proposed Expansion

The proposed expansion of the Green Mountain ACEC would include lands south of the existing ACEC and would expand the ACEC to 24,860 acres of BLM-administered surface (Map 131). As with the existing ACEC, the proposed expansion contains wildlife resources. In addition, the expansion area includes an elk parturition area near the top of Green Mountain. This portion of Green Mountain consists of open sagebrush surrounded by forested areas. Management challenges for the existing ACEC also apply to the expansion.

South Pass Historic Mining Area

The South Pass Historic Mining Area ACEC is 12,576 acres of BLM-administered surface, consisting of a historic gold mining region southwest of Lander (Map 130). The ACEC has both sagebrush steppe and forested areas, with steep to rolling hills. The value that met the ACEC importance and relevance criteria in the 1987 RMP was cultural resources. For the current RMP revision, cultural resources and hazards (abandoned mines) are the resources that have met the importance and relevance criteria. The area contains important historic resources from mining activities. Historic resources range from early mining towns like Miner's Delight and South Pass City to numerous prospect holes. Many of these resources are still intact and visited by the public. However, abandoned mines resulting from this activity now constitute hazards to the public. Abandoned mine shafts and adits can be dangerous to visitors, and some of the tailings and deteriorated construction materials are hazardous and/or unstable.

Management challenges for this area primarily include the preservation of cultural resources and the reclamation of unsafe mines. Due to the fragile nature of the historic sites in the ACEC, these resources are vulnerable to effects from development, looting and vandalism, and wildland fire. The reclamation of dangerous abandoned mine sites can be problematic because the BLM and the State of Wyoming have not yet been able to alleviate all hazards. At present, the BLM manages the area as VRM Classes II through IV; mineral and realty actions in the ACEC are open with major constraints (except a portion that is withdrawn); and travel is limited to existing roads and trails with seasonal limitations.

Proposed Expansion

The proposed expansion of the South Pass Historic Mining Area ACEC would include lands adjacent to the existing ACEC and would expand the ACEC to 23,439 acres of BLM-administered surface under Alternative B (Map 131). Under Alternative D, the South Pass Historic Mining Area would be located within the newly designated South Pass Historical Landscape ACEC (124,229 acres) (Map 132). As with the existing ACEC, the proposed expansions contain cultural resources and hazards associated with historic mining activities. In addition, the area proposed as the South Pass Historical Landscape ACEC contains 27.15 miles of Congressionally Designated Trails. Historic resources in the proposed expansions include historic ditches, dredging, and structures. The risks posed by abandoned mines in the expansion areas are perhaps even more pronounced than in the existing ACEC because of the areas' remoteness and limited public knowledge of the hazards. Management challenges for the existing ACEC

also apply to the expansions. Additional management challenges associated with the proposed South Pass Historical Landscape ACEC include protecting the NHTs and their settings from surface-disturbing activities and other activities.

National Historic Trails ACEC

Discussion of the National Historic Trails ACEC and proposed expansion is provided within the *Congressionally Designated Trails* section.

3.7.4.3. Proposed ACECs

This section describes the areas proposed as new ACECs (Map 131 and Map 132). Chapter 2 of this document provides specific management prescriptions for proposed ACECs.

Continental Divide Scenic Trail

Discussion of the Continental Divide Scenic Trail proposed ACEC is provided within the *Congressionally Designated Trails* section.

Cedar Ridge

The proposed Cedar Ridge ACEC consists of approximately 7,039 acres of BLM-administered surface in northeastern Fremont County (Map 131). Cedar Ridge is a northwest-southeast trending ridge in central Wyoming. It is on the southwestern edge of the Bighorn Mountain Range and overlooks a large part of the Wind River Basin to the south. The resources that meet the ACEC importance and relevance criteria are cultural, and Cedar Ridge has been determined by the BLM and Wyoming SHPO as eligible for listing on the NRHP as both a TCP and a prehistoric archeological resource. The Cedar Ridge TCP was recognized in 1997 as sacred to several tribes. This locality has been used for more than 5,500 years as a ceremonial site for prayers and rituals, and represents a sacred place for Eastern Shoshone religious observances. Due to the fragile nature of the remains in this TCP, these resources are vulnerable to development and other types of disturbance. Changes to this area could create conflicts with traditional Eastern Shoshone religious beliefs or practices. At present, the BLM manages the area of the proposed ACEC as VRM Classes II through IV; mineral and realty actions in the area are open; and travel is limited to existing roads and trails.

Castle Gardens

The proposed Castle Gardens ACEC consists of approximately 8,469 acres of BLM-administered surface in the eastern portion of the Wind River Basin (Map 131). The Castle Gardens area consists of a rugged and broken landscape containing uplifted layers of sandstone, shale, and coal exposed along a northwest-southeast trending anticline. The area's shallow soils support a varied vegetative community. The resources that meet the ACEC importance and relevance criteria are cultural. The east end of Castle Gardens has a concentration of regionally significant prehistoric rock art which is listed on the NRHP. It contains a large number of painted and incised prehistoric rock art, and is generally recognized as one of the best shield motif rock art sites in the Northern High Plains. The site is also considered sacred by several tribes, such as the Eastern Shoshone and Northern Arapaho. Vegetation communities in the area, although they do not meet importance and relevance criteria, contain many relic plant communities that could have been related to the prehistoric settlement of the area.

The existing plan recognized the important cultural values associated with the Northern High Plains shield motif rock art at Castle Gardens, but did not designate the site as an ACEC. Management prescriptions have thus far not reversed the deterioration of the site from vandalism, natural deterioration, and neglect. At present, the BLM manages the immediate site area as VRM Class II; mineral and realty actions in the area are closed, withdrawn, and excluded. The rest of the proposed ACEC is open to mineral and realty actions and is managed as VRM Class III and IV.

Sweetwater Rocks

The proposed Sweetwater Rocks ACEC consists of approximately 152,347 acres of BLM-administered surface in the Granite Mountain Range, starting at Long Creek Mountain east to the Sentinel Rocks, in Fremont, Natrona, and Carbon Counties (Map 131). The Sweetwater Rocks portion of the Granite Mountain Range consists of four WSAs: Lankin Dome, Savage Peak, Miller Springs, and Split Rock. Resources that met the ACEC importance and relevance criteria were geologic, cultural, and scenic. The Granite Mountains-Sweetwater Rocks area represents a preserved landscape from Wyoming's geologic past, unique in Wyoming for its mountain tops' partial burial in upper Tertiary sedimentary deposits. Other mountain ranges in Wyoming have been almost entirely exhumed, and the Tertiary sedimentary record destroyed by erosion. The geologic history that caused this phenomenon has also resulted in uranium ore deposits and jade and agate occurrences. Scenic values in the area include large granite spires, domes, and peaks, which the most recent VRI found to be one of the most scenic areas in the planning area. The Granite Mountains are a focal point for travelers along State Highways 220 and 287, where there are several rest areas, scenic pullouts, and interpretive facilities. Climbing in the Granite Mountain area is a rapidly increasing activity. Cultural values in the area include landmarks used during the historic western migration through this portion of Wyoming (e.g., Devil's Gate, Split Rock, Three Crossings, and Independence Rock).

Threats to the proposed ACEC include damage to scenic or cultural values from surface disturbance. Observers from Highways 220 and 287 and recreational users could be sensitive to changes to the form, color, and texture of the landscape resulting from such activities. At present, the BLM manages the area of the proposed ACEC as VRM Classes I through IV; mineral and realty actions in the area are open (except within the WSA).

Regional Historic Trails and Early Highways

The proposed Regional Historic Trails and Early Highways ACEC consists of approximately 89,016 acres of BLM-administered surface along regionally significant historic trails and early highways that run through various parts of the planning area (Map 131). These trails and highways include the Bridger Trail, the Casper to Lander Stage Road, the Rawlins-Fort Washakie Stage Trail, the Green River-Fort Washakie Stage Road, the Birdseye Pass Stage Trail, the Point of Rocks to South Pass Stage Trail, the Yellowstone Highway, and the National Park to Park Highway. The resource that meets the ACEC importance and relevance criteria is cultural. These trails and early highways were in use from the 1860s until the 1920s and were considered important components of efforts during this time to settle and expand industry in Wyoming. All the historic trails and highways are eligible for nomination to the NRHP and are of at least statewide significance. Due to the fragile nature of the historic trails, these resources are vulnerable to surface-disturbing and other activities. At present, mineral and realty actions in the area are open (except within ¼ mile or the visible horizon, which are open with moderate constraints), and travel is limited to existing roads and trails on non-historic roads.

Government Draw/Upper Sweetwater Sage-Grouse

The proposed Government Draw/Upper Sweetwater Sage-Grouse ACEC under Alternative B consists of approximately 1,246,791 acres of BLM-administered surface east of Lander and south of the WRIR to its boundary with the Sweetwater River (Map 131). The proposed ACEC consists of sagebrush-steppe habitat intermixed with riparian-wetland habitats ranging in elevation from approximately 5,080 feet to 8,760 feet. The resource that meets the ACEC importance and relevance criteria is wildlife. The area contains breeding, nesting, brood-rearing, and winter habitats for greater sage-grouse. There are 87 occupied and 8 unoccupied leks within the proposed boundary of the ACEC. Breeding and nesting occurs throughout sagebrush-grass habitats in the area and brood-rearing occurs predominantly in riparian-wetland habitats south of U.S. Highway 287. The area of the proposed ACEC has one of the greatest densities of male greater sage-grouse per square mile in Wyoming and is considered to be an important component in the conservation of greater sage-grouse throughout its range. Greater sage-grouse winter use areas are found throughout the proposed ACEC, although the greatest amount of winter use occurs in the taller sagebrush stands in the northern half of the proposed area. Increased interest in wind-energy development and CBNG projects in the area in recent years could affect the greater sage-grouse population and its seasonal habitats. At present, mineral and realty actions in the area are open with greater sage-grouse considerations, and travel is limited to existing roads and trails.

A small portion of the area proposed as the Government Draw/Upper Sweetwater Sage-Grouse ACEC under Alternative B that straddles State Highway 287 to the southwest of Lander is designated as the Twin Creek ACEC under Alternative D (36,302 acres) (Map 132). The proposed Twin Creek ACEC has the same values of concern as the proposed Government Draw/Upper Sweetwater Sage-Grouse ACEC. There are 7 occupied and 1 unoccupied leks within the proposed boundary of the Twin Creek ACEC. The area has high bentonite potential that, if developed, would fragment greater sage-grouse habitat and connectivity in the area. Because the proposed Twin Creek ACEC is contained within the area proposed as the Government Draw/Upper Sweetwater Sage-Grouse ACEC, current management of the two areas is similar.

3.8. Socioeconomic Resources

This section addresses social conditions, economic conditions, public health and safety, environmental justice, and tribal treaty rights. Each resource section describes the resource, the existing condition of the resource, and management challenges and actions related to the resource, as appropriate.

The social and economic data on which the following analysis is based are from the period prior to the economic downturn that began nationally in 2007. Although the impact of the recession was not felt generally in Wyoming until much later than the nation as a whole, the rapid decrease in the price of petroleum equivalents was felt immediately in Wyoming, with resulting impacts to the oil and gas industries.

3.8.1. Social Conditions

Management decisions on BLM-administered lands have the potential to impact surrounding communities and state and private lands, and the BLM must consider such impacts. This section provides a framework for analysis of potential impacts to social conditions in the planning area.

Human social conditions are related to towns, cities, rural areas, and the custom, culture, history, and existing social values. BLM management actions can impact social conditions in the planning

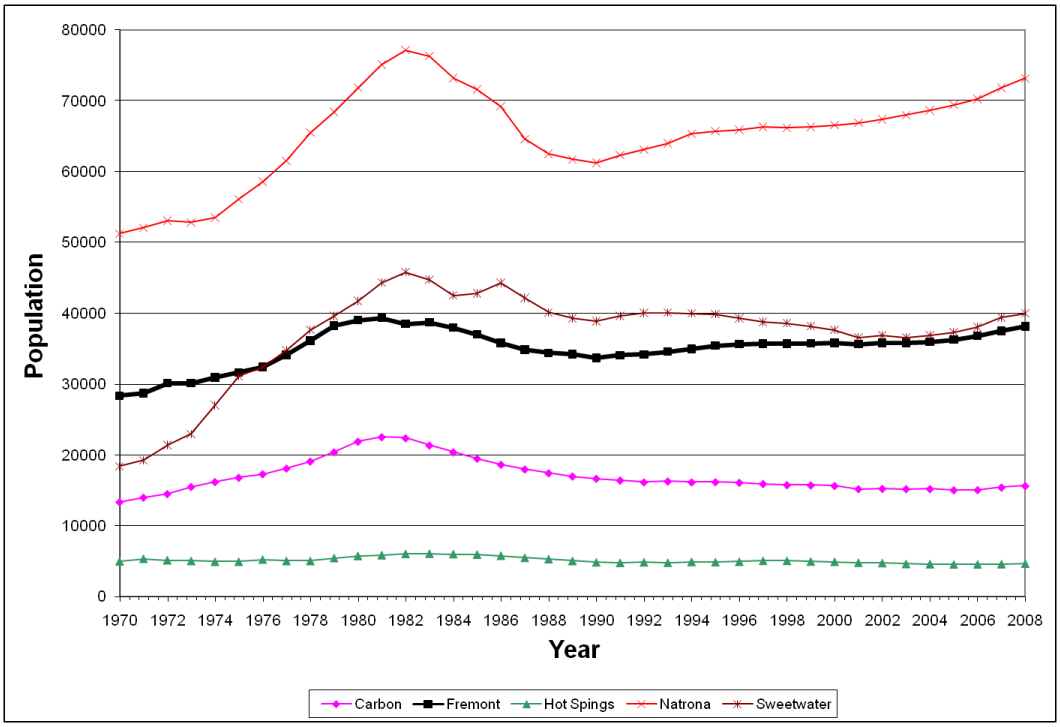
area and in nearby communities; therefore, this section describes conditions for an area larger than the planning area (the study area). The study area is comprised of the entire counties of Carbon, Fremont, Hot Springs, Natrona, and Sweetwater. While the planning area crosses all five counties, it contains only small portions of Natrona, Carbon, Hot Springs, and Sweetwater Counties and primarily lies in Fremont County. Therefore, social conditions in Fremont County most accurately reflect social conditions in the planning area. An additional important component of the study area is the WRIR, which is in Fremont and Hot Springs Counties, and data in this section for those counties includes people living on the WRIR. This section also includes some WRIR specific information.

The following sub-sections summarize population and demographic information for the study area, including housing, customs and social trends, public safety and educational services. Social conditions are often based on a wide range of community and demographic characteristics and involve broad areas of community interest.

Population and Demographics

In 2008, Natrona was the most populous county in the study area, with 73,129 people; Carbon County had a population of 15,624; Fremont County had a population of 38,113; Hot Springs County had a population of 4,622; and Sweetwater County had a population of 39,944 (Wyoming Economic Analysis Division 2009a). Except for Hot Springs County, populations in each of these counties increased in the late 1970s and early 1980s during the oil and gas boom, and decreased following the oil bust in the mid-1980s. By comparison, the population of Wyoming in 2008 was 529,630 (Wyoming Economic Analysis Division 2009a).

Figure 3.20, "Population Trends in Carbon, Fremont, Hot Springs, Natrona, and Sweetwater Counties, Wyoming, 1970-2008" (p. 474) shows population trends for the five counties from 1970 to 2008. Since 1990, the population has stayed relatively constant in Hot Springs County, increased steadily in Natrona and Fremont Counties, decreased slightly in Carbon County, and, until 2000, decreased in Sweetwater County (Sweetwater County has recently seen a population increase).



Sources: BEA 2009; Wyoming Economic Analysis Division 2009b

Figure 3.20. Population Trends in Carbon, Fremont, Hot Springs, Natrona, and Sweetwater Counties, Wyoming, 1970-2008

The WRIR encompasses approximately 2.2 million acres, primarily in Fremont County, with a portion in Hot Springs County. The 2000 Census reported a population of about 23,000 within the boundaries of the WRIR, including about 6,500 Native Americans (Headwaters Economics 2009a). About two-thirds of the Native American population is Northern Arapaho, about one-third is Eastern Shoshone (Massey 2004).

The Northern Arapaho tribe filed a lawsuit against Fremont County and the State of Wyoming in late 2008 challenging the boundaries of the WRIR (Merrill 2008). Depending on the outcome of the lawsuit, the reservation boundaries may be amended to include an area north of the Big Wind River and east of the Popo Agie River; which could influence population and demographic conditions. Native Americans living in this area would also be exempt from certain state and county taxes and vehicle registration fees (Merrill 2008).

Table 3.62, "Population of Counties and Towns in the Study Area Over Time" (p. 476) summarizes the population of each county and the incorporated cities and towns in each county. The largest city in the study area is Casper, the county seat of Natrona County; the second largest is Rock Springs, the county seat of Sweetwater County. Neither of these cities are in the planning area. The only incorporated towns and cities in the planning area are in Fremont County. The largest city in the planning area is Riverton.

A substantial proportion of the population in the study area lives outside incorporated cities and towns. For example, about half of Fremont County's population lives outside incorporated areas. In contrast, about 15 percent of the population in Carbon, Natrona, and Sweetwater Counties, and about 30 percent in Hot Springs County, live outside cities and towns (Table 3.62, "Population of

Counties and Towns in the Study Area Over Time" (p. 476)). This population pattern contributes to the small-town character of the area.

Table 3.62. Population of Counties and Towns in the Study Area Over Time

Area	1990	2000	2008	Percent Change (1990-2000)	Percent Change (2000-2008)	Percent Change (1990-2008)
Fremont County	33,662	35,804	38,113	+6.4	+6.4	+13.2
Dubois town	895	964	1,053	+7.7	+9.2	+17.7
Hudson town	392	407	429	+3.8	+5.4	+9.4
Lander city	7,023	6,914	7,264	-1.6	+5.1	+3.4
Pavillion town	126	165	169	+31.0	+2.4	+34.1
Riverton city	9,202	9,251	10,032	+0.5	+8.4	+9.0
Shoshoni town	497	635	689	+27.8	+8.5	+38.6
Unincorporated Areas [1]	15,527	17,468	18,477	+12.5	+5.8	+19.0
Carbon County	16,659	15,639	15,624	-6.1	-0.1	-6.2
Baggs town[2]	272	348	400	+27.9	+14.9	+47.1
Dixon town[2]	70	79	81	+12.9	+2.5	+15.7
Elk Mountain town[2]	186	192	200	+3.2	+4.2	+7.5
Grand Encampment town[2]	490	443	452	-9.6	+2.0	-7.8
Hanna town[2]	1,076	873	866	-18.9	-0.8	-19.5
Medicine Bow town[2]	389	274	267	-29.6	-2.6	-31.4
Rawlins city[2]	9,380	9,008	8,740	-4.0	-3.0	-6.8
Riverside town[2]	85	59	63	-30.6	+6.8	-25.9
Saratoga town[2]	1,969	1,726	1,759	-12.3	+1.9	-10.7
Sinclair town[2]	500	423	405	-15.4	-4.3	-19.0
Unincorporated Areas[1]	2,242	2,214	2,391	-1.2	+8.0	+6.6
Hot Springs County	4,809	4,882	4,622	+1.5	-5.3	-3.9
East Thermopolis town[2]	221	274	264	+24.0	-3.6	+19.5
Kirby town[2]	59	57	55	-3.4	-3.5	-6.8
Thermopolis town[2]	3,247	3,172	2,971	-2.3	-6.3	-8.5
Unincorporated Areas[1]	1,282	1,379	1,332	+7.6	-3.4	+3.9
Natrona County	61,226	66,533	73,129	+8.7	+9.9	+19.4
Bar Nunn town[2]	835	936	1,828	+12.1	+95.3	+118.9
Casper city[2]	46,765	49,740	54,047	+6.4	+8.7	+15.6
Edgerton town[2]	247	169	176	-31.6	+4.1	-28.7
Evansville town[2]	1,486	2,259	2,393	+52.0	+5.9	+61.0
Midwest town[2]	495	408	435	-17.6	+6.6	-12.1
Mills town[2]	2,267	2,832	3,143	+24.9	+11.0	+38.6
Unincorporated Areas[1]	9,131	10,189	11,107	+11.6	+9.0	+21.6
Sweetwater County	38,823	37,613	39,944	-3.1	+6.2	+2.9
Bairoil town[2]	228	97	96	-57.5	-1.0	-57.9
Granger town[2]	126	146	145	+15.9	-0.7	+15.1
Green River city[2]	12,711	11,808	12,149	-7.1	+2.9	-4.4
Rock Springs city[2]	19,050	18,654	20,200	-2.1	+8.3	+6.0
Superior town[2]	273	244	237	-10.6	-2.9	-13.2
Wamsutter town[2]	240	261	269	+8.8	+3.1	+12.1
Unincorporated Areas[1]	6,195	6,403	6,848	+3.4	+6.9	+10.5
State of Wyoming	453,588	493,782	529,630	+8.9	+7.3	+16.8

Sources: Wyoming Economic Analysis Division 2009a; Wyoming Economic Analysis Division 2002
[1] Might include some people who live in the county but outside the Lander Field Office boundaries.
[2] These cities are outside the Lander Field Office boundaries, but within the five-county study area.

There have been changes in the distribution of different age groups in the study area. Since 1990, the proportion of people age 60 and over and those aged 40 to 59 have increased in all

five counties. However, the proportion of people age 20 to 39 and the proportion of school age children (age 5 to 19) have decreased. One implication of this change is declining enrollments in primary and secondary schools, a trend addressed later in this section. Table 3.63, "Change in Population Age Groups in Study Area Counties, 1990-2008" (p. 477) summarizes the changing demographics in each county. As the table shows, the trend toward an older population (higher percentage of residents over age 40) is also a statewide trend.

Table 3.63. Change in Population Age Groups in Study Area Counties, 1990-2008

	Fremont			Carbon			Hot Springs		
Percent of population in age group	**1990**	**2000**	**2008**	**1990**	**2000**	**2008**	**1990**	**2000**	**2008**
Percent aged 0-4	8	7	8	7	6	7	5	5	5
Percent aged 5-19	26	24	20	25	21	18	23	20	14
Percent aged 20-39	28	23	24	31	25	25	24	18	20
Percent aged 40-59	22	28	28	23	31	32	23	30	29
Percent aged 60 and over	16	18	20	14	17	19	25	27	32
	National			**Sweetwater**			**Wyoming**		
Percent of population in age group	**1990**	**2000**	**2006**	**1990**	**2000**	**2006**	**1990**	**2000**	**2006**
Percent aged 0-4	8	6	7	8	7	9	8	6	7
Percent aged 5-19	24	23	20	29	26	21	25	23	20
Percent aged 20-39	31	26	27	32	26	26	31	26	27
Percent aged 40-59	21	28	28	21	30	30	21	29	29
Percent aged 60 and over	15	17	17	10	11	14	14	16	18
Sources: U.S. Census Bureau 1990; U.S. Census Bureau 2000a; Wyoming Economic Analysis Division 2009c									

Table 3.64, "Population Age Groups by Race and Ethnicity in Select Areas, 2000" (p. 477) lists age groups in 2000 for key racial and ethnic categories. The table focuses on Fremont County, the WRIR, and the State of Wyoming. The table shows that the median age is substantially lower for Native Americans and Hispanic and Latino people than for the population as a whole, both statewide and in Fremont County and the WRIR. Correspondingly, the percentage of people aged 0 to 4 and 5 to 19 in these racial/ethnic categories is also higher than for the population as a whole. The median age of the white (European-American) population is somewhat higher than for the population as a whole, and the percent of people age 40 to 59 and 60 and over among European-Americans is greater than for the overall population.

Table 3.64. Population Age Groups by Race and Ethnicity in Select Areas, 2000

Demographic	Total Population	White (European-American)	Native American	Hispanic or Latino of any Race
Fremont County				
Percent aged 0-4	7	5	11	12
Percent aged 5-19	24	21	34	33
Percent aged 20-39	23	22	28	28
Percent aged 40-59	28	31	19	19
Percent aged 60+	18	21	8	8
Median age (year 2000)	37.7	41.2	23.0	23.3
Median age (year 2005-2007)	39.0	44.0	22.4	24.7
WRIR				
Percent aged 0-4	7	6	11	12
Percent aged 5-19	25	22	34	32
Percent aged 20-39	24	23	28	28
Percent aged 40-59	27	30	19	20
Percent aged 60+	16	20	8	7

Demographic	Total Population	White (European-American)	Native American	Hispanic or Latino of any Race
Median age (year 2000)	35.0	40.0	22.9	23.6
Median age (year 2005-2007)	38.4	44.0	22.4	27.3
State of Wyoming				
Percent aged 0-4	6	6	10	11
Percent aged 5-19	23	23	31	30
Percent aged 20-39	26	26	30	31
Percent aged 40-59	29	29	22	20
Percent aged 60+	16	16	8	8
Median age (year 2000)	36.2	37.2	26.0	24.8
Median age (year 2005-2007)	37.3	38.7	26.4	26.7
Sources: U.S. Census Bureau 2000a; U.S. Census Bureau 2008a Note: All data are for 2000 unless otherwise noted.				

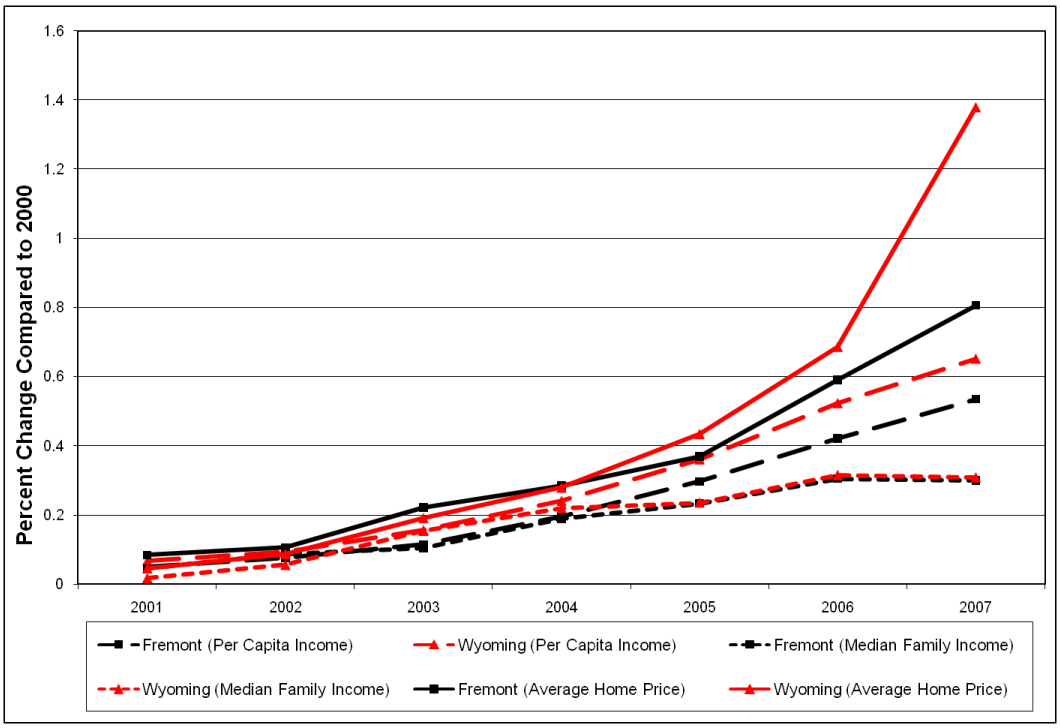
Housing

Because boom and bust cycles can impact the demand for housing, it is important to know the supply of housing in the study area. Table 3.65, "Population and Housing Units Over Time in the Study Area" (p. 478) shows the number of housing units over time in the study area. From 2000 to 2008, the number of housing units in all five counties has increased only slightly (by 8 percent in Sweetwater County, 6 percent in Natrona County, 1 percent in Hot Springs County, and 4 percent in the remaining counties). As the table shows, the growth in housing units has been generally consistent compared to the changes in population in each county.

Table 3.65. Population and Housing Units Over Time in the Study Area

Measure	2008 (number)	Percent Change Since 2000					
		2003	2004	2005	2006	2007	2008
Fremont (Population)	38,113	0	0	1	3	5	6
Fremont (Housing Units)	16,234	2	3	4	4	4	4
Carbon (Population)	15,624	-3	-3	-4	-4	-1	0
Carbon (Housing Units)	8,619	1	1	2	2	3	4
Hot Springs (Population)	4,622	-6	-7	-8	-7	-7	-5
Hot Springs (Housing Units)	2,573	1	1	1	1	1	1
Natrona (Population)	73,129	2	3	4	6	8	10
Natrona (Housing Units)	31,767	1	2	3	4	5	6
Sweetwater (Population)	39,944	-3	-2	-1	1	5	6
Sweetwater (Housing Units)	17,153	1	1	2	4	5	8
Source: Wyoming Economic Analysis Division 2009d							

Housing costs have also increased in recent years. Figure 3.21, "Change in Median Family Income and Average Home Price Since 2001 in Fremont County and Wyoming" (p. 479) shows how median family income, per capita income, and average home sales price have changed since 2001 for Fremont County and Wyoming. Increases in the average home sales price have generally outpaced increases in per capita and family income in Fremont County and in Wyoming. This observation is especially true in recent years. For example, from 2001 to 2007 median family income and per capita income increased 30 percent and 54 percent in Fremont County, respectively, while the average home sales price increased 81 percent.



Source: Wyoming Housing Database Partnership 2009
Note: All percent changes are based on nominal income and price because the intent of the figure is to show how income has changed in relation to one element of the cost of living (housing for purchase).

Figure 3.21. Change in Median Family Income and Average Home Price Since 2001 in Fremont County and Wyoming

This figure above underscores how growth in average home prices has generally outpaced growth in income. However, note that per capita income has grown at a faster rate than median family income and, in some cases, comparably to average home sales prices. Similar to home prices, monthly rents have generally increased faster than median family income in some places in the study area. Table 3.66, "Monthly Rent and Median Family Income in 2008 and Change from 2000" (p. 480) lists monthly rents in 2008 and changes since 2000, and for comparison, changes in median family income for the same period. Median family income increased from 2000 to 2008, but rents also increased in all areas. Apartment rents increased faster than median family income, and in all areas except Hot Springs, house rents increased substantially faster than median family income. Rent for mobile homes generally increased more than median family income or increased at the same pace except for Fremont County where mobile home rents increased slightly slower than median family income and in Hot Springs County where mobile home rents have remained constant since 2000.

Rent for mobile home lots grew faster, or at the same pace, compared to median family income for all counties with data (there is no available 2008 data for Hot Springs County). The area experiencing the greatest rise in rents in relation to median income was Carbon County, followed by Sweetwater County and Natrona County. While rents in Fremont County outpaced median family income, the increase was less than surrounding counties (except Hot Springs County) compared to the state as a whole.

Table 3.66. Monthly Rent and Median Family Income in 2008 and Change from 2000

Area[5]	Median Family Income		Apartment Rent[1]		House Rent[2]		Mobile Home Rent[3]		Mobile Home Lot Rent[4]	
	2008 ($)	Percent Change From 2000	2008 ($)	Percent Change From 2000	2008 ($)	Percent Change From 2000	2008 ($)	Percent Change From 2000	2008 ($)	Percent Change From 2000
Fremont	49,700	+34.3	524	+46.8	675	+47.1	190	+27.5	577	+78.1
Carbon	55,600	+24.1	706	+107.6	900	+107.4	298	+170.9	691	+155.0
Hot Springs	51,600	+31.6	401	+37.3	492	+33.0	150	0.0	N/A	
Natrona	60,700	+37.6	702	+95.0	1088	+108.0	229	+51.7	548	+42.0
Sweet-water	71,300	+22.9	779	+112.3	1113	+130.0	294	+49.2	749	+92.1
Wyom-ing	60,400	+35.1	645	+68.0	931	+70.8	254	+50.3	592	+47.6

Sources: Wyoming Housing Database Partnership 2009; Wyoming Economic Analysis Division 2009e (rental costs for 2008); Wyoming Economic Analysis Division 2000 (rental costs for 2000)

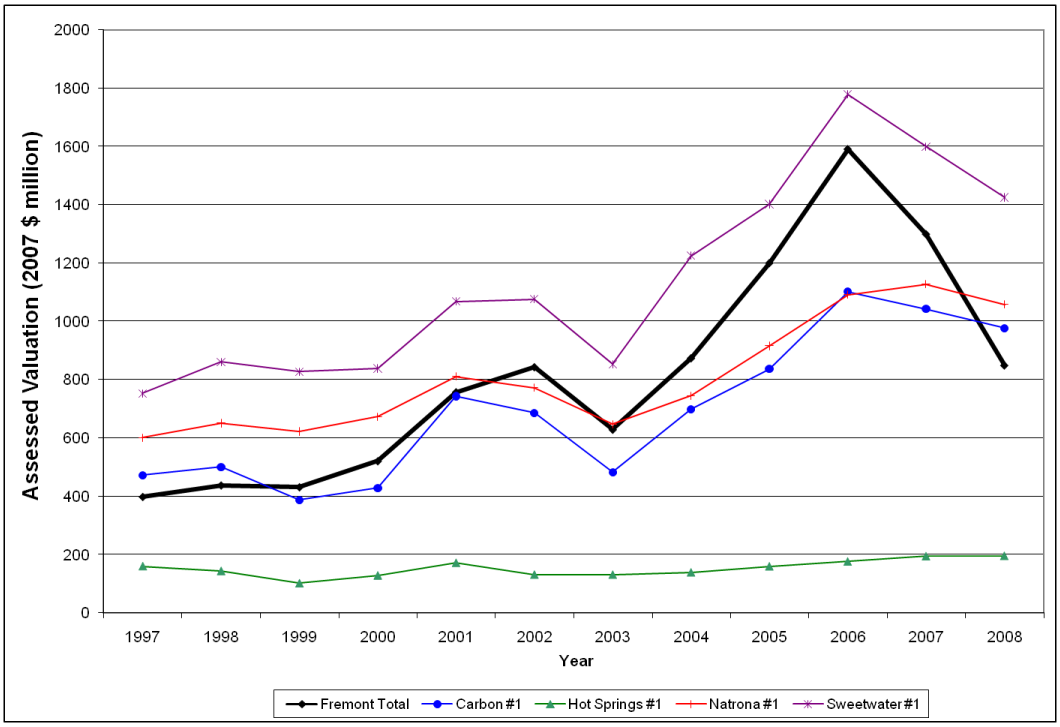
N/A Not disclosed due to limited observations.
[1] Two bedroom, unfurnished unit; excludes gas and electric.
[2] Two or three bedroom single family house; excludes gas and electric.
[3] Single-wide mobile home lot, including water.
[4] Total monthly rental expense, including lot rent.
[5] Rents are based on a sample in communities that meet certain population thresholds. Carbon County is based on Rawlins; Fremont County is based on Lander and Riverton; Hot Springs County is based on Thermopolis; Natrona County is based on Casper; and Sweetwater County is based on Green River and Rock Springs. Data for Wyoming as a whole is based on 28 communities across the state, including the largest community in each county and other communities with a population of more than 5,000 or a population of at least 85 percent of the county's largest city or town.

Table 3.67, "Rental Vacancy Rates Over Time in the Study Area (Percent)" (p. 481) lists rental vacancy rates by county in the study area. The Wyoming Housing Database Partnership (2009) reported on a survey of rental vacancy rates by county. Across all counties, the vacancy rates have generally decreased over the seven years reviewed. In general, the vacancy rates in 2008 were especially low. Carbon, Fremont, and Natrona Counties all had vacancy rates between 1 and 2 percent; Sweetwater County had a vacancy rate slightly above 1 percent. Carbon and Hot Springs Counties had the highest vacancy rates in 2008, with levels higher than those seen since 2002-2003 in both counties. Based on the data, there does not appear to be a clear seasonal variation of vacancy rates in any of the counties. Because the data are based on a sample, it is not certain whether these rates represent a trend toward lower rental vacancy rates or sampling error. It is important to note that the table lists only rental vacancy rates. Comprehensive vacancy data (including properties for sale) from the 2000 Census indicate that vacancy rates in Carbon, Fremont, Hot Springs, Natrona, and Sweetwater Counties were 26, 13, 17, 10, and 11 percent, respectively (U.S. Census Bureau 2000b).

Table 3.67. Rental Vacancy Rates Over Time in the Study Area (Percent)

Year	Fremont		Carbon		Hot Springs		Natrona		Sweetwater	
	June/ July	Decem-ber	June/ July	Decem-ber	June/ July	Decem-ber	June/ July	Decem-ber	June/ July	Decem-ber
2001	6.6	5.4	5.7	16.1	5.4	6.4	2.5	1.9	8.2	4.5
2002	16.1	8.5	15.0	9.6	11.0	11.7	3.6	4.5	6.1	4.5
2003	3.5	5.7	11.9	11.0	10.6	9.9	2.7	3.4	2.1	0.9
2004	4.6	2.9	8.4	14.5	6.8	4.7	2.6	2.8	0.9	1.6
2005	1.2	1.9	7.6	3.7	8.3	6.8	2.7	2.0	2.4	2.4
2006	2.5	1.4	2.4	1.0	4.4	8.5	1.6	1.7	1.9	0.6
2007	0.8	1.4	0.8	2.0	5.4	5.3	0.6	1.1	1.2	0.1
2008	1.6	1.9	1.6	10.8	9.3	5.9	1.1	1.0	1.2	1.6
Source: Wyoming Housing Database Partnership 2009										

Figure 3.22, "Assessed Property Valuation Trends by County, 1997-2008" (p. 481) shows recent trends in assessed property valuation by county, based on inflation-adjusted 2008 dollars. Assessed property valuation in Hot Springs County has remained relatively constant, with a slight increase in recent years, but well below the valuation in the other four counties. The trends in assessed property valuation in Fremont, Carbon, Natrona, and Sweetwater Counties are similar. Assessed property valuation for these school districts experienced a sharp decrease between 2002 and 2003, followed by a steady and substantial increase in assessed property valuation between 2003 and 2006. As shown in the figure, the trend at the state level is consistent with the trend observed in these four counties. Overall, assessed property valuation increased substantially between 1997 and 2006 in these four counties and in the state as a whole (Wyoming Department of Education 2008a). This substantial increase was followed by a steep decrease between 2006 and 2008, particularly in Fremont and Sweetwater Counties.



Source: Wyoming Department of Education 2008a
Note: Adjusted for inflation (to 2008 dollars) using the Wyoming Cost of Living Index for central Wyoming (Wyoming Economic Analysis Division 2009e).

Figure 3.22. Assessed Property Valuation Trends by County, 1997-2008

Customs, Culture, and Social Trends

State and federal agencies administer approximately 58 percent of the land in Fremont County. The Lander Field Office administers relatively small portions of Hot Springs, Carbon, Natrona, and Sweetwater Counties, although other BLM field offices administer lands in these counties. The BLM also administers federal mineral estate in all five counties. Therefore, BLM management decisions can impact social conditions in all five counties. However, regarding social conditions related to ranching on public lands, for which surface ownership is the primary consideration, management decisions in this document have more potential to impact conditions in Fremont County than Carbon, Hot Springs, Natrona, and Sweetwater Counties (Fremont County accounts for the most BLM-administered surface area in the planning area).

Land use, resource development, community values, and economic development are closely intertwined, and BLM land and resource management decisions can impact social and economic conditions for all of the communities in the study area. Community values regarding land and resource management are central to social issues in the study area because they are closely tied to issues of economic development, customs and culture, and quality of life. Understanding the development, culture, and history of the area provides valuable insight into how changes in the study area might impact the livelihood and quality of life of residents.

Before European settlement, the Eastern Shoshone inhabited the planning area. The Eastern Shoshone were confined to the original boundaries of the WRIR in 1863. In 1877, the surviving members of the Northern Arapaho tribe were placed on the WRIR, and in 1878, the original 44 million-acre reservation was reduced to approximately 2.3 million acres (Massey 2004).

In 1906, WRIR tribal representatives ceded reservation lands north and west of the "big bend of the Wind River" to the U.S. government. This cessation led to the opening of these lands to European-American settlement under the Homestead Act, the establishment of nonnative owned farming areas near the big bend of the Wind River, and founding of the town of Riverton (Riverton Museum 2007).

Historically, economic development in the study area has been based on resource extraction and tourism. Agriculture, particularly sheep and cattle ranching, has contributed to the economy and the social fabric of communities since the first nonnative settlement. Sugar beet production also contributed to development historically, but there is little sugar beet production in the planning area today. Tourism has historically represented an important economic generator, primarily in Dubois and Lander. Timber played an important role in development in Fremont County from the 1910s through the 1940s. Oil and gas development and minerals mining also played a role, with uranium from 1953 to the 1980s constituting the primary mineral "boom."

Oil was discovered near Riverton in approximately 1918. Since that time, there has always been some oil and gas development, but historically, uranium contributed more to mineral development in the area. The discovery of uranium in the Gas Hills near Riverton in 1953 brought a new boom to the Riverton area. According to the Riverton Museum, the uranium industry transformed Riverton from a quiet farming community of 2,500 people into a bustling commercial center of more than 10,000 (Riverton Museum 2007). Although market forces brought dramatic cutbacks in area mining during the 1980s (most of the area is now being reclaimed), during the uranium boom Riverton became the largest community in west-central Wyoming. Riverton continues to have a relatively diversified commercial economy and attracts people from a wide area. Lands outside the planning area, but in the five-county study area, also represent important areas for mining and mineral development. For example, Sweetwater County is the only county in the state that produces trona (soda ash), which is used in glassmaking and other industries.

Beginning in 1914, railroad ties in the forests north and west of Dubois were cut and floated down the Wind River to Riverton, where they were delivered to the Chicago and North Western Railroad (see cultural resources discussion of the Warm Springs Flume). This operation was one of the principal suppliers of ties for the Chicago and North Western Railroad until the late 1940s. Many of the tie hacks were Scandinavian immigrants, some descendants whom still live in the area.

As early as the 1920s, Lander was known as "where the rails end and the trails begin," a reference to the freight and passenger rail service that extended from Casper to Lander in 1906 as part of the Wyoming and Northwestern Railway Company. The rail service never extended west of Fremont County, but the line to Lander contributed to the development of the towns of Riverton, Hudson, and Shoshoni, all of which had depots. In the early 20th Century, commercial bus service provided access from Lander to Yellowstone National Park. Lander also provided recreational opportunities in its own right. Tourists would frequently visit dude ranches in Dubois, with the height of the dude ranch activity coming in the 1930s and 1940s (Jost 2007).

Agriculture has contributed to the local economy since the domestic livestock industry began in the 1860s and 1870s. Around the turn of the century, the open range sheep industry was more substantial than the cattle industry (Jost 2007). Today, there are still large numbers of both cattle and sheep grazed in the planning area, a portion of which rely on public lands grazing. The development of irrigation water supplies increased in the 1920s when the U.S. Bureau of Reclamation took over the big bend of the Wind River area that had been opened for European-American settlement, and helped to speed up agricultural development. Irrigated

crop farming is most prominent near Pavillion and Riverton and, to a lesser extent, in Lander (Jost 2007).

Although ranching today makes a relatively small contribution to the economy in the study area, it is an important part of its culture and history. Historically, and today, ranching has provided direct and indirect employment; maintenance of scenic vistas; stewardship of remote, privately owned lands; wildlife habitat; and the continuation of a way of life that helps draw tourists to the state. However, livestock grazing has its critics. Improper livestock grazing management has degraded the health of some public lands. As a result, there is an ongoing dialog between the BLM and some of the livestock operators focusing on stocking levels and seasons of use. At present, approximately 97 percent of the planning area is available for livestock grazing under 310 permits; some permittees have multiple permits. Increasingly, these permits are held by out-of-state owners with no historic ties to the community.

With mounting economic pressures on the livestock sector, some ranch owners have raised money for their retirement by subdividing portions of their land into "ranchettes" that are then sold to individuals, often "amenity retirees" who chose the area for its open spaces, recreational opportunities, and other lifestyle aspects. The sale of these ranchettes provides liquidity to ranchers who frequently have most of their assets in land. This trend is reflected in both the increase in value of farm land and the decrease in farmed acres, as discussed below.

Because of these sales, there are often more fences and road development on private lands, which can adversely impact open views near developed communities, wildlife habitat, and rangeland health amenities valued by many residents, including many of those who live on ranchettes. This trend is important because of the potential for BLM-authorized actions to affect the profitability of ranching that depends on public lands grazing and thereby increase the trend of subdividing lands that have been traditionally part of livestock operations. The development of ranchettes on the hills around Lander is entirely on privately owned and mostly subdivided ranches.

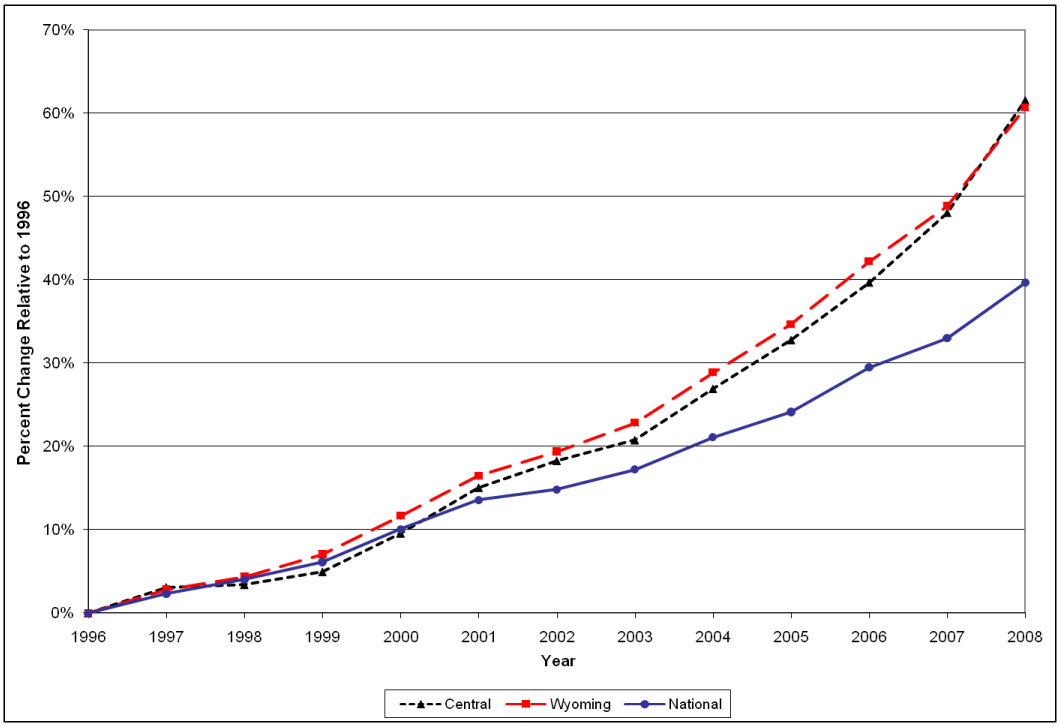
The availability of a wide spectrum of recreational opportunities on public lands is another important component of many lifestyles and communities. Many towns in the planning area continue to serve as "gateway cities" for recreational activities in Yellowstone and Teton National Parks, and have become recreation destinations in their own right. Because recreation involves diverse groups with activities that are sometimes competing, changes in management of public lands can impact the various recreational sectors and interests differently.

The land itself has influenced the social fabric of the communities. The land has provided hunting and fishing opportunities for people from the Native American inhabitants before European settlement to today's residents. It also has provided job opportunities related to tourism. Tourists travel to the area to enjoy scenic vistas and historic places that appeal not only to non-local travelers but also permanent residents. In addition to tourism, the *Economic Conditions* section provides information on the contributions of mining and other sectors to current employment, earnings, and tax revenues.

One factor that affects the customs, culture, and social trends in communities is the cost of living. The Wyoming Economic Analysis Division calculates relative changes in cost of living over time by estimating the cost of a set of goods and services that represents the average consumer's purchases for housing, food, health care, travel costs, and other items. If the cost of living for a particular area increases faster than average income, that could mean that long-time residents, especially those on fixed incomes, find their lifestyle less affordable over time. Over the long term, a higher cost of living might encourage people to relocate from a community and discourage

migration into the community because households would not seek to relocate where there are no employment opportunities.

The Wyoming Economic Analysis Division calculates changes in the cost of living over time for a three-county region (Converse, Fremont, and Natrona Counties) in central Wyoming (Wyoming Economic Analysis Division 2009e). Figure 3.23, "Cost of Living Changes in Central Wyoming, Wyoming and the Nation, 1996-2008" (p. 485) shows how the cost of living in central Wyoming has changed in relation to the cost of living for the entire state and in the United States. Starting in about 2000, the cost of living in the central region and Wyoming as a whole began to increase at a greater rate than the nation. However, it is important to note that the three-county region for which data are shown differs from the planning area in several ways, including the inclusion of Converse County and all of Natrona County, and excluding Carbon, Hot Springs, and Sweetwater Counties. Therefore, it is possible that trends observed in the central region deviate slightly from the actual trends in the planning area.



Source: Wyoming Economic Analysis Division 2009e

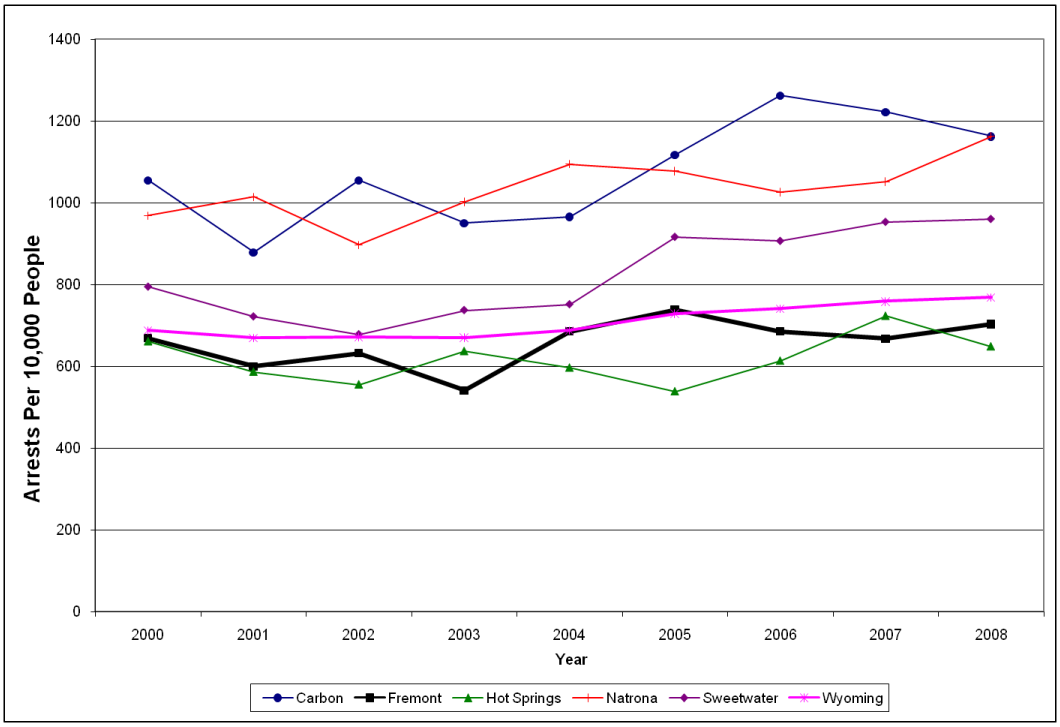
Figure 3.23. Cost of Living Changes in Central Wyoming, Wyoming and the Nation, 1996-2008

Public Safety

This section describes recent trends in crime rates and vehicle traffic, both of which BLM management decisions could affect. Figure 3.24, "Arrests Per 10,000 Persons in the Study Area, 2000-2008" (p. 486) shows arrests per 10,000 people for each of the counties in the study area and for the state. Since 1999, the crime rate in Wyoming has increased somewhat and currently stands at almost 800 arrests per 10,000 people. Over the same period, the rate in Fremont County has been below or approximately equal to that for Wyoming. The crime rates in Carbon, Natrona, and Sweetwater Counties have been consistently higher than in Wyoming, and especially higher in Carbon and Natrona Counties. The crime rate in Carbon County increased from 2002 through

2006, but has decreased since 2006. The crime rate in Natrona County decreased from 2004 through 2006, but has risen since 2006.

Drug-related crimes, including sale, manufacture, and possession of controlled substances, increased substantially since 2000 in all five counties, more than doubling in Sweetwater and Hot Springs Counties, and outpaced population growth substantially (BLM 2009b). In the study area in general, the largest increase in drug-related crimes occurred between 2000 and 2004 and then either stabilized or decreased between 2004 and 2005. Sweetwater County experienced increases through 2005, and Hot Springs County observed a spike in drug-related crimes between 2005 and 2006. All five counties saw decreases in index crimes (homicide, rape, robbery, aggravated assault, burglary, larceny-theft, and motor vehicle theft) since 2000. Driving under the influence increased between 2000 and 2006 in all five counties. In Fremont County, driving under the influence increased approximately 40 percent compared to the state average increase of approximately 18 percent.



Sources: Wyoming Division of Criminal Investigation 2001; Wyoming Division of Criminal Investigation 2002; Wyoming Division of Criminal Investigation 2003; Wyoming Division of Criminal Investigation 2004; Wyoming Division of Criminal Investigation 2005; Wyoming Division of Criminal Investigation 2006; Wyoming Division of Criminal Investigation 2007; Wyoming Division of Criminal Investigation 2008; Wyoming Division of Criminal Investigation 2009

Figure 3.24. Arrests Per 10,000 Persons in the Study Area, 2000-2008

Vehicular traffic in all five counties has increased over the last 10 years (BLM 2009b). Specifically, vehicle miles traveled increased 23 percent, 22 percent, 3 percent, 26 percent, and 28 percent in Fremont, Carbon, Hot Springs, Natrona, and Sweetwater Counties, respectively, between 1997 and 2006. Over the same 10 years, population increased approximately 4 percent in Fremont County, 6 percent in Natrona County, stayed virtually constant in Sweetwater County, and decreased 4 percent and 8 percent in Carbon and Hot Springs Counties, respectively. At the state level, vehicle miles traveled increased 24 percent between 1997 and 2006 (from 14.1

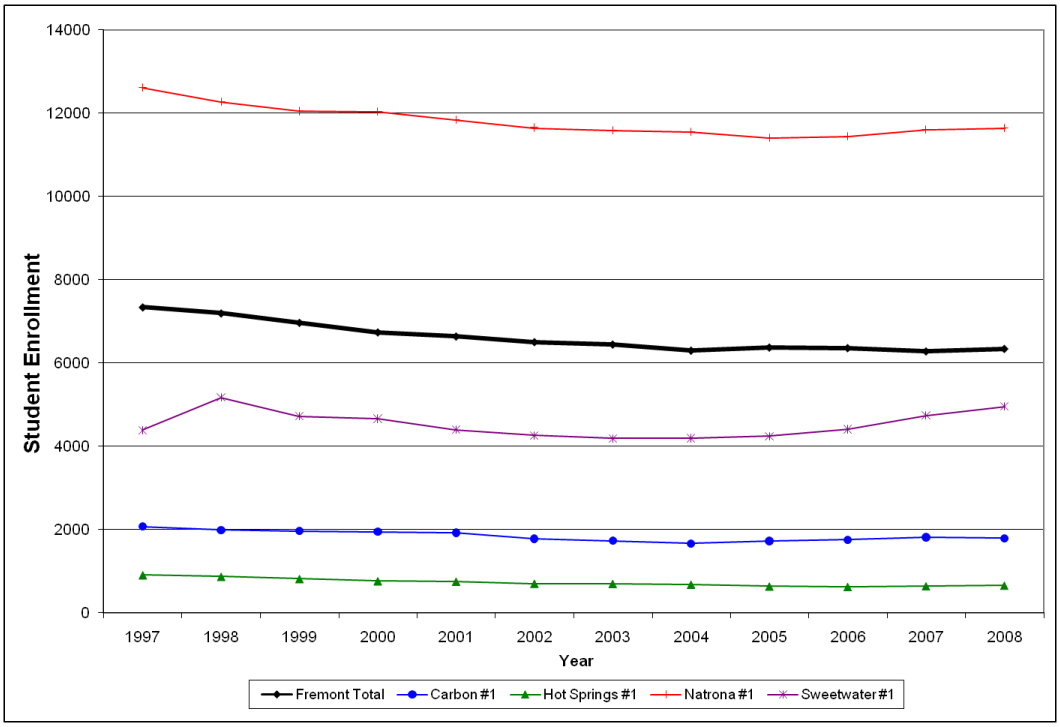
million miles to 17.5 million miles), whereas the population increased only 5.2 percent over the same period.

With the exception of Sweetwater County, compared to the increase in vehicle miles traveled described above, the number of vehicle crashes has either declined or increased by a smaller margin in the last 10 years (BLM 2009b). Specifically, the number of crashes dropped 10 percent in Fremont County, 3 percent in Carbon County, and 30 percent in Hot Springs County, and increased only 4 percent in Natrona County. In Sweetwater County, both vehicle miles traveled and the number of crashes increased 28 percent. At the state level, the number of crashes increased only 2 percent between 1997 and 2006 (16,663 to 17,429 crashes) compared to a 24-percent increase in vehicle miles traveled.

Educational Services

BLM management of public lands has the potential to directly affect many of the economic sectors in the study area, and local tax revenues are correspondingly affected; in turn, this affects local services funded by those revenues. However, in the case of school districts, funding is a function of what is defined as "local resources" and "entitlements." In general, Wyoming school districts have a "guarantee" regarding funding. The guaranteed level of district funding is a function of the number of students and the number of schools in the district. If the local resources exceed entitlements, the excess is "recaptured" and made available to other school districts throughout the state. Conversely, if local resources are less than the guarantee, that difference is made up from entitlements. Therefore, while local revenues do not directly affect education funding because of the Recapture component, changes in local tax revenues do affect education funding from a statewide perspective.

Figure 3.25, "School Enrollment Trends by County, 1997-2008" (p. 487) shows historical school enrollment trends by county based on data from the Wyoming Department of Education (Wyoming Department of Education 2008b). Consistent with trends for the school-age population previously shown, Figure 3.25, "School Enrollment Trends by County, 1997-2008" (p. 487) shows the school enrollment level in 2008 has declined from enrollment levels in 2000 for all counties besides Sweetwater. However, school enrollment levels remained the same or increased slightly starting in 2003 or 2004. Enrollment decreased steadily at the state level between 1997 and 2005 and increased slightly between 2006 and 2008.



Source: Wyoming Department of Education 2008b
Note: Enrollment figures are measured on October 1 of each year.

Figure 3.25. School Enrollment Trends by County, 1997-2008

Because people have different values regarding changes in demographics and communities, residents might have different opinions and values regarding the decline in school enrollment and property evaluations. Part of the BLM mission is to work with local governments to ensure that its management decisions support local goals and plans, community values, and the needs of residents, and to address regional and national issues.

3.8.2. Economic Conditions

Economic conditions relate to the analyses of production, distribution, and consumption of goods and services. Economic conditions describe how individuals and communities participate in the exchange of goods and services by earning a living and consuming products and services they need and want. The BLM has the capacity, through its decision-making responsibilities, to manage resource development in the planning area and influence the economy of the wider region. As for social conditions, the study area for economic conditions is all of Carbon, Fremont, Hot Springs, Natrona, and Sweetwater Counties. This section summarizes demographic and economic information, including trends and existing conditions. It also identifies and describes major economic sectors in the study area that BLM management actions could affect.

Economic Activity and Output

Industries most affected by BLM land management policies and programs in the study area are mining (including oil and gas exploration and development), tourism and recreation, and agricultural production. BLM policies and programs also affect, in a somewhat more limited fashion, logging and the harvest of forest. However, in recent years, there has been a limited

amount of commercial cutting in forested areas in the study area. The focus of the local timber market is on local demand for various wood products, including house logs, character wood, and fencing material (BLM 2009b).

Mining and Mineral Production

Mining and mineral production, including oil and gas exploration and development, constitutes a substantial economic activity in the study area. Table 3.68, "Estimated Mineral Production Value by County in the Study Area, Production Year 2007" (p. 489) summarizes the quantity and value of mineral production in the counties in the study area and the State of Wyoming. Economically, the largest contributors to mining activity in all five counties are oil and gas exploration and development, most substantially in Sweetwater and Fremont Counties. There is also substantial coal and trona mining in Sweetwater County, but it occurs entirely outside of the planning area. The *Mineral Resources* section of this document provides additional information about mineral resources produced in the planning area.

Table 3.68. Estimated Mineral Production Value by County in the Study Area, Production Year 2007

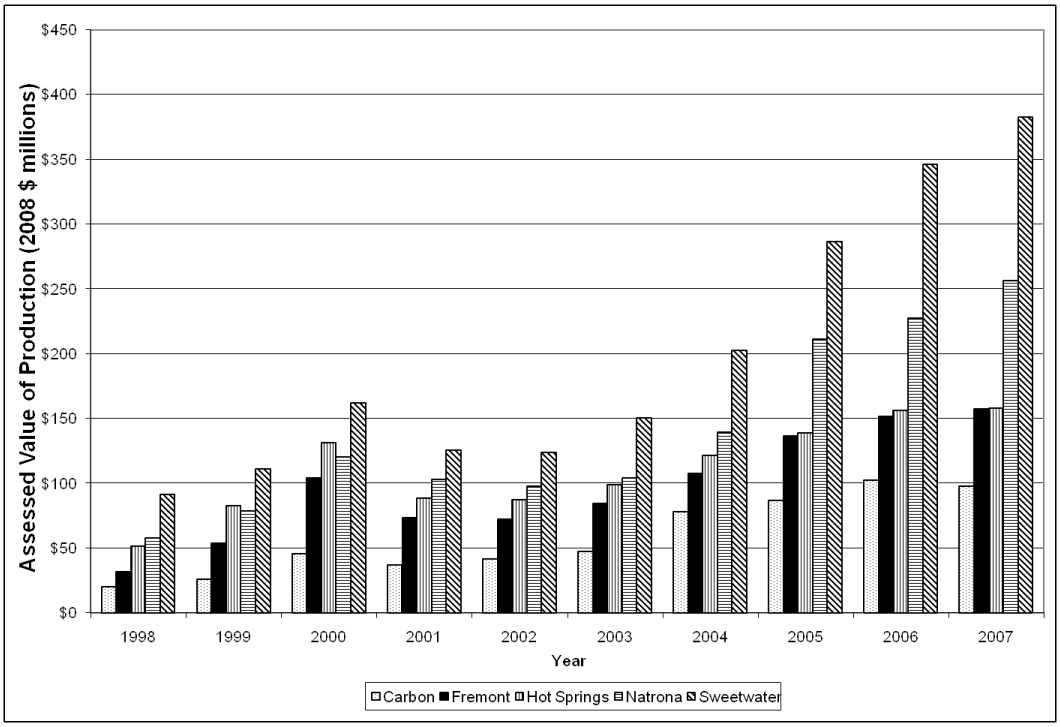
Mineral	Carbon	Fremont	Hot Springs	Natrona	Sweetwater	Wyoming
Production or Sales (units)						
Oil (bbls sold)	1,462,699	3,132,380	3,158,113	3,759,457	5,359,955	52,411,076
Gas (mcf sold)	103,569,986	123,122,643	243,474	27,990,886	185,169,485	2,012,866,007
Coal (tons produced)	134,207	0	443	0	10,090,002	451,963,767
Trona (tons produced)	0	0	0	0	19,660,455	19,660,455
Bentonite (tons)	0	0	2,849	72,160	0	4,031,817
Sand and Gravel (tons)	888,207	575,195	45,922	1,198,969	1,280,683	16,035,609
Uranium (lbs)	0	0	0	0	0	1,984,267
Decorative Stone (tons)	0	0	0	0	0	4,484
Taxable Valuation ($ million)						
Oil (bbls sold)	$90	$144	$145	$235	$351	$2,843
Natural Gas	$530	$338	$1	$118	$840	$7,271
Coal (tons produced)	$4	$0	$0.01	$0	$131	$3,280
Trona (tons produced)	$0	$0	$0	$0	$340	$340
Bentonite	$0	$0	$0.03	$1	$0	$49
Sand and Gravel	$2	$1	$0.05	$3	$2	$28
Uranium	$0	$0	$0	$0	$0	$20
Decorative Stone	$0	$0	$0	$0	$0	$0.2

Source: Production and valuation are for July 1, 2007, through June 30, 2008, from Wyoming DOR 2008.

Notes: Taxable valuation might differ from market or sales value because it excludes certain costs of production. This table includes all minerals for which the Wyoming Department of Revenue (Wyoming DOR 2008) provides data on production from the counties in the study area.

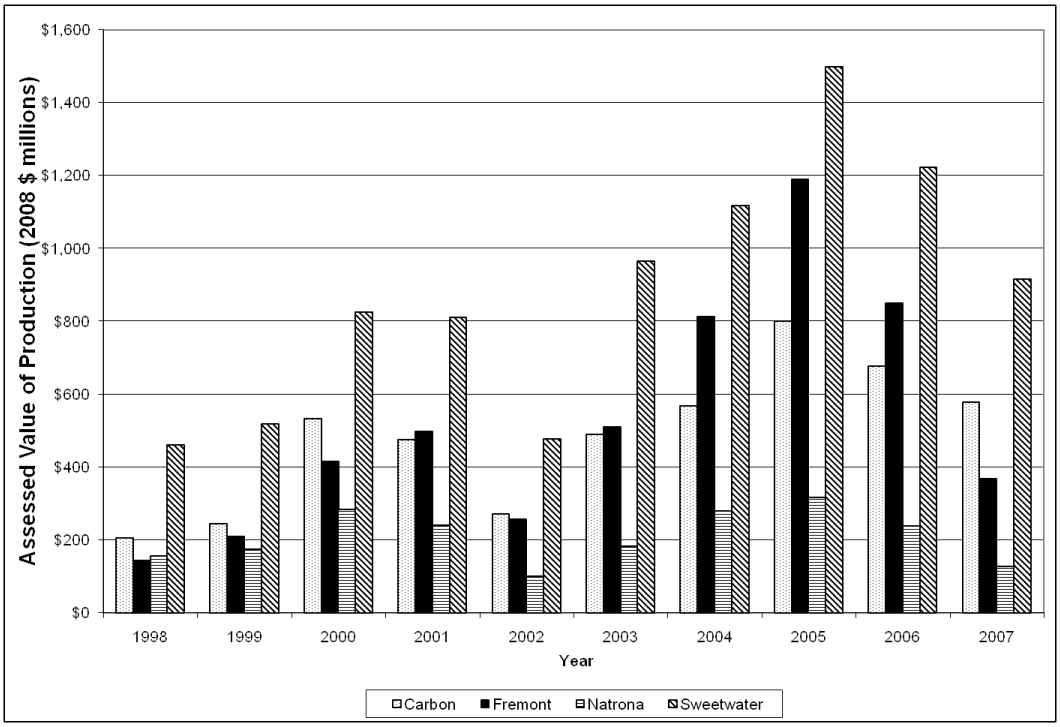
bbl barrel
lb pound
mcf thousand cubic feet

Figure 3.26, "Assessed Valuation of Oil Production by County in the Study Area, 1998-2007" (p. 490) and Figure 3.27, "Assessed Valuation of Gas Production by County in the Study Area, 1998-2007" (p. 490) show the trends in the value of oil and gas production over recent years for the study area counties. The assessed valuation in the figures is adjusted for inflation using the Wyoming Cost of Living Index for the central region (Converse, Fremont, and Natrona Counties) as defined by the Wyoming Economic Analysis Division (Wyoming Economic Analysis Division 2009e). As Figure 3.26, "Assessed Valuation of Oil Production by County in the Study Area, 1998-2007" (p. 490) shows, oil production value has generally risen since 2002, but the greatest rise has been in Fremont and Sweetwater Counties. Gas production value has also substantially risen in Carbon, Fremont, and Sweetwater Counties since 1998; however, gas production value fell in 2002 and again in 2006 for these three counties. Gas production rose moderately in Natrona County, and the small production in Hot Springs County has further decreased since 1998. Figure 3.27, "Assessed Valuation of Gas Production by County in the Study Area, 1998-2007" (p. 490) does not display the assessed valuations of gas production in Hot Springs County because the gas production valuation is approximately $1 million or less (varies from $0.3 to $1.1 million over the period shown), which is so much smaller than the other counties that it does not show on the graph.



Sources: Wyoming DOR 1999; Wyoming DOR 2000; Wyoming DOR 2001a; Wyoming DOR 2002; Wyoming DOR 2003; Wyoming DOR 2004; Wyoming DOR 2005; Wyoming DOR 2006; Wyoming DOR 2007; Wyoming DOR 2008.
Note: Adjusted for inflation using Wyoming Economic Analysis Division 2009e.

Figure 3.26. Assessed Valuation of Oil Production by County in the Study Area, 1998-2007



Sources: Wyoming DOR 1999; Wyoming DOR 2000; Wyoming DOR 2001a; Wyoming DOR 2002; Wyoming DOR 2003; Wyoming DOR 2004; Wyoming DOR 2005; Wyoming DOR 2006; Wyoming DOR 2007; Wyoming DOR 2008.
Notes: Adjusted for inflation using Wyoming Economic Analysis Division 2009e
Assessed valuation of gas production in Hot Springs County is $1 million and below for the entire time period, and therefore does not show on the graph.

Figure 3.27. Assessed Valuation of Gas Production by County in the Study Area, 1998-2007

As noted in detail in the *Locatable Minerals* section of this chapter, Fremont County has produced more than 26 million tons of uranium ore since the 1950s, but all producing mines have been closed for more than 20 years. The recent increase in the price of uranium ore has sparked renewed interest in uranium exploration in several areas. There are numerous notices, plans of operation, and two pending or expected EISs related to uranium exploration and development in the planning area. Although uranium exploration is not at a stage where it contributes to the existing employment and economic base, depending on market conditions and mineral recoverability, uranium mining could again contribute to economic conditions in the planning area.

In 1981, the Wyoming Geological Survey identified the potential for gold deposits in the Rattlesnake Hills area, and subsequent exploration has revealed a large-tonnage, low-grade deposit with the potential to host more than 1 million ounces of gold. In a December 2008 news release, one company exploring the area announced that it found a large halo of gold mineralization (BLM 2009b). In 2009, this company filed a Plan of Operations to expand its drilling program, and an EIS to support an eventual mining operation is possible in the future. Thus, like uranium, gold mining could eventually contribute some employment and economic base in the planning area. The *Locatable Minerals* section of this chapter provides additional information about gold deposits.

Wind for electric power generation is another resource in the planning area that does not currently contribute large amounts of earnings and employment but could in the future. The BLM PEIS

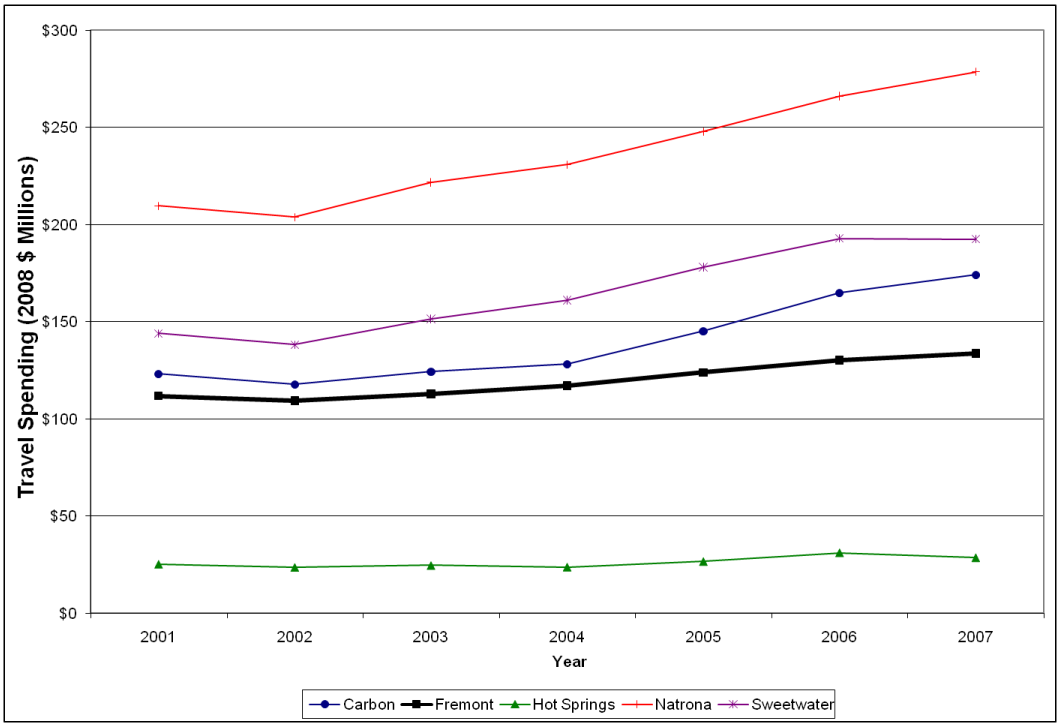
for a wind-energy development program identified Lander as a low-potential area for wind development due to the lack of transmission infrastructure. The Lander Field Office has nine ROW applications for wind site testing and monitoring, although it has no applications for full wind-energy development (BLM 2009b). Wind generated electricity is still highly speculative for most areas of Wyoming including the planning area. Located far from population centers and with limited existing transmission capacity the planning area may not be competitive enough to justify the very high capital costs associated with wind generation even without regard to resource conflicts such as sage-grouse habitats and Congressionally Designated Trails.

Pending federal legislation and other factors could lead to increased interest in wind-energy development solar-power development in the planning area. At present, there are several private solar projects of various sizes in the area – the National Outdoor Leadership School Rocky Mountain installation in Lander is one of the largest in the state – and there is potential for future generation. Wind- and/or solar-power generation could eventually provide employment opportunities. Refer to the *Renewable Energy* section of this chapter for additional information on the potential for renewable energy development in the planning area.

Recreation

Recreation activities also contribute to the region's economy. In 2003, the WGFD found that direct expenditures from hunting, fishing, and wildlife watching in the counties in the study area totaled $26.6 million (WGFD 2003). About $10.3 million of these expenditures were attributable to activities on BLM-administered surface area in the planning area (WGFD 2003). Direct expenditures include visitor spending on lodging, food and groceries, gasoline, motor vehicle repairs and service, outfitters and guides, access fees, entertainment, souvenirs, equipment, and other categories.

The WGFD has not performed a more recent survey of expenditures from hunting, fishing, and wildlife watching for the planning area (Stewart 2008). However, trend data for 2001 through 2007 (Figure 3.28, "Travel and Tourism Spending in the Study Area, 2001-2007" (p. 492)) shows that, generally, travel and tourism spending (including recreation and other travel-related spending), adjusted for inflation, has recently increased in all five counties. The figure shows that inflation-adjusted spending remained the same or decreased between 2001 and 2002 and has increased steadily since 2002. Between 2006 and 2007, inflation-adjusted spending increased slightly or remained about the same for all of the counties in the study area.



Source: Dean Runyan Associates 2008
Note: Adjusted for inflation using Wyoming Economic Analysis Division 2009e.

Figure 3.28. Travel and Tourism Spending in the Study Area, 2001-2007

Note that travel and tourism spending includes all travel to the counties, except for commuting and other routine travel; therefore, trips for non-recreational purposes also are included. The Wyoming State Office of Travel and Tourism reported that more than 90 percent of all trips to Wyoming were for pleasure; this percentage could differ for specific counties (WTT 2007).

When discussing the economic contribution of recreational activities, it is noteworthy that one of the largest permitted outfitters in the United States, the National Outdoor Leadership School, has its international headquarters in Lander. National Outdoor Leadership School provides wilderness based education in technical outdoor skills, leadership, and environmental studies. It employs approximately 100 full-time and 40 seasonal employees in Wyoming, its students contribute an estimated $1.1 million in annual retail sales in Lander, and it comprises 20 percent of the commercial air travel through the Riverton Airport (NOLS 2006). The continued operation of the local recreation-based portion of National Outdoor Leadership School's activities, including the contribution of its students, is predicated on the continued management of the BLM and USFS managed lands in and surrounding the planning area in a manner that is conducive to wilderness based and remote activities.

Similarly, the Wyoming Catholic College is planning the development of a "green campus" on private lands adjoining BLM managed lands in the South Pass-Red Canyon area. The goal of the college is to integrate the campus and its students into the remote and undeveloped lands. These lands are currently protected by ACEC designation that limits surface-disturbing activities.

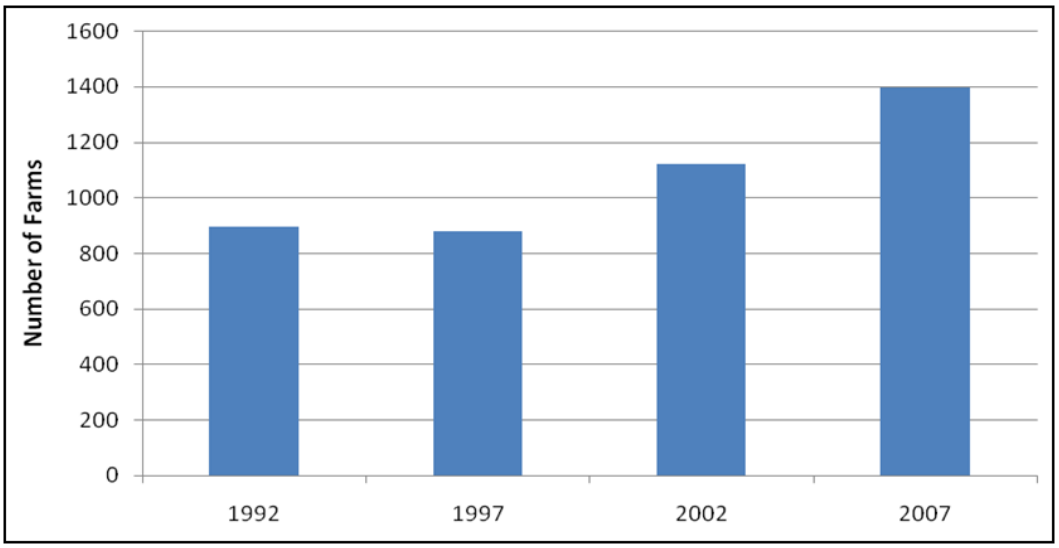
Livestock Grazing

There are 310 grazing allotments covering 2,352,458 acres of BLM-administered surface with approximately 279,000 AUMs. While cattle use most of the AUMs, sheep and horses also graze on BLM-administered lands.

BLM-administered lands are important to local ranch operations using allotments in all five counties, particularly Fremont County. On average, the BLM leases grazing allotments at lower fees than state or private lands. Federal (BLM) grazing fees in Wyoming were $1.56 per AUM in 2006, and $1.35 per AUM in 2007 and 2008 (BLM and USFS 2007, BLM and USFS 2009). For comparison, grazing fees on state land were $4.78 per AUM in 2006, $5.17 per AUM in 2007, and $5.21 in 2008 (Pannell 2008). The average grazing rate on privately owned non-irrigated land in Wyoming was $15.10 per AUM in 2006, $15.40 in 2007, and $15.70 in 2008 (Shepler 2008, NASS 2009).

However, the lower lease fees correspond to potentially greater use restrictions and responsibilities for the lessee. Federal grazing leases typically restrict the number and species of animals that may be grazed; on private leases, there is normally no penalty for grazing more animals other than potential nonrenewal of the lease. Federal leases tend to be less flexible than private leases regarding turnout and roundup dates. There are differences in terms of construction and maintenance of rangeland improvements, although a perfect comparison is not possible because there are different specifications that vary for private leases. On federal leases, construction of improvements can be accomplished in a variety of ways, and expenses other than materials might be the responsibility of the lessee, who is generally responsible for maintaining the improvements. On private leases, the landowner typically bears a substantial part of the cost of major range improvements and typically pays for revegetation (USFS and BLM 1992).

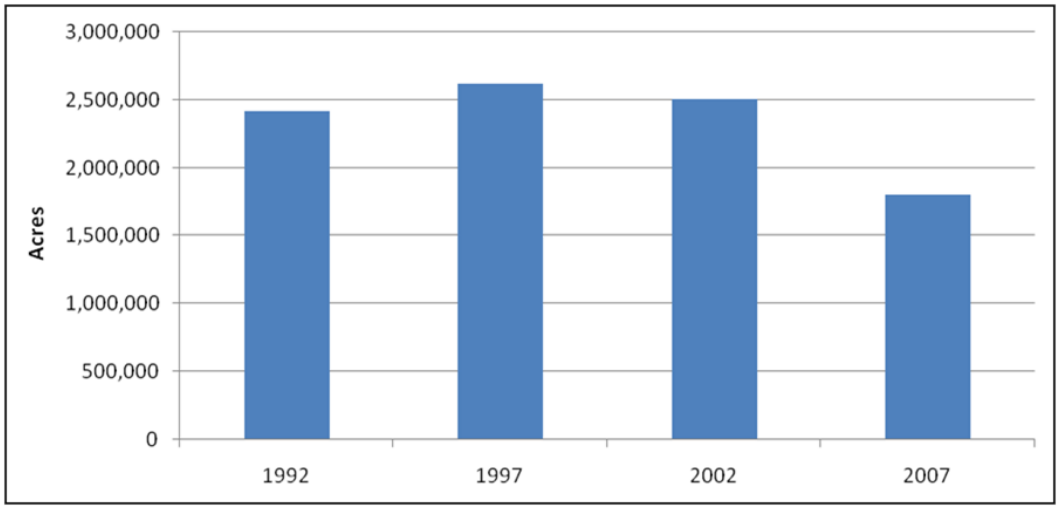
Although statewide the number of farms has remained constant, in Fremont County the number of farms has increased while the total acreage devoted to agriculture decreased. Figure 3.29, "Total Number of Farms in Fremont County, 1992-2007" (p. 494) shows the total number of farms in Fremont County from 1992 to 2007 (USDA - NASS 2009). The number of farms includes all farms and not just those utilizing public lands for livestock grazing.



Source: USDA - NASS 2009

Figure 3.29. Total Number of Farms in Fremont County, 1992-2007

Figure 3.30, "Total Farm Acres in Fremont County, 1992-2007" (p. 495) shows the total number of acres (private, state, and federal) used for farming in Fremont County from 1992 to 2007.

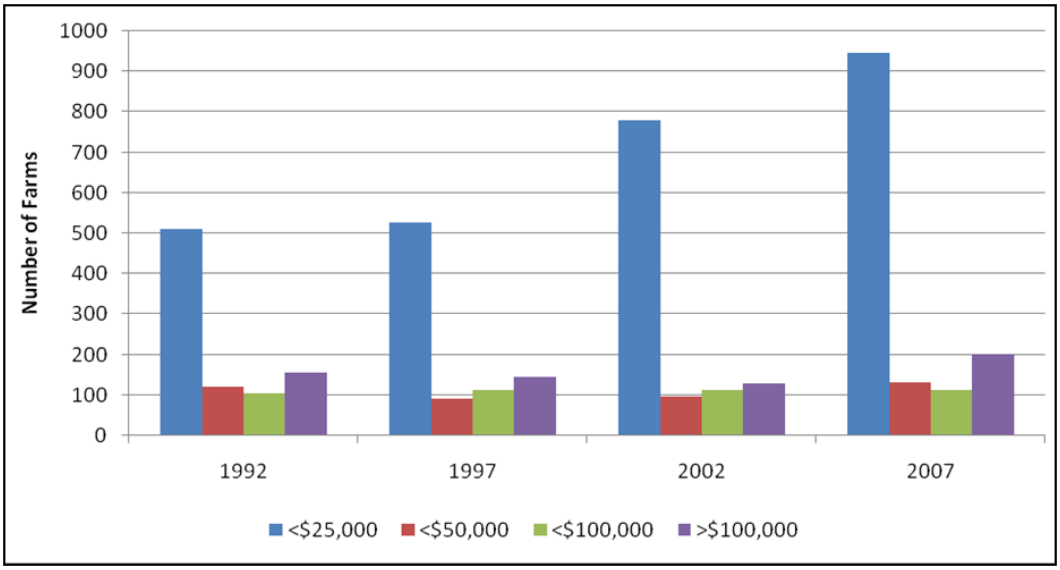


Source: USDA - NASS 2009

Figure 3.30. Total Farm Acres in Fremont County, 1992-2007

There were changes in the number of farms of all sizes as measured by sales of farm products, but the most substantial change was in the number of farms with less than $25,000 in sales. Figure 3.31, "Number of Farms in Fremont County Grouped by Sales Volume, 1992-2007" (p. 495) shows the change in number of farms in Fremont County grouped by sales volume from 1992 through 2007. The growth in number of farms with smaller output is in accord with the pattern of increasing number of farms with decreasing acreage of farm lands.

Figures 3.29 through 3.31 include all farms in Fremont County, not just those with public land grazing. As noted above, there are only 310 public land allotments, with some permittees holding more than one permit. At least six permittees hold 10 or more allotments.



Source: USDA - NASS 2009

Figure 3.31. Number of Farms in Fremont County Grouped by Sales Volume, 1992-2007

Cattle inventories in the study area declined steadily from 2000 to 2003, rose slightly in 2004, and fluctuated between 2005 and 2007. Overall, the number of cattle decreased from 330,000 in 2000 to 303,000 in 2007. Fremont County had the highest inventory with 105,000 cattle in 2007.

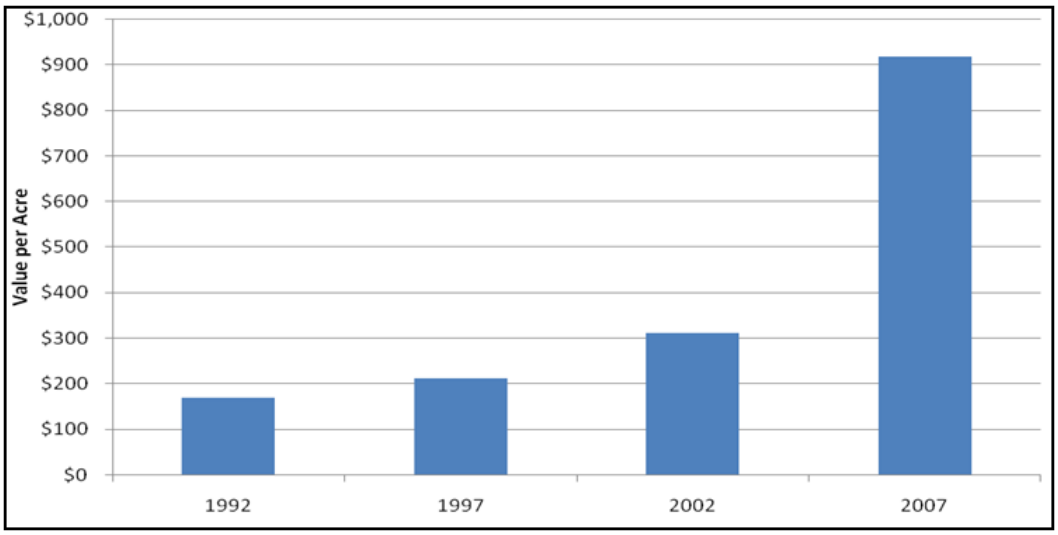
Breeding-sheep inventories declined steadily between 2000 and 2004, stabilized in 2005, but again declined slightly in 2006. The overall decrease was from 90,000 in 2000 to 59,000 in 2008 (USDA - NASS 2009). An extended multi-year drought across much of the Rocky Mountain west contributed to the declines. The presence and magnitude of drought could also affect the portion of permitted grazing area permittees utilize. For example, between 1980 and 2006, the proportion of permitted land actually used for grazing in the Green Mountain common allotment ranged from 16.3 percent to 73.1 percent; low levels of usage correspond with periods of drought.

A 1991 study by University of Wyoming economists revealed that agriculture is an important source of export income for the state's economy, because many agricultural products produced in the state are sold outside the state. The study also showed that most inputs to agricultural production come from within the state, and that profits and other income from agricultural production tend to stay in the state. Taken together, these findings indicate that agricultural production is an important contributor to Wyoming's economy (Moline et al. 1991).

It is uncertain whether these trends are still valid, because there has been an increase in ranching operations owned by entities other than the families, all federally licensed slaughter houses in the State of Wyoming have been closed, and there has been an increase in use of out-of-state concentrated animal feeding operations.

In a 2000 study, economists at the University of Wyoming compared the income provided to county governments and public schools to the financial demands on community services from agricultural and residential developments. The study showed that, on average in Wyoming, ranching activity generates almost twice as much income for community services as it requires in expenditures from community services, whereas residential development generates about half as much income as it requires in expenditures (Taylor and Coupal 2000). The study did not assess the cost to communities to support the subdivision of private ranches into ranchettes or the cost of the resulting loss of wildlife habitat.

Figure 3.32, "Average Market Value per Acre of Farms in Fremont County, 1992-2007" (p. 496) shows the rise in fair market value of farm land in Fremont County from 1992 through 2007 (USDA 2009, USDA 1997). Note that the values in the figure have not been adjusted for inflation.



Source: USDA - NASS 2009

Figure 3.32. Average Market Value per Acre of Farms in Fremont County, 1992-2007

The importance of BLM-administered land for livestock grazing in Fremont County was analyzed using a simulated enterprise level ranch budget (Taylor et al. 2004). Most ranches depend only partially on federal land grazing for forage, but this forage source is a critical part of their livestock operations because of seasonal dependency, even when the proportion of acres of AUMs federal land grazing contributes is relatively small for the operation. Private ranches use much of their land to produce hay for winter feeding. Using hay-producing acreage to graze cattle during summer means a ranch has to purchase hay for winter. The rigidity of seasonal forage availability means that the optimal use of other forages and resources are affected when federal AUMs are not available (Taylor et al. 2004). From 1975 through 2002 potential reductions in income and net ranch returns were greater than the direct economic loss from reductions in federal grazing (Taylor et al. 2004).

Income

Fremont County had the lowest per capita personal income in 2007 of the five counties in the study area; residents of Fremont County had an average per capita income of $38,744, including wages, salaries, income from investments and rent, and transfer payments such as social security (BEA 2009). This reflects the high unemployment rate on the WRIR which was 32.2 percent in 1999 (Massey and Blevins 1999).

Table 3.69, "Personal Income by Source in Study Area Counties, 2007 (Percent of Total)" (p. 498) summarizes sources of personal income by county in 2007. Among the sectors for which data are available, government, mining, and construction are substantial contributors to income in all five counties.

According to the Bureau of Economic Analysis data, the contribution of the farming and ranching sector in Carbon, Fremont, Hot Springs, and Sweetwater Counties was negative in 2007. This may mean the economic losses in these sectors for proprietors outweighed profits and wages; however, this could also result from an accumulation of inventory – that is, more goods were produced than sold (BEA 2009). The 2007 USDA Census of Agriculture reported that most farming and ranching income in Carbon (97 percent), Fremont (74 percent), and Hot Springs (89 percent) Counties is from livestock and livestock products (USDA - NASS 2009).

Trend data provide a good overview of how the contributions from different sectors in the planning area have changed over time. However, because of a change in the industrial classification system in 2000, it is not possible to construct a single continuous data set that would provide sector-level data both before and after 2000. Accordingly, Figure 3.33, "Historical Earnings Trends, Five-County Aggregation, 1980-2000" (p. 499) shows trend information on sources of income for the five counties, aggregated, from 1980 through 2000.

As Figure 3.33, "Historical Earnings Trends, Five-County Aggregation, 1980-2000" (p. 499) shows, from 1980 through 2000, changes in income (adjusted for inflation) were largely driven by changes in non-labor income, such as investment income and Social Security payments. Income from both government and manufacturing was higher in the early 1980s, but has been lower, and relatively steady, since approximately the mid-1980s. Income from construction increased steadily in the late 1990s. Generally, the relative contributions from different high-level sectors did not change substantially from 1980 through 2000.

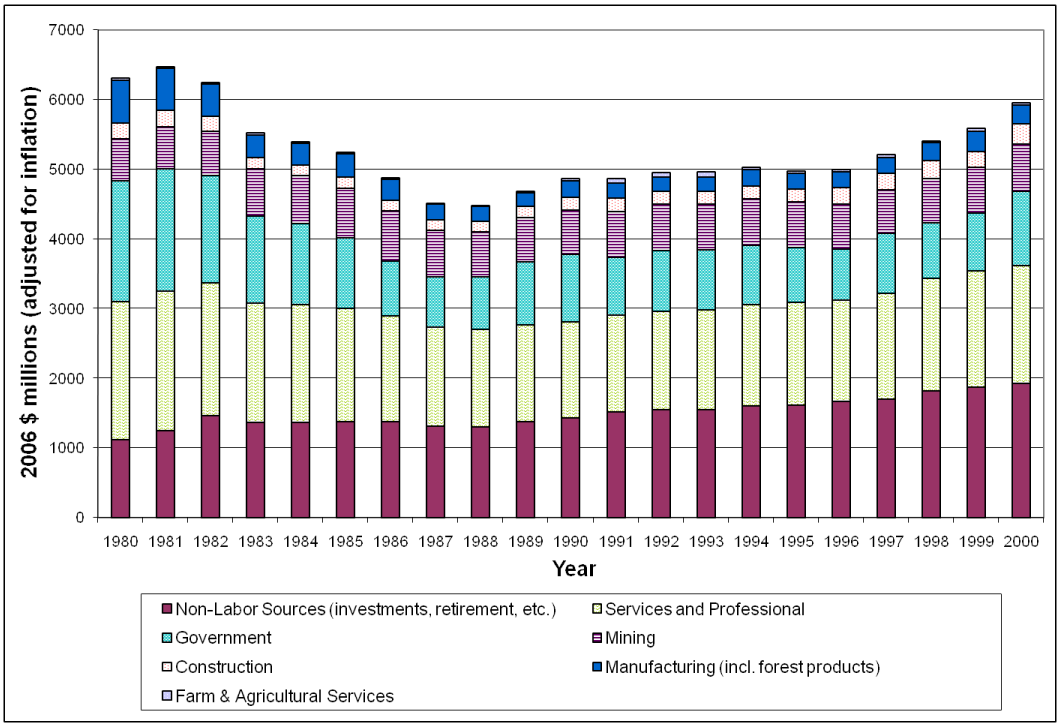
Table 3.69. Personal Income by Source in Study Area Counties, 2007 (Percent of Total)

Source	Personal Income				
	Carbon	Fremont	Hot Springs	Natrona	Sweetwater
Farm Earnings	-0.4	-0.2	-0.9	0.0	-0.1
Forestry, Fishing, and Other	N/A	0.2	N/A	N/A	N/A
Mining	3.6	6.2	14.9	18.9	32.1
Utilities	0.8	N/A	N/A	N/A	N/A
Construction	16.0	4.6	N/A	4.9	8.4
Manufacturing	N/A	1.2	2.1	3.4	6.9
Wholesale Trade	3.0	N/A	N/A	5.8	N/A
Retail Trade	4.1	5.0	2.5	4.7	4.7
Transportation and Warehousing	6.4	2.1	2.2	N/A	6.6
Information	0.4	0.9	0.6	0.7	0.4
Finance and Insurance	1.3	1.3	1.4	2.2	1.5
Real Estate and Rental and Leasing	0.8	1.6	0.4	2.4	2.0
Professional and Technical Services	1.6	3.2	1.8	3.3	2.5
Management of Companies and Enterprises	0.2	0.2	N/A	0.3	0.2
Administrative and Waste Services	0.9	0.7	N/A	1.3	2.1
Educational Services	0.0	N/A	0.1	0.1	0.1
Health Care and Social Assistance	N/A	N/A	5.4	7.7	2.5
Arts, Entertainment, and Recreation	0.7	1.0	1.9	0.5	N/A
Accommodation and Food Services	2.8	1.9	2.5	1.7	2.6

Source	Personal Income				
	Carbon	Fremont	Hot Springs	Natrona	Sweetwater
Other Services, Except Public Administration	1.6	2.0	1.2	2.5	3.1
Government and Government Enterprises	17.0	19.0	13.6	8.8	11.5
Categories for which Data were Not Disclosed	10.9	8.4	4.5	3.0	5.9
Non-Labor Income[1]	31.7	38.5	42.2	27.9	14.1
Residence Adjustment[2]	-3.3	2.3	3.7	-0.1	-7.2
Total Personal Income (millions of dollars)	**619**	**1,330**	**179**	**3,772**	**1,819**

Source: BEA 2009

N/A Not available (data were not disclosed due to confidentiality reasons; the Bureau of Economic Analysis does not report data when there are three or fewer employers in a sector). The line item "Categories for which Data were Not Disclosed" shows the total income attributable to these categories for each county.
[1]Non-labor income includes dividend, interest, and rental income, and net transfer payments (retirement, disability, insurance, Medicare, and welfare, less contributions for government social insurance, which are included in earnings for each sector but not included in total personal income). See the text for detail.
[2]Residence adjustment represents the net inflow of the earnings of inter-area commuters (here, expressed as a percentage of total personal income). A positive number indicates that on balance, county residents tend to commute outside the county to find jobs; a negative number indicates that on balance, people from other counties tend to commute in to find jobs. See the text for detail.



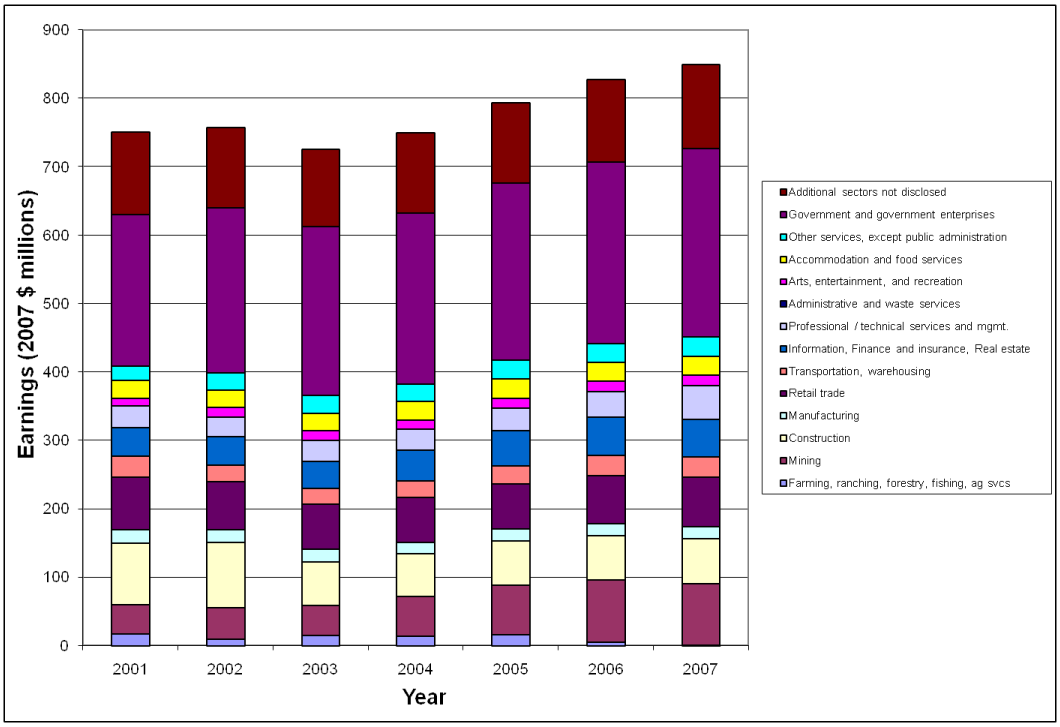
Source: BEA 2009
Note: Adjusted to 2006 dollars using Headwaters Economics 2009b.

Incl including

Figure 3.33. Historical Earnings Trends, Five-County Aggregation, 1980-2000

Figure 3.34, "Historical Earnings Trends, Fremont County, 2001-2007" (p. 500) shows similar earnings trends from 2001 through 2007. However, this figure shows data only for Fremont County. Building meaningful trend information for multiple counties is difficult due to the number of sectors for which the Bureau of Economic Analysis does not disclose data (for confidentiality reasons). For example, across the five counties and seven years from 2001 through 2007, data are consistently reported for only seven out of the Bureau of Economic Analysis's 21 top-level sectors. This problem is alleviated for data from 1980 through 2000 because Headwaters Economics developed a special algorithm to estimate disclosed sectors for these years; however, at present, there is no algorithm for the 2001 through 2007 series. Non-disclosure still prevents some data from being shown for Fremont County, but the problem is reduced by selecting just one county (Fremont) instead of aggregating information for all five counties.

Figure 3.34, "Historical Earnings Trends, Fremont County, 2001-2007" (p. 500) shows that in Fremont County, mining, construction, government, information, finance and insurance, and real estate contributed the most in earnings from 2001 through 2007. Growth in earnings over the last few years since the mid-2000s has been largely due to growth in earnings from mining, construction, professional services, and government. Generally, the relative contributions from different high-level sectors did not change substantially from 2001 through 2007.



Source: BEA 2009. Adjusted to 2007 dollars using Wyoming Economic Analysis Division 2009e
Note: Sectors not disclosed are utilities, wholesale trade, educational services, and health care and social assistance in all years, and in 2001 through 2002 also include management services and administrative and waste services.

ag svcs agriculture services
mgmt management

Figure 3.34. Historical Earnings Trends, Fremont County, 2001-2007

Census County Business Patterns (U.S. Census Bureau 2008b) provides additional data on mining related earnings and employment. Table 3.70, "Earnings and Employment for Mining Activities in Study Area Counties, 2007" (p. 501) lists mining related earnings and employment for the counties in the study area from this source.

Table 3.70. Earnings and Employment for Mining Activities in Study Area Counties, 2007

Industry Description	Carbon		Fremont		Hot Springs	
	Employees[1]	Payroll (1,000$)	Employees	Payroll (1,000$)	Employees	Payroll (1,000$)
Mining	185	10,565	841	35,313	397	16,646
Oil and Gas Extraction	20-99	N/A[2]	90	7,831	20-99	N/A[2]
Crude Petroleum and Natural Gas Extraction	20-99	N/A[2]	90	7,831	20-99	N/A[2]
Natural Gas Liquid Extraction	0-19	N/A[2]	-	-	-	-
Mining (except oil and gas)	0-19	N/A[2]	0-19	N/A[2]	0-19	N/A[2]

Industry Description	Carbon		Fremont		Hot Springs	
	Employees[1]	Payroll (1,000$)	Employees	Payroll (1,000$)	Employees	Payroll (1,000$)
Coal Mining	-	-	0-19	N/A[2]	-	-
Bituminous Coal and Lignite Surface Mining	-	-	0-19	N/A[2]	-	-
Metal Ore Mining	0-19	N/A[2]	0-19	N/A[2]	-	-
Gold Ore and Silver Ore Mining	-	-	0-19	N/A[2]	-	-
Gold Ore Mining	-	-	0-19	N/A[2]	-	-
Other Metal Ore Mining	0-19	N/A[2]	0-19	N/A[2]	-	-
Uranium-Radium-Vanadium Ore Mining	0-19	N/A[2]	0-19	N/A[2]	-	-
Nonmetal-lic Mineral Mining and Quarrying	0-19	N/A[2]	-	-	0-19	N/A[2]
Stone Mining and Quarrying	-	-	-	-	0-19	N/A[2]
Dimension Stone Mining and Quarrying	-	-	-	-	0-19	N/A[2]
Sand, Gravel, Clay, and Ceramic and Refractory Minerals Mining and Quarrying	0-19	N/A[2]	-	-	-	-
Construc-tion Sand and Gravel Mining	0-19	N/A[2]	-	-	-	-
Support Activities for Mining	92	3,685	743	26,692	360	14,705
Drilling Oil and Gas Wells	0-19	N/A[2]	195	5,999	100-249	N/A[2]

Industry Description	Carbon		Fremont		Hot Springs	
	Employees[1]	Payroll (1,000$)	Employees	Payroll (1,000$)	Employees	Payroll (1,000$)
Support Activities for Oil and Gas Operations	81	2,875	534	19,918	192	11,932
Support Activities for Coal Mining	-	-	0-19	N/A[2]	-	-

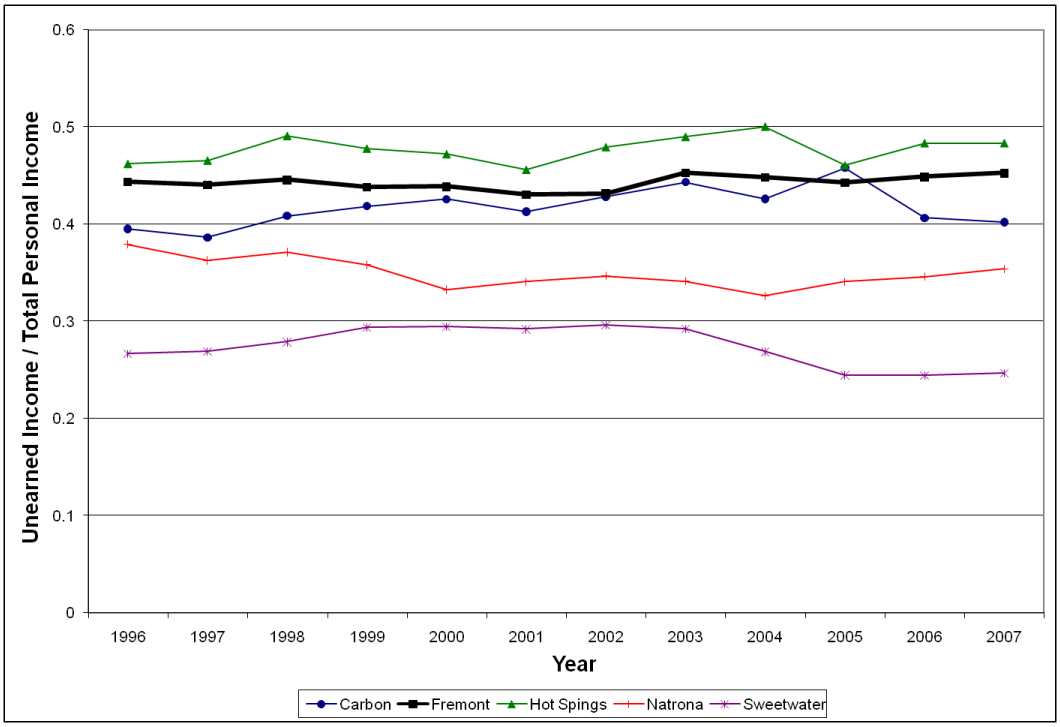
Industry Description	Natrona		Sweetwater	
	Employees	Payroll (1,000$)	Employees	Payroll (1,000$)
Mining	2,913	180,653	2,621	160,175
Oil and Gas Extraction	214	13,746	328	21,998
Crude Petroleum and Natural Gas Extraction	208	13,246	153	10,336
Natural Gas Liquid Extraction	0-19	N/A[2]	100-249	N/A[2]
Mining (except oil and gas)	20-99	N/A[2]	500-999	N/A[2]
Coal Mining	-	-	500-999	N/A[2]
Bituminous Coal and Lignite Surface Mining	-	-	500-999	N/A[2]
Bituminous Coal Underground Mining	-	-	100-249	N/A[2]
Metal Ore Mining	0-19	N/A[2]	-	-
Gold Ore and Silver Ore Mining	-	-	-	-
Gold Ore Mining	-	-	-	-
Other Metal Ore Mining	0-19	N/A[2]	-	-
Uranium-Radium-Vanadium Ore Mining	0-19	N/A[2]	-	-
Nonmetallic Mineral Mining and Quarrying	20-99	N/A[2]	100-249	N/A[2]
Stone Mining and Quarrying	-	-	0-19	N/A[2]
Other Crushed and Broken Stone Mining and Quarrying	-	-	0-19	N/A[2]
Sand, Gravel, Clay, and Ceramic and Refractory Minerals Mining and Quarrying	20-99	N/A[2]	-	-
Construction Sand and Gravel Mining	0-19	N/A[2]	-	-
Clay and Ceramic and Refractory Minerals Mining	20-99	N/A[2]	-	-
Other Nonmetallic Mineral Mining and Quarrying	0-19	N/A[2]	100-249	N/A[2]
Potash, Soda, and Borate Mineral Mining	-	-	100-249	N/A[2]
All Other Nonmetallic Mineral Mining	0-19	N/A[2]	-	-
Support Activities for Mining	2,642	N/A[2]	1,389	81,626
Drilling Oil and Gas Wells	1,149	80,717	119	8,552
Support Activities for Oil and Gas Operations	1,456	81,641	1,217	60,843
Support Activities for Coal Mining	0-19	N/A[2]	2,049	N/A[2]
Support Activities for Metal Mining	0-19	N/A[2]	-	-
Support Activities for Nonmetallic Minerals (except Fuels)	0-19	N/A[2]	0-19	N/A[2]

Source: U.S. Census Bureau 2008b

Note: Number of employees is for mid-March 2007. Payroll data are for the entire year.
[1]For some sectors and sub-sectors, the data source reveals only a range for the number of employees so as not to disclose confidential business information (there are very few employers in the sector).
[2]The data source does not reveal data on payrolls for this sub-sector due to confidentiality requirements (there are relatively few employers in the sector).

Although the County Business Patterns data do not disclose all data on employee counts and payrolls due to confidentiality requirements, the data provided help to show the economic importance of mineral commodities. Table 3.70, "Earnings and Employment for Mining Activities in Study Area Counties, 2007" (p. 501) shows that oil and gas extraction and operations support activities substantially contribute to mining-related earnings in all five counties. Based on summing actual employment where those data are provided, and the lower bounds of ranges where actual employment is not shown, oil and gas extraction and operations support contributes at least 101 jobs in Carbon County (at least 55 percent of mining-related jobs), 819 jobs in Fremont County (97 percent of mining-related jobs), at least 312 jobs in Hot Springs County (at least 79 percent of mining-related jobs), 2,819 jobs in Natrona County (97 percent of mining-related jobs), and 1,664 jobs in Sweetwater County (63 percent of mining-related jobs).

Transfer payments such as Social Security, disability, insurance, Medicare, and welfare, and income from dividends, interest, and rent, make up a substantial portion of income in all five counties. Figure 3.35, "Percent of Total Personal Income from Dividends, Interest, Rent, and Transfer Payments " (p. 504) shows the trend in percentage of income from these sources over time. As the figure shows, the share of total income from unearned income remained relatively constant in Fremont County between 1996 and 2007, starting at 44 percent and ending at 45 percent. In Sweetwater County, the percentage of total income from unearned income rose from 1996 to 2002 and then declined between 2002 and 2006. Between 2006 and 2007, the percentage of total income from unearned income in Sweetwater County rose slightly from 24 percent to 25 percent, about 2 percent lower than the 1996 level. The percentage of income from unearned income fell 5 percent in Natrona County between 1996 and 2000, and between 2001 and 2007 the percentage of income from unearned income remained relatively constant between 34 and 35 percent. In Hot Springs County, the percentage of income from unearned income increased between 1996 and 2004, reaching up to 50 percent before decreasing to 48 percent in 2007. The total percentage of income from unearned income in Carbon County increased up to 46 percent by 2005 before decreasing to the 1996 level of 40 percent by 2007. In Wyoming as a whole, the percentage of income from unearned income remained relatively constant, increasing 3 percent from 37 percent to 40 percent between 1996 and 2007. Note, however, that the absolute amount (adjusted for inflation) of income from transfer payments, dividends, interest, and rent has increased in all five counties (Figure 3.36, "Amount of Dividends, Interest, Rent, and Transfer Payments" (p. 505)) and the state.

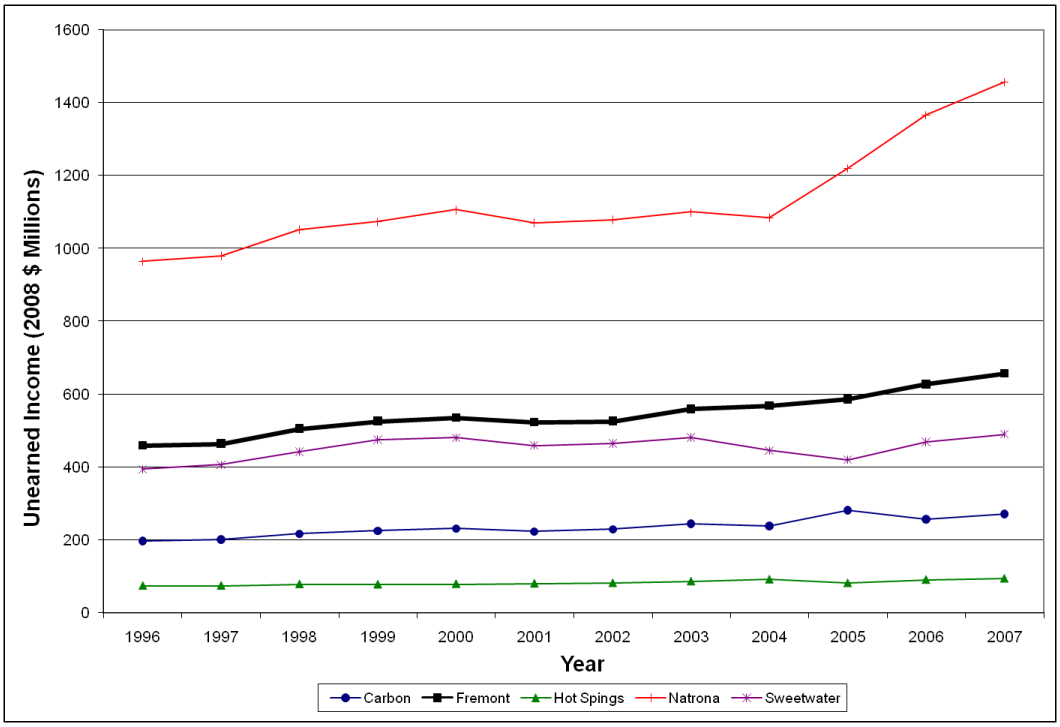


Source: BEA 2009

Figure 3.35. Percent of Total Personal Income from Dividends, Interest, Rent, and Transfer Payments

Most of the counties had more non-labor (unearned) income than the United States as a whole in 2007 (nationally, the rate was 32 percent). Several factors could cause a higher proportion of income from dividends, interest, rent, and transfer payments, including a higher proportion of families with incomes derived from assets such as stocks and real estate, or a higher proportion of people receiving income from government payments such as Social Security.

At a regional level, a larger share of non-labor income could lead to views different from those traditionally held in an area dominated by extractive industries. In addition, these changes in views often tend to support preservation policies that favor a less-intense dependence on the extractive industries.



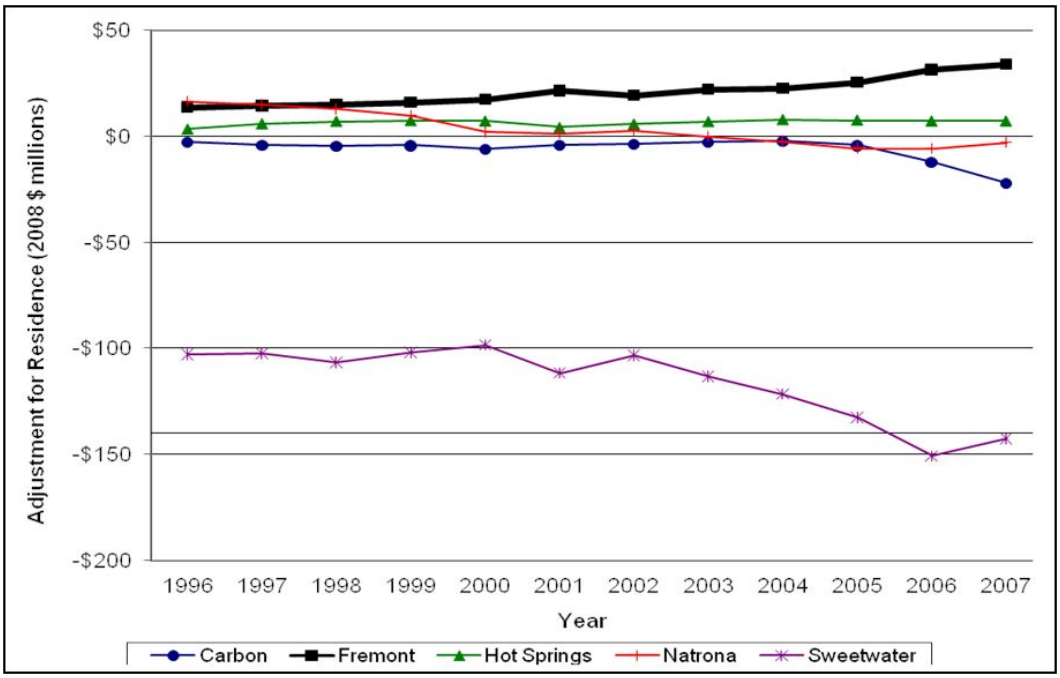
Source: BEA 2009
Note: Adjusted for inflation using the Wyoming Cost of Living Index for the central region (Converse, Fremont, and Natrona Counties) (Wyoming Economic Analysis Division 2009e).

Figure 3.36. Amount of Dividends, Interest, Rent, and Transfer Payments

Diversified regional economies in the west that are located next to protected public lands tend to do better from an economic standpoint compared to those that rely primarily on the extractive industries (BLM 2009b). In addition to being more stable, there is some evidence to suggest that more diverse economic regions tend to generate faster growth over the long term. A recent study by a nonprofit research group (Headwaters Economics 2008) compared long-term growth in "energy-focusing" counties in the western United States with "peer counties" of similar size and found that over the long term, employment and income grew measurably faster in the peer counties. The study identified 26 energy-focusing counties, rural counties with populations less than 57,000 and more than 7 percent of private-sector employment from energy-related industries, and compared their growth with 254 peer counties (comparable counties with lower energy-related employment). The study found that from 1990 to 2005, inflation-adjusted personal income in the energy-focusing counties grew at an average rate of 2.3 percent, compared to 2.9 percent for the peer counties. Employment in energy-focusing counties grew an average of 1.8 percent compared to 2.3 percent for peer counties. The analysis period for long-term growth studies must be chosen carefully so as to not bias the results through the choice of an ending year that coincides with an energy bust. In this case, the timeframe was well chosen. The starting year for the analysis coincides with both a national recession and a relative low point for energy development, and the ending year coincides with the approximate peak of the most recent economic expansion, which included an energy boom.

Another indicator of income is the residence adjustment, which measures cross-county flows of income and earnings. While many people live and work in the same county, other people work outside the county in which they live (they commute across county boundaries). For each county, the net residence adjustment represents the net inflow of earnings due to cross-county income

flows, or the difference between the income of those who reside in the county and those who work in the county. Thus, a residence adjustment more than zero indicates that, on balance, the flow of income due to inter-county commuting is positive; that is, people tend to commute outside the county to find jobs. Similarly, a county with a residence adjustment less than zero indicates that people from other counties tend to commute in to find jobs. Figure 3.37, "Resident Adjustment Factors" (p. 507) shows the residence adjustment factors for each of the five counties, in real terms (adjusted for inflation). The figure shows that the residence adjustment in Sweetwater County is far more substantial than in the other four counties in the study area; Sweetwater County has a large negative residence adjustment (-$143 million in 2007), which indicates that there are a large number of people commuting into Sweetwater County to work. In 2007, Carbon and Natrona were the only other counties with a net influx of workers, with residence adjustments of -$22 million and -$3 million, respectively. The residence adjustment was $34 million for Fremont and $7 million for Hot Springs County; therefore, Fremont County had the largest income generated by jobs outside the county.



Source: BEA 2009
Note: Adjusted for inflation using the Wyoming Cost of Living Index for the central region (Converse, Fremont, and Natrona Counties) (Wyoming Economic Analysis Division 2009e).

Figure 3.37. Resident Adjustment Factors

Employment

The breakout of employment by industry shows a pattern similar to that of the personal income statistics, highlighting the importance of mining, government, construction, and services in all five counties (excluding mining in Carbon County). Table 3.71, "Employment by Industry in Study Area Counties, 2007 (Percent of Total)" (p. 508) summarizes total employment by sector for the counties in the study area. Note that data on employment for a finer breakout of the mining sector is shown inTable 3.71, "Employment by Industry in Study Area Counties, 2007 (Percent of Total)" (p. 508).

Table 3.71. Employment by Industry in Study Area Counties, 2007 (Percent of Total)

Source	Number of Jobs					
	Carbon	Fremont	Hot Springs	Natrona	Sweetwater	Wyoming
Farm Employment	4.4	4.6	5.8	0.8	0.6	2.9
Forestry, Fishing, and Other	N/A	0.8	N/A	N/A	N/A	0.7
Mining	3.2	4.2	7.6	9.5	20.0	8.0
Utilities	0.6	N/A	N/A	N/A	N/A	0.7
Construction	14.2	8.2	N/A	7.9	8.9	9.4
Manufacturing	N/A	2.7	2.9	4.1	4.3	3.1
Wholesale Trade	2.7	N/A	N/A	5.4	N/A	2.5
Retail Trade	9.8	11.4	9.3	12.3	10.0	10.7
Transportation and Warehousing	5.5	2.6	2.8	N/A	5.9	3.8
Information	0.7	1.5	1.5	1.2	0.8	1.2
Finance and Insurance	2.0	2.1	2.8	3.4	2.1	3.0
Real Estate and Rental and Leasing	4.5	4.7	3.1	5.1	3.5	4.6
Professional and Technical Services	2.6	3.7	3.6	4.7	2.7	4.4
Management of Companies and Enterprises	0.2	0.2	N/A	0.2	0.2	0.3
Administrative and Waste Services	2.7	2.3	N/A	4.2	3.5	3.4
Educational Services	0.3	N/A	(L)	0.6	0.5	0.8
Health Care and Social Assistance	N/A	N/A	11.0	11.1	4.3	7.2
Arts, Entertainment, and Recreation	1.9	1.6	3.1	1.7	N/A	1.7
Accommoda-tion and Food Services	9.5	7.0	10.4	6.9	8.1	8.5
Other Services, Except Public Administration	4.9	6.2	7.2	6.1	4.9	5.2
Government and Government Enterprises	19.1	22.8	18.4	11.2	14.1	17.9
Data were Not Disclosed	11.3	13.3	10.2	3.4	5.4	0.0

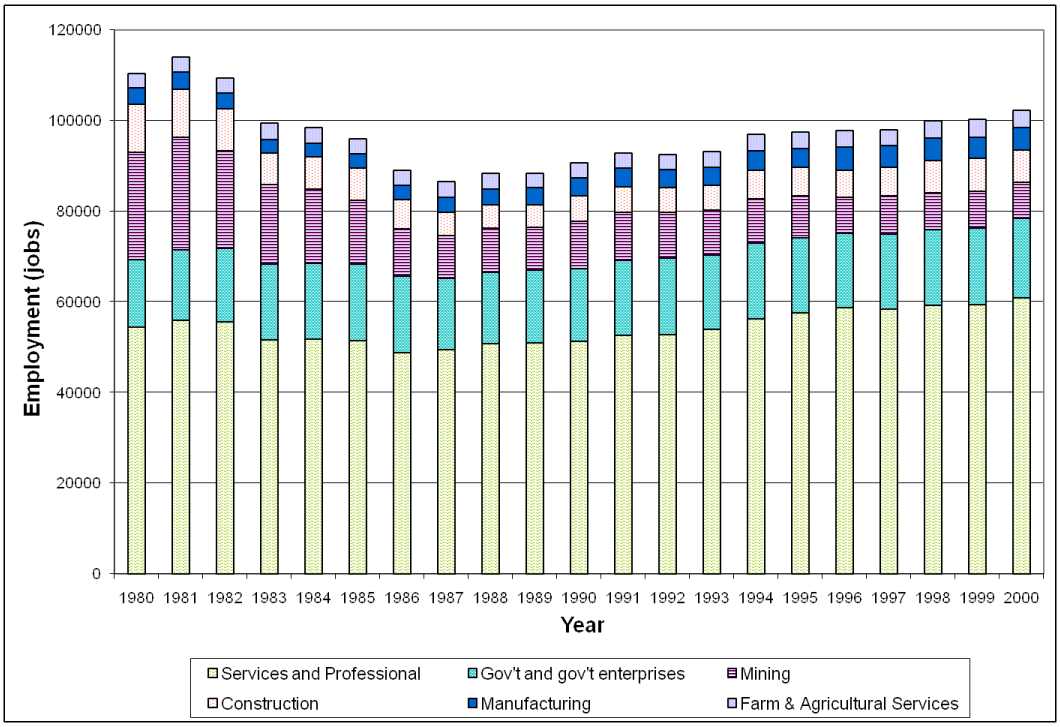
Source	Number of Jobs					
	Carbon	Fremont	Hot Springs	Natrona	Sweetwater	Wyoming
Total Employment (2007)	**11,340**	**24,040**	**3,192**	**53,927**	**30,878**	**389,776**

Source: BEA 2009

N/A Not available (not disclosed by the data source for reasons of confidentiality).
(L) Less than 10 jobs, but the estimates for this item are included in the totals.

As in the earnings section, this section provides trend data to illustrate how the contributions from different sectors in the planning area have changed over time. The same change in the industrial classification system in 2000 makes it impossible to construct a single continuous data set that would provide sector-level data both before and after 2000. In addition, the same problems with non-disclosure make it impossible to provide meaningful data for the five counties for the seven years from 2001 through 2007. Accordingly, Figure 3.38, "Historical Employment Trends, Five-County Aggregation, 1980-2000" (p. 509) shows trend information on sources of employment for the five counties, aggregated, from 1980 to 2000, and Figure 3.39, "Historical Employment Trends, Fremont County, 2001-2007" (p. 510) shows information on employment for Fremont County from 2001 to 2007.

As Figure 3.38, "Historical Employment Trends, Five-County Aggregation, 1980-2000" (p. 509) shows, from 1980 through 2000, changes in employment were largely driven by changes in service and professional employment. Employment in construction and mining was higher in the early 1980s than at any other point through 2000, but did grow somewhat from a low in the late 1980s through 2000. Generally, the relative contributions from different high-level sectors did not change substantially from 1980 through 2000.



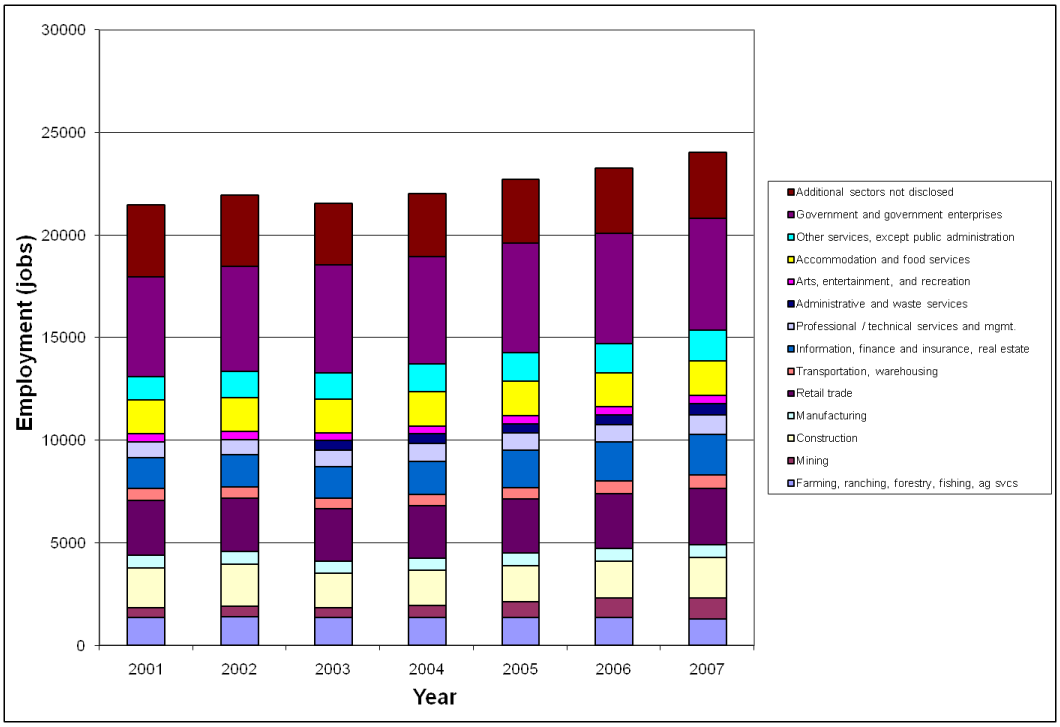
Source: BEA 2009

Gov't Government

Figure 3.38. Historical Employment Trends, Five-County Aggregation, 1980-2000

Figure 3.39, "Historical Employment Trends, Fremont County, 2001-2007" (p. 510) shows that in Fremont County all sectors grew more or less equally; that is, the relative contributions from different high-level sectors did not change substantially from 2001 through 2007. The relative contribution of the mining sector grew slightly over the period shown, but for all other sectors, relative contributions have been basically stable since 2001.

Average earnings per job in 2007 were lower than the national and state averages in Carbon, Fremont, and Hot Springs Counties. Sweetwater County and Natrona County had an average earnings per job higher than both the nation and state. Table 3.72, "Average Earnings Per Job for Study Area Counties, Wyoming, and the Nation, 2007" (p. 511) lists the average earnings per job by county in 2007. Figure 3.40, "Average Earnings Per Job, 2001-2007 (adjusted for inflation)" (p. 511) shows the average earnings per job by county from 2001 through 2007. In each of the counties, the state, and the nation, average earnings per job remained more or less steady, sometimes with very slight increases or decreases.



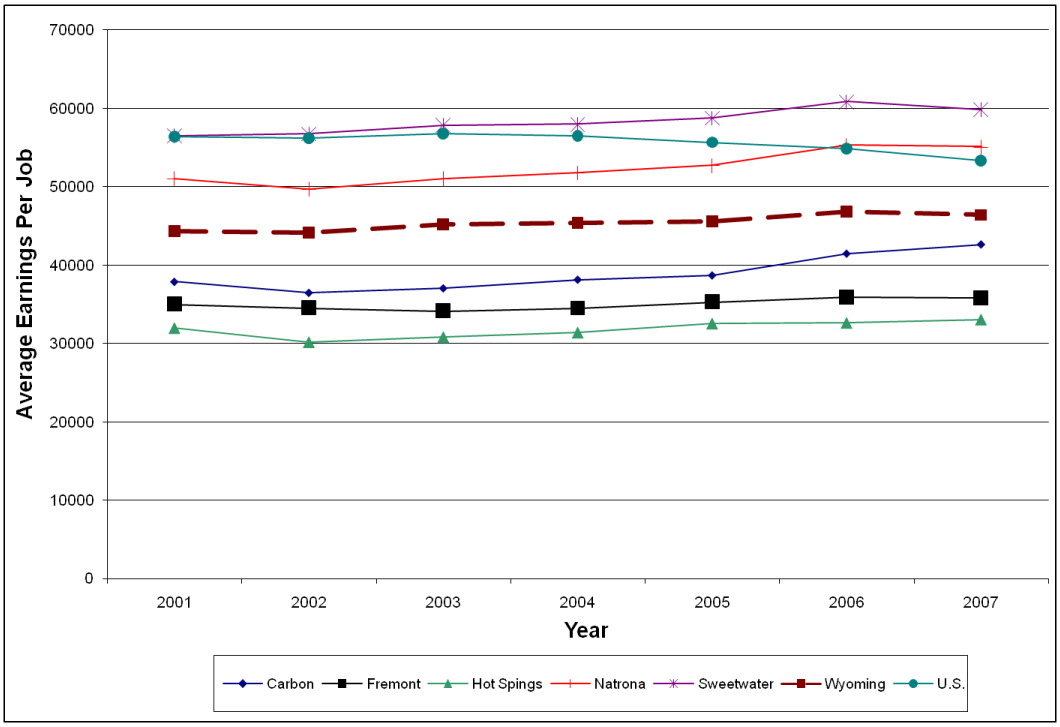
Source: BEA 2009
Note: Sectors not disclosed are utilities, wholesale trade, educational services, and health care and social assistance in all years, and in 2001 through 2002 also include management services and administrative and waste services.

ag svcs Agriculure services
mgmt management

Figure 3.39. Historical Employment Trends, Fremont County, 2001-2007

Table 3.72. Average Earnings Per Job for Study Area Counties, Wyoming, and the Nation, 2007

Locality	Average Earnings Per Job
Carbon County	$39,047
Fremont County	$32,766
Hot Springs County	$30,268
Natrona County	$50,472
Sweetwater County	$54,847
Wyoming	$42,506
United States	$48,900
Source: BEA 2009	



Source: BEA 2009
Note: Adjusted for inflation using Wyoming Economic Analysis Division 2009e.

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Figure 3.40. Average Earnings Per Job, 2001-2007 (adjusted for inflation)

It is important to consider how different average wages could affect the ability of different employers to attract workers. For example, a study in nearby Sublette County (Jacquet 2006) found that wages for jobs in gas development and exploration are higher than in any other sector and are high for both unskilled and skilled workers. Depending on the need for labor in relatively high-paying sectors, this could adversely affect the ability of other employers (in relatively low-paying sectors) to attract workers. Table 3.73, "Fourth Quarter 2008 Average Monthly Employment and Average Weekly Wage for the Five Counties in the Study Area" (p. 513) lists recent data (from the fourth quarter of 2008) on relative earnings by sector and total employees in each sector for the five counties. As the table shows, with the exception of Carbon County, the mining sector (including oil and gas development) has the highest average weekly wage of any sector. This observation is also true for the state as a whole. In Carbon County, construction has high, albeit comparable, average weekly wages compared to the mining sector. Furthermore, in Sweetwater County, average weekly wages in the manufacturing sector are comparable to the mining sector.

Table 3.73. Fourth Quarter 2008 Average Monthly Employment and Average Weekly Wage for the Five Counties in the Study Area

Sector	Carbon		Fremont		Hot Springs	
	Average Monthly Employment	Average Weekly Wage ($)	Average Monthly Employment	Average Weekly Wage ($)	Average Monthly Employment	Average Weekly Wage ($)
Agriculture, Forestry, Fishing, and Hunting	198	652	107	467	N/A	N/A
Animal Production	183	668	71	411	N/A	N/A
Mining	467	1,307	898	1,376	192	1,447
Oil and Gas Extraction	N/A	N/A	N/A	N/A	N/A	N/A
Mining, Except Oil and Gas	N/A	N/A	N/A	N/A	N/A	N/A
Support Activities for Mining	407	1,296	592	1,219	122	1,405
Utilities	55	1,035	55	1,381	N/A	N/A
Construction	908	1,430	1,154	804	104	1,016
Manufacturing	N/A	N/A	423	656	66	600
Wholesale Trade	75	898	348	869	28	804
Retail Trade	794	505	2,101	530	183	409
Transportation and Warehousing	260	1,028	413	1,066	82	920
Information	82	571	243	603	44	313
Finance and Insurance	145	694	333	784	49	782
Real Estate and Rental and Leasing	96	343	397	890	8	344
Administrative and Waste Services	113	682	179	827	N/A	N/A
Health Care and Social Assistance	447	711	1,693	735	282	551
Arts, Entertainment, and Recreation	50	741	108	252	47	279
Accommodation and Food Services	906	321	1,399	265	251	252
Other Services, Except Public Administration	159	521	506	587	57	384
Total Government	**2,061**	**795**	**5,737**	**748**	**556**	**649**
All Private Sectors (Non-Government)	**5,369**	**861**	**11,156**	**714**	**1,492**	**659**

Sector	Carbon		Fremont		Hot Springs	
	Average Monthly Employment	Average Weekly Wage ($)	Average Monthly Employment	Average Weekly Wage ($)	Average Monthly Employment	Average Weekly Wage ($)
All Sectors	**7,430**	**843**	**16,892**	**726**	**2,048**	**656**
Sector	**Natrona**		**Sweetwater**		**Wyoming**	
	Average Monthly Employment	**Average Weekly Wage ($)**	**Average Monthly Employment**	**Average Weekly Wage ($)**	**Average Monthly Employment**	**Average Weekly Wage ($)**
Agriculture, Forestry, Fishing, and Hunting	140	717	11	628	2,373	617
Animal Production	109	791	N/A	N/A	1,656	620
Mining	3,995	1,670	6,266	1,592	30,372	1,511
Oil and Gas Extraction	814	1,592	544	1,510	4,719	1,704
Mining, Except Oil and Gas	97	1,506	2,257	1,714	9,876	1,500
Support Activities for Mining	3,083	1,697	3,465	1,526	15,776	1,460
Utilities	N/A	N/A	N/A	N/A	2,657	1,598
Construction	3,078	1,233	2,162	1,278	27,915	1,014
Manufacturing	1,915	984	1,329	1,522	10,169	990
Wholesale Trade	2,738	1,262	810	1,149	9,240	1,164
Retail Trade	5,404	554	2,545	552	32,383	500
Transportation and Warehousing	953	956	1,486	1,222	11,018	913
Information	518	707	213	514	4,673	686
Finance and Insurance	1,085	1,016	454	962	7,290	933
Real Estate and Rental and Leasing	976	994	508	1,195	4,450	823
Administrative and Waste Services	1,305	585	537	748	7,873	600
Health Care and Social Assistance	5,208	952	962	652	32,086	840
Arts, Entertainment, and Recreation	375	302	132	207	3,744	518
Accommoda-tion and Food Services	3,807	292	2,469	347	29,752	317
Other Services, Except Public Administration	1,931	767	659	734	8,889	628
Total Government	**5,650**	**900**	**4,380**	**811**	**64,756**	**837**

Sector	Carbon		Fremont		Hot Springs	
	Average Monthly Employment	Average Weekly Wage ($)	Average Monthly Employment	Average Weekly Wage ($)	Average Monthly Employment	Average Weekly Wage ($)
All Private Sectors (Non-Government)	**35,187**	**935**	**21,656**	**1,114**	**222,722**	**854**
All Sectors	**40,837**	**930**	**26,036**	**1,063**	**287,478**	**850**

Sources: Wyoming Department of Employment 2009a; Wyoming Department of Employment 2009b; Wyoming Department of Employment 2009c; Wyoming Department of Employment 2009d; Wyoming Department of Employment 2009e; Wyoming Department of Employment 2009f; Wyoming Department of Employment 2009g

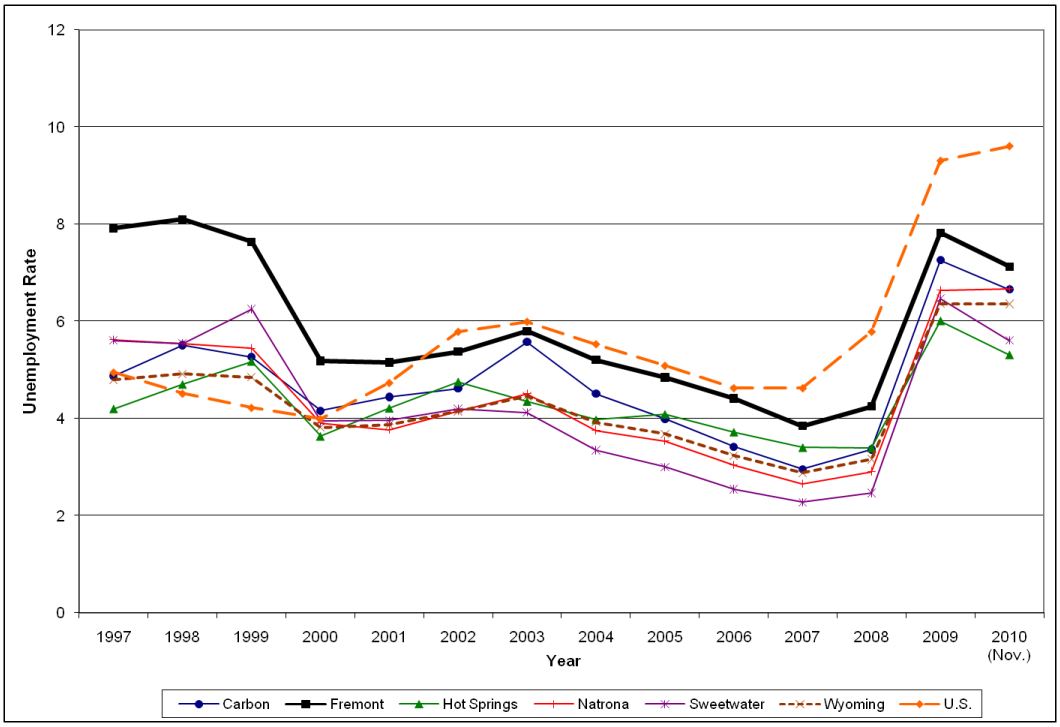
N/A Not available (not disclosed in the data source, for reasons of confidentiality).

All five counties follow the general unemployment trend observed at the national and state levels from 1997 through 2010. As of November 2010, all five counties had lower unemployment than the national average of 9.6 percent. Fremont County had an unemployment rate of 7.1 percent, Carbon County 6.7 percent, Hot Springs County 5.3 percent, Natrona County 6.7 percent, and Sweetwater County had an unemployment rate of 5.6 percent. Wyoming had 6.4 percent unemployment overall (BLS 2011a, BLS 2011b). These rates are generally about three percentage points higher than prior to the latest economic downturn, when unemployment in the five counties was generally between 2 and 5 percent. Figure 3.41, "Unemployment Rates, 2000-2008" (p. 515) shows unemployment rates in recent years for the five counties in the study area, Wyoming, and the United States. Unemployment in the study area has been lower than the national rate since at least 2002, and has been decreasing since 2003 in all five counties (and since 2002 in Sweetwater and Hot Springs Counties). Unemployment in Fremont County has been larger than in the four other counties and the state during this period.

Unemployment statistics are shifting rapidly due to the economic downturn that began in December 2007. While the recession appears to have affected Wyoming less than other states, the state has not been immune. For each of the counties in the study area, unemployment rose between 2007 and 2008 for the first time since 2003.

Tax Revenue

Activities on public lands contribute to the fiscal well-being of federal, state and local governments. BLM management actions have the potential to affect tax revenues from mining and mineral production; travel, tourism, and recreation; and livestock grazing.



Sources: BLS 2009, BLS 2011a, and BLS 2011b

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Figure 3.41. Unemployment Rates, 2000-2008

Mining, Including Oil and Gas

The mining industry contributes substantially to state and local tax revenues and explains in part why Wyoming has no income tax. The Wyoming State Auditor reported that state mineral severance taxes and federal mineral royalties returned to the state represented 31 percent of total state revenues in Fiscal Year 2007, a total of $1.45 billion. Sales and use taxes represented another 11 percent of total state revenues (Wyoming State Auditor 2008). The Wyoming Legislative Service Office (WLSO 2003) indicated that the mining sector paid about $806 million in state and local tax revenues in Fiscal Year 2002. This represents 54 percent of total state and local tax revenues from major tax sources (severance, ad valorem, sales and use, cigarettes, gross receipts, liquor, and franchise taxes) for Fiscal Year 2002 (WLSO 2003).

Oil and gas production on federal lands in Wyoming is subject to state, federal, and local taxes. Ad valorem production and production-equipment taxes are payable to the county in which the production occurs. Because oil and gas are produced from all five study area counties, ad valorem production and production equipment taxes are important for these counties.

State severance taxes are levied on current production at the rate of 6 percent of the taxable value of crude oil and natural gas, and at 7 percent of taxable value for surface coal, 4 percent for trona, and 2 percent for most other minerals. Taxable value is defined as the gross sales value minus certain allowable deductions for royalties, transportation, and natural gas processing. Rates are lower for less productive stripper wells and new wells (Wyoming DOR 2008). State and local taxes, including the ad valorem tax, also apply to coal and trona mining. Using the data on production valuation shown above, along with state severance tax rates, it is possible to estimate

state severance tax collections for each county for the different mineral products. Table 3.74, "Estimated State Severance Tax Collections (dollars) on Mineral Production in the Study Area Counties, Production Year 2007" (p. 517) lists estimated state severance tax collections for the counties for Production Year 2007.

Table 3.74. Estimated State Severance Tax Collections (dollars) on Mineral Production in the Study Area Counties, Production Year 2007

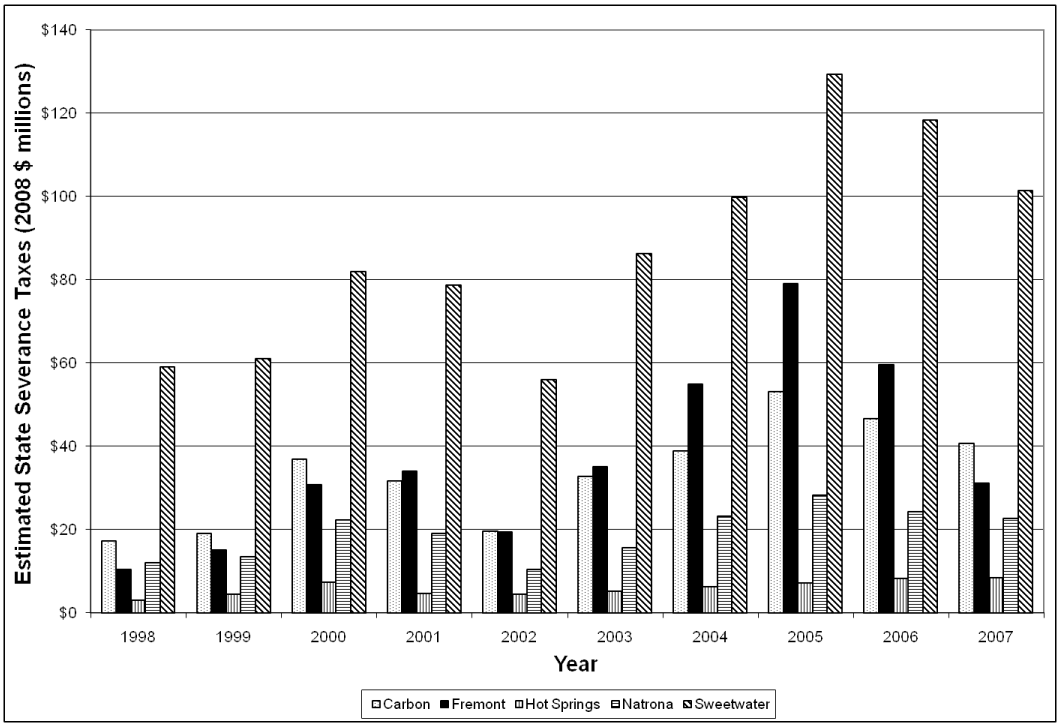
Mineral	Carbon	Fremont	Hot Springs	Natrona	Sweetwater
Crude Oil	4,985,500	7,716,500	5,653,800	13,042,300	20,989,500
Stripper Oil	272,400	624,100	2,019,200	706,800	33,600
Natural Gas	31,810,200	20,274,400	62,200	7,059,200	50,407,500
Surface Coal	266,800	0	700	0	6,708,600
Underground Coal	0	0	0	0	1,329,800
Trona	0	0	0	0	13,587,400
Bentonite	0	0	500	11,300	0
Sand and Gravel	31,200	18,700	1,000	60,600	45,400
Uranium	0	0	0	0	0
Decorative Stone	0	0	0	0	0
Total	**37,366,100**	**28,633,700**	**7,737,400**	**20,880,200**	**93,101,800**

Source: Calculated from data in Wyoming DOR 2008.

Note: Estimated using state severance tax rates of 6 percent of taxable valuation for crude oil and natural gas, 4 percent for stripper oil and trona, and uranium, 7 percent for surface coal, 3.75 percent for underground coal, and 2 percent for all other minerals shown. Rounded to the nearest $100.

As the table shows, state severance taxes based on production in the counties in the study area were greatest in Sweetwater County, which is consistent with the relative importance of mining for employment and earnings in that county. Natural gas was the largest contributor to state severance taxes for all counties except Hot Springs (crude oil).

Table 3.74, "Estimated State Severance Tax Collections (dollars) on Mineral Production in the Study Area Counties, Production Year 2007" (p. 517) also shows that gas, oil, coal, and trona accounted for most of the state severance tax collections in the study area counties in 2007. Figure 3.42, "Estimated State Severance Taxes, 1998-2007" (p. 517) shows historical trends in estimated state severance taxes based on production of these commodities in the counties in the study area (the data on assessed valuation shown in Figure 3.26, "Assessed Valuation of Oil Production by County in the Study Area, 1998-2007" (p. 490) and Figure 3.27, "Assessed Valuation of Gas Production by County in the Study Area, 1998-2007" (p. 490)). Severance taxes on natural gas, coal, trona, and other minerals are distributed according to a legislatively approved formula. Most of the revenues are transferred to the state general fund, the state budget reserve account, and the Permanent Wyoming Mineral Trust Fund. In recent years, less than 4 percent of the total has been distributed to cities, towns, and counties across the state.



Sources: Calculated using data in Wyoming DOR 1999; Wyoming DOR 2000; Wyoming DOR 2001a; Wyoming DOR 2002; Wyoming DOR 2003; Wyoming DOR 2004; Wyoming DOR 2005; Wyoming DOR 2006; Wyoming DOR 2007; Wyoming DOR 2008
Note: Adjusted for inflation using Wyoming Economic Analysis Division 2009e.

Figure 3.42. Estimated State Severance Taxes, 1998-2007

Local ad valorem production taxes are levied on sales of oil and gas. Ad valorem production tax rates vary by county and within counties. In 2007, average tax rates on mineral production were about 6.2 percent in Carbon County, 7.1 percent in Fremont County, 7 percent in Hot Springs County, 6.6 percent in Natrona County, and 6.6 percent in Sweetwater County (Wyoming DOR 2007). Based on these tax rates and the total taxable value of mineral production, it is possible to estimate ad valorem production tax assessments in the counties. According to the Wyoming Department of Revenue, total taxable value of mineral production for Production Year 2007 was $625 million in Carbon County, $483 million in Fremont County, $146 million in Hot Springs County, $356 million in Natrona County, and $1,664 million in Sweetwater County (Wyoming DOR 2008). Thus, applying the 2007 tax rates to 2007 mineral production, the Wyoming Department of Revenue calculated ad valorem mineral production tax assessments of $39 million in Carbon County, $34 million in Fremont County, $10 million in Hot Springs County, $23 million in Natrona County, and $110 million in Sweetwater County (Wyoming DOR 2008). The data in Table 3.74, "Estimated State Severance Tax Collections (dollars) on Mineral Production in the Study Area Counties, Production Year 2007" (p. 517) illustrates the relative importance of different minerals in the counties in contributing to these tax assessments. The table shows taxable valuation for the different minerals in the counties.

Local ad valorem property taxes are levied on the taxable valuation of oil and gas equipment. Rates are the same as those for ad valorem production, but the taxable valuation of oil and gas equipment is 11.5 percent of the assessed value (Grenvik 2005; Wyoming DOR 2001b).

Federal royalties on production of oil, gas, and surface coal are levied at 12.5 percent of the value of production, after allowable deductions. Federal royalties on underground coal are levied at 8 percent of the value of production; note that the only active production site for underground coal in the planning area is the Jim Bridger Mine in Sweetwater County. Half the royalties collected and the net of a 1 percent administrative processing fee are returned to Wyoming; a portion of the royalties the state receives are disbursed to cities and towns (State of Wyoming 2004). Federal mineral royalties are also collected on production of other minerals. The rate on trona production has been 6 percent since 1995, but in the fall of 2006 was reduced to 2 percent, which will be the effective rate for at least the next 5 years (Hardy 2006). According to the Wyoming Consensus Revenue Estimating Group, federal mineral royalties for production in the state were $927 million in Fiscal Year 2007 and $1,186 million in Fiscal Year 2008 (CREG 2009a). This includes royalties from oil, gas, and gas plant products, and coal, including coal lease bonuses. The Wyoming Consensus Revenue Estimating Group projects lower royalty revenue for the next several fiscal years due to lower gas prices and other factors (CREG 2009a).

The state sales tax applies to retail purchases of goods and some services in Wyoming, while the use tax applies to a retail purchase of goods outside Wyoming by firms in Wyoming (Wyoming DOR 2006). For example, for the oil and gas industry, a firm with operations in Wyoming that purchases equipment from outside the state for use in state would remit use taxes to the State of Wyoming for the purchase.

Property Tax and Sales Tax Base (Tax Revenues)

The fiscal stability of local and state governments, and the economic viability of communities themselves, depends on the viability and stability of local industry and commerce. Table 3.75, "Local and State Assessed Property Valuation, 2007" (p. 519) lists local and state assessed property valuation in 2007 for the planning area counties and Wyoming.

Table 3.75. Local and State Assessed Property Valuation, 2007

County	Total ($ millions)	Agricultural (Percent)	Residential (Percent)	Commercial Percent)	Mineral (Percent)	Industrial (Percent)
Local Assessed Valuation						
Carbon County	201	4	39	9	45	2
Fremont County	345	3	59	14	22	2
Hot Springs County	41	7	61	17	14	1
Natrona County	662	1	66	24	7	2
Sweetwater County	562	1	36	12	46	5
State of Wyoming	7,135	3	60	14	21	2
State Assessed Valuation						
Carbon County	695	0	0	0	90	10
Fremont County	504	0	0	0	96	4
Hot Springs County	154	0	0	0	95	5
Natrona County	397	0	0	0	90	10
Sweetwater County	1,831	0	0	0	91	9

County	Total ($ millions)	Agricultural (Percent)	Residential (Percent)	Commercial Percent)	Mineral (Percent)	Industrial (Percent)
State of Wyoming	14,763	0	0	0	94	6
Total (State and Local) Assessed Valuation						
Carbon County	896	1	9	2	80	8
Fremont County	848	1	24	6	66	3
Hot Springs County	848	1	24	6	66	3
Natrona County	1,059	1	41	15	38	5
Sweetwater County	2,394	0	9	3	80	8
State of Wyoming	21,898	1	20	5	70	5
Source: Wyoming DOR 2008						

Consistent with other data in this section, the property tax base in the planning area counties is relatively well diversified (compared to the state average). Mining contributes a relatively large share to the local property tax base in all counties, while agricultural uses contribute less to local property valuation. In all the counties, residential and commercial property provide important contributions to local assessed valuation. Mining contributes the largest amount to state assessed valuation in all the counties.

Table 3.76, "State and Local Sales Tax Collections by Sector, 2008 (percent)" (p. 520) lists local and state sales tax revenues by sector for each of the counties. Along with the data on property tax valuations, the table on sales tax collections by sector provide insight into the economic base of the counties. Retail trade contributes the largest share of sales tax revenues in all the counties. Several other sectors, such as wholesale trade, utilities, mining, leisure and hospitality, and public administration, also contributed substantial shares.

Table 3.76. State and Local Sales Tax Collections by Sector, 2008 (percent)

Sector	Carbon County	Fremont County	Hot Springs County	Natrona County	Sweetwater County	State of Wyoming
Agriculture, Forestry, Fishing, and Hunting	0.1	0.04	0.01	0.001	0.02	0.04
Mining	29	15	20	7	26	17
Utilities	3	2	9	3	3	4
Construction	3	2	2	3	2	3
Manufacturing	2	2	1	4	5	4
Wholesale Trade	9	8	8	15	12	12
Retail Trade	26	41	27	39	29	33
Transportation and Warehousing	0.1	0.1	0.03	0.1	0.3	0.2
Information	2	3	3	1	2	2
Financial Activities	6	3	2	4	5	4
Professional and Business Services	0.4	1.0	0.3	1	1	1

Sector	Carbon County	Fremont County	Hot Springs County	Natrona County	Sweetwater County	State of Wyoming
Educational and Health Services	0.01	0.1	0.02	0.04	0.1	0.1
Leisure and Hospitality	10	8	13	8	6	10
Other Services	3	4	3	4	4	4
Public Administration	7	11	11	11	5	7
Total ($ millions)	**28.2**	**37.1**	**4.8**	**103.1**	**106.5**	**849**
Source: Wyoming Economic Analysis Division 2008						

Separate data on sales tax revenues from retail trade, accommodation, and food sales (Table 3.77, "Retail, Accommodation, and Food Sales: State and Local Sales Tax Collections, 2008 (percent)" (p. 521)) provide some additional insight into the contribution from elements that might be related to travel and tourism specifically (e.g., eating and drinking establishments and lodging). A sizable portion of tax collections from eating and drinking establishments also accrue from local residents, and a portion of gasoline station tax collections would also accrue from tourists and business travelers. These data suggest that travel and tourism provide an important contribution to sales tax collections in the study area counties. This is particularly true for Hot Springs County, where eating and drinking establishments and lodging contribute 31 percent of the sales tax collections attributable to retail, accommodation, and food sales (about $0.6 million annually), and Carbon County, where these subsectors account for 27 percent of the sales tax collections attributable to retail, accommodation, and food sales (about $2.7 million annually).

Table 3.77. Retail, Accommodation, and Food Sales: State and Local Sales Tax Collections, 2008 (percent)

Sector	Carbon County	Fremont County	Hot Springs County	Natrona County	Sweetwater County	State of Wyoming
Auto Dealers and Parts	6	7	3	8	9	8
Building Material and Garden Supplies	20	20	30	14	15	15
Clothing and Shoe Stores	1	1	1	4	3	3
Department Stores	4	4	0	6	3	4
Eating and Drinking Places	13	12	17	13	12	14
Electronic and Appliance Stores	2	3	3	6	2	5
Gasoline Stations	13	8	6	4	12	8
General Merchandise Stores	7	22	6	20	12	14
Grocery and Food Stores	5	4	5	2	4	3

Sector	Carbon County	Fremont County	Hot Springs County	Natrona County	Sweetwater County	State of Wyoming
Home Furniture and Furnishings	1	1	1	3	3	3
Liquor Stores	1	2	1	2	1	2
Lodging Services	14	3	14	3	6	8
Miscellaneous Retail	14	13	14	15	17	15
Total ($ millions)	**10**	**18**	**2**	**48**	**38**	**359**
Source: Wyoming Economic Analysis Division 2008						

Travel, Tourism, and Recreation

BLM management actions also affect travel and tourism, both directly (through decisions that affect access to recreation) and indirectly (through decisions that affect wildlife populations). The State Office of Travel and Tourism estimates that in 2007, travel and tourism accounted for $107 million in tax revenues, including $65 million (rounded figure) in state revenues and $43 million (rounded figure) in local revenues (2007 dollars), not including property tax collections related to recreation infrastructure (Dean Runyan Associates 2008). Most trips (an estimated 98 percent) are due to tourism for pleasure (WTT 2007). Table 3.78, "Local and State Tax Receipts Due to Travel and Tourism in Study Area Counties and Wyoming in 2007 ($ million)" (p. 522) lists tax receipts for the counties in the study area. This study does not include spending by local residents on recreation.

Table 3.78. Local and State Tax Receipts Due to Travel and Tourism in Study Area Counties and Wyoming in 2007 ($ million)

County	Local Tax Receipts	State Tax Receipts	Total Tax Receipts
Fremont	$1.0	$3.0	$4.0
Carbon	$2.4	$4.4	$6.8
Hot Springs	$0.4	$0.7	$1.1
Natrona	$3.6	$6.4	$10.0
Sweetwater	$3.0	$4.7	$7.7
Wyoming	$43.2	$64.6	$107.8
Source: Dean Runyan Associates 2008			

Table 3.79, "Local and State Tax Receipts Due to Travel and Tourism, 2001-2007 ($ million)" (p. 522) lists trends in local and state tax receipts for counties in the planning area from 2001 through 2007. Note that the data in the table are in current dollars; that is, they are not adjusted for inflation. The table shows that local and state tax receipts rose slowly but steadily between 2001 and 2007 for all five counties in the planning area and in the state. Among the five counties, tax receipts are consistently highest in Natrona County.

Table 3.79. Local and State Tax Receipts Due to Travel and Tourism, 2001-2007 ($ million)

County	2001	2002	2003	2004	2005	2006	2007
Local Tax Receipts							
Fremont	0.6	0.7	0.7	0.7	0.8	0.9	1.0
Carbon	1.5	1.5	1.5	1.6	1.9	2.3	2.7
Hot Springs	0.3	0.3	0.3	0.3	0.4	0.4	0.4
Natrona	2.1	2.2	2.3	2.5	2.8	3.1	3.6
Sweetwater	1.5	1.8	1.9	2.1	2.4	2.8	3.0
Wyoming	28	30	31	32	36	40	43

County	2001	2002	2003	2004	2005	2006	2007
State Tax Receipts							
Fremont	2.3	2.3	2.4	2.5	2.6	2.8	3.0
Carbon	3.0	3.0	3.0	3.1	3.4	3.9	4.2
Hot Springs	0.5	0.5	0.5	0.5	0.6	0.7	0.7
Natrona	4.7	4.7	4.9	5.1	5.5	6.0	6.4
Sweetwater	3.4	3.3	3.5	3.7	4.1	4.5	4.7
Wyoming	50	50	51	52	56	61	65

Sources: Dean Runyan Associates 2007; Dean Runyan Associates 2008

Note: Data are in current dollars (not adjusted for inflation).

Livestock Grazing and Ranching

Livestock grazing and ranching, and agriculture more generally, contribute directly to local and state tax revenues from local ad valorem property taxes and local and state sales and use taxes. According to a 2003 report on state and local tax revenues, agriculture, along with forestry, fishing, and hunting, brought in $9.2 million in state and local tax revenues due to ad valorem property taxes, and $1.4 million due to sales and use taxes, for a total of more than $10.6 million (WLSO 2003).

Economic Considerations on the Wind River Indian Reservation

Due to the size of the WRIR and its location within the Lander Field Office, it is important to note the economic contributions of the reservation. The Northern Arapaho, who constitute about 54 percent of the Native American population on the WRIR (U.S. Census Bureau 2000a), operate three casinos on the reservation (Wind River Casino, Little Wind Casino, and 789 Smoke Shop & Casino). The Eastern Shoshone, who constitute about 30 percent of the Native American population on the reservation, operate one casino (Shoshone Rose Casino). These are the only casinos in the State of Wyoming. The casinos provide job opportunities for Native Americans and other people, both directly and indirectly (through a multiplier effect). Although the casinos in Wyoming do not pay state taxes on their proceeds (NCSL 2004), they do provide revenue to the state via other sources, such as sales taxes and hotel occupancy taxes. A 2008 report commissioned by the Northern Arapaho tribe found that the three Northern Arapaho casinos generated $90 million in economic activity, including multiplier effects, $800,000 in county sales tax revenue, and $1.6 million in state sales tax revenue (NativeBiz 2009, Over 2009).

In addition to the casino business, several other initiatives generate economic activity. For example, the Northern Arapaho Tourism Information Council, a recently established nonprofit organization, plans to develop several recreational and cultural attractions for visitors to the WRIR. The Northern Arapaho Tourism Information Council has no projects currently under construction, but ideas for future projects include a visitor center, a site commemorating the Sand Creek Massacre Trail, and concessions from which native guides could take visitors to the best spots for hunting and fishing on the WRIR. These projects would require additional funding and approvals from several different agencies on the WRIR. Thus, the schedule for implementation is not known at this time (Barela 2009, Northern Arapaho Public Relations Department 2009).

3.8.3. Health and Safety

The BLM addresses a variety of potential hazards on public surface lands to reduce risks to visitors and employees. Hazards include hazardous materials; mine shafts and adits; abandoned

equipment and structures; explosives and munitions; natural geologic hazards; and spills from pipelines, tankers, and storage tanks.

Abandoned Mine Lands

Extreme physical hazards are common at abandoned mine sites, and for visitors, these hazards are not always apparent. Abandoned mine sites have proven to be a luring and sometimes life-threatening attraction for both children and adults. Serious injury or death could occur at these sites. Common hazards include open vertical shafts; unstable overhead rock and decayed support structures; deadly gases and lack of oxygen; remnant explosives and toxic chemicals; high walls, open pits, and open drill holes; and becoming lost and disoriented while underground. Subsidence at abandoned coal mines and coal fires pose additional hazards.

Abandoned mines are a common feature on BLM-administered lands. The BLM has identified 934 known AML sites throughout the State of Wyoming (BLM 2009j). Remediation projects have begun at several of these sites, including projects within the planning area such as the Gas Hills Haul Road, for which the BLM completed remediation in 2004; the South Pass mining area, for which the BLM has partially completed remediation; and the Copper Mountain mines, for which remediation is pending (BLM 2009k). Several additional AML sites on BLM-administered lands in the Copper Mountain and South Pass areas were reclaimed in 2009 and 2010, such as the Carrie Shields Mine near South Pass City. Many additional sites in the planning area, especially in the South Pass area, await reclamation. Also, the Gas Hills and Crooks Gap areas have had many AML reclamation projects for old uranium mines.

The Wyoming State Office of the BLM has a prioritized list of AML sites that pose the greatest risk to people and the environment. AML sites affecting water quality are addressed using the watershed approach. Using this approach accomplishes the following objectives:

- Allows for mitigation to be risk-based by identifying priority sites first
- Fosters collaborative efforts across federal, state, and private administrative boundaries
- Considers all issues important to water resource protection
- Reduces the cost of mitigation
- Provides the most efficient method of remediating AML sites by utilizing a wide range of available resources

The most substantial type of mine hazard features in the planning area are open shafts, adits, and high-walls remaining at AML sites in the South Pass mining district (recreation concerns), and at the Copper Mountain mining district (high use area). The South Pass mining district and the Copper Mountain mining district have been prioritized as hazardous areas due to the severity of hazards (falling, entrapment), proximity to population centers, and likelihood of access (recreation) (BLM 2009b). Final reclamation of these sites has not been accomplished; therefore, the BLM created a temporary fencing program to immediately address safety concerns. The BLM completed fencing at over 10 sites in late fall 2008. Further work is planned to address other fencing needs and to bring additional hazardous and abandoned sites to closure through a final reclamation solution.

In 2004 and 2005, the BLM and the Wyoming DEQ, AML Division signed cooperative agreements that further facilitated the reclamation of AML sites on BLM-administered lands.

The state program, as required by the Surface Mining Control and Reclamation Act of 1977, focuses on public safety hazards. In addition, the BLM has received some funding within its Soil, Water, and Air Program to address environmental hazards and watershed concerns associated with abandoned mines on a site-specific basis. Starting in Fiscal Year 2011, reclamation of safety hazards will be under a separate BLM AML subactivity; the Soil, Water and Air subactivity will continue to address hazards affecting water quality. By combining available funding, safety hazards and environmental impacts to water quality and watershed function can continue to be addressed in a more comprehensive way at priority AML sites.

The Wyoming DEQ, AML Division works closely with federal land management agencies, private land owners, and the general public to ensure that the views of all interested parties are considered in the reclamation process. According to an August 2007 fact sheet, the projected budget for the Wyoming DEQ, AML Division is $69 to $149 million annually for Calendar Years 2009 through 2015 (Wyoming DEQ No Date-a). These funds will be used to identify and reclaim AMLs and to construct public works projects in communities adversely affected by mining activities. According to the Wyoming DEQ AML Division Coordinator, the state AML program will focus on abandoned coal mines in the foreseeable future (Wyoming DEQ 2008b). However, the BLM will continue to identify and remediate abandoned mine hazards in concert with the Wyoming DEQ, AML Division and on its own.

Other Hazards

Other hazards identified in the planning area include unexploded ordinance and other hazards associated with formerly used defense sites, and hazardous materials and wastes. Hazardous materials are used and/or stored in connection with a variety of permitted activities on BLM-administered land, including oil and gas drilling and mining. Air, soil, surface water, and groundwater contamination can be found at sites associated with hazardous material use and storage.

Earthquakes, landslides, and rockslides are natural geological hazards that pose a potential threat to public health and safety in the planning area. There has been seismic and volcanic activity in the Greater Yellowstone area throughout the past several million years; hazards include earthquakes, as well as ash falls from volcanic eruptions. While most of the planning area is in a moderate earthquake zone, the likelihood of seismic activity increases with proximity to the Teton Range. There are fault lines in the planning area, particularly in the southeastern corner and along the Wind River fault. Rockslides and landslides also pose a potential threat in the planning area. Rock type and percent slope are factors that contribute to the potential for rockslides.

Management Challenges for Health and Safety

Successful reclamation of AML sites is a management challenge in the planning area. AML sites can be difficult to reclaim and remediation must be considered before starting new mining activity or other development. In addition, the repurposing of AML sites in the planning area poses a challenge due to the contaminated nature of many of the sites. Reclaimed lands are sometimes suitable for repurposing for other uses, such as for siting communications towers, transmission lines or renewable energy development. However, many of the AML sites in the planning area are radioactive or otherwise contaminated and are not suitable for other uses. Assessment for repurposing must be performed on a site-specific basis.

3.8.4. Environmental Justice

Environmental justice pertains to the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, regarding the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the adverse environmental or human health consequences or be denied benefits from federal, state, local, and tribal programs and policies (Executive Order 12898 – Federal Actions to Address Environmental Justice In Minority Populations and Low-Income Populations).

The BLM incorporates both the "fair treatment" and "meaningful involvement" aspects of environmental justice into its planning process. To address the "meaningful involvement" aspects of environmental justice, the BLM provides low-income, minority, and Native American populations the opportunity to be involved in the planning process through public involvement, scoping, consultation and coordination, and comment periods during the development of this RMP revision. Refer to the *Consultation and Coordination* section of Chapter 5 in the RMP for additional information.

To address "fair treatment" aspects of environmental justice, the environmental analysis in the EIS includes an analysis of all human health and environmental impacts (including impacts on the physical or natural environment) that could affect low-income populations, populations of racial and ethnic minorities, and Native American tribes. This analysis identifies any disproportionately high and adverse human health or environmental impacts on these populations. The analysis in the EIS also addresses whether low-income and minority populations have equal access to the benefits provided by the alternatives. To determine what environmental impacts are "disproportionately high and adverse," BLM considers three factors (Council on Environmental Quality 1997), as follows:

a. whether there is or will be an impact on the natural or physical environment that significantly and adversely affects a minority population, low-income population, or Native American tribe. Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities, low-income communities, or Native American tribes when those impacts are interrelated to impacts on the natural or physical environment;

b. whether environmental effects are significant (as employed by NEPA) and are or may be having an adverse impact on minority populations, low-income populations, or Native American tribes that appreciably exceeds or is likely to appreciably exceed those on the general population or other appropriate comparison group; and

c. whether the environmental effects occur or would occur in a minority population, low-income population, or Native American tribe affected by cumulative or multiple adverse exposures from environmental hazards (Council on Environmental Quality 1997).

In considering environmental justice, it is important to recognize that both local residents and transitory low-income and minority populations can be users of public lands. The BLM does not have data to identify whether non-area users of the public lands are low-income or minority populations. Because of the lack of good data concerning low-income and minority populations from residents outside the planning area, this section focuses on residential demographics.

Minority and Low-Income Populations

Instructional Memorandum 2002-164 defines minority persons as "Black/African American, Hispanic, Asian and Pacific Islander, American Indian, Eskimo, Aleut, and other nonwhite persons." Furthermore, Instructional Memorandum 2002-164 indicates that an area should be considered to contain a minority population where either the minority population of the affected area exceeds 50 percent, or the percentage of minority population in the affected area is meaningfully greater than the percentage in the general population.

Table 3.80, "Minority Populations in 2000 and 2008; Low-Income Populations in 2000 and 2007" (p. 528) lists the percent of minority and low-income populations in the counties in the planning area compared to the United States and Wyoming. Most of the population in the planning area resides in Fremont County. Note that the economic data for the WRIR influence the data for Fremont County as a whole. Unemployment is higher on the reservation, as is the percentage of people in poverty (Table 3.80, "Minority Populations in 2000 and 2008; Low-Income Populations in 2000 and 2007" (p. 528)).

The Council on Environmental Quality (CEQ) guidance for environmental justice analysis under NEPA notes that agencies may consider as a community "either a group of individuals living in geographic proximity to one another, or a set of individuals (such as migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure or effect" (Council on Environmental Quality 1997). The CEQ guidance also indicates that low-income populations should be identified with the statistical poverty thresholds from the Census Bureau. These thresholds are defined differently for different household sizes and numbers of dependents. For example, the threshold for a two-parent family with no children is different from the threshold for a single parent with five children. Thus, the Census Bureau poverty thresholds comprise a 48-cell matrix that varies by family size and composition. Because the Census Bureau collects data on income and family composition for individual households, the agency can compare family-level income data to the applicable threshold. In 2007, the Census poverty threshold for a family of two adults and two children was $21,027 (U.S. Census Bureau 2007).

Although the CEQ guidance does not provide a quantitative threshold (such as a limit on the percent of persons in poverty) for determining whether a population should be considered low-income, typically, the percent of persons in poverty in the study area is compared to that in a larger geographic comparison area, such as the state or the overall planning area. Neither the CEQ, EPA, or BLM guidance specifies quantitative criteria for what constitutes a low-income population.

Table 3.80. Minority Populations in 2000 and 2008; Low-Income Populations in 2000 and 2007

County	Percent Minority Population in 2000	Percent Minority Population in 2008	Percent in Poverty in 2000	Percent in Poverty in 2007
Carbon	17	19	13	10
Fremont	25	27	18	13
Hot Springs	5	7	11	11
Natrona	8	10	12	10
Sweetwater	13	17	8	7
Wind River Indian Reservation[1]	34	33[2]	21	N/A[3]
Wyoming	11	13	11	10
United States	31	34	12	13

Sources: U.S. Census Bureau 2000a; U.S. Census Bureau 2008a; U.S. Census Bureau 2008c; U.S. Census Bureau 2009a; U.S. Census Bureau 2009b; U.S. Census Bureau 2009c

[1]The Census Bureau defines the Wind River Indian Reservation (WRIR) as including the towns of Riverton, Shoshoni, Pavillion, and Hudson.
[2]Data for 2008 for the WRIR are not available; the data shown are for a three-year sample covering 2005 through 2007.
[3]The most recent poverty data available for the WRIR are for 2000.

Table 3.81, "Racial and Ethnic Groups for Planning Area Counties, WRIR, and Wyoming (percent)" (p. 529) summarizes the study area population by race and ethnicity for major racial and ethnic groups. In Carbon, Hot Springs, Sweetwater, and Natrona Counties, the largest ethnic or racial group other than non-Hispanic whites is Hispanic or Latino (of any race). In Fremont County, and for the WRIR, Native Americans constitute the largest ethnic or racial group other than non-Hispanic whites. The percent of racial "minorities" (people other than non-Hispanic whites) is greater than that for the state in Carbon, Fremont, and Natrona Counties. Note that Hispanic/Latino denotes an ethnicity, and people of this ethnic background can be of any race.

Table 3.81. Racial and Ethnic Groups for Planning Area Counties, WRIR, and Wyoming (percent)

Race or Ethnicity	Carbon County	Fremont County	Hot Springs County	Sweetwater County	Natrona County	WRIR	State of Wyoming
Non-Hispanic, White	81	73	93	90	83	67	87
Non-Hispanic, Black	1	1	1	1	1	0	1
Non-Hispanic, American Indian/ Alaska Native	1	19	2	1	1	25	2
Non-Hispanic, Asian, Native Hawaiian, or Other Pacific Islander	1	1	0	1	1	1	1
Non-Hispanic, some other race, or two or more races	1	2	1	1	2	2	1
Hispanic or Latino (of any race)	15	6	3	6	12	6	8

Sources: U.S. Census Bureau 2009a (counties); U.S. Census Bureau 2009b (state); U.S. Census Bureau 2008a (WRIR)

Note: County data are for 2008. WRIR data are from a rolling survey collected in from 2005 to 2007.

WRIR Wind River Indian Reservation

The WRIR is downstream of public lands in the northwestern and southern Wind River drainages and could be affected by BLM management decisions that affect water quality or quantity. A wide range of activities have the potential to impact the WRIR, such as activities affecting air quality or activities that could impact the WRIR gaming industry, incipient tourism industry (see the *Economic Conditions* section), or livestock grazing operations.

Table 3.82, "Population, Racial and Ethnic Groups, and Poverty for Tribal Census Tracts of the WRIR, Year 2000" (p. 530) provides data on minority and low-income populations in Tribal Census Tracts of the WRIR, and Map 133 shows the locations of the Tribal Census Tracts. The percentage of Native American residents is greatest in Tribal Census Tract 9401, which constitutes the western half of the WRIR, and second greatest in Tribal Census Tract 9402, which constitutes most of the eastern portion. In Tracts 9403, 9404, and 9405, which comprise Riverton and its immediate surroundings, the percent of Native American people is much lower. Poverty is also greatest in Tracts 9401 and 9402.

Note that the table shows the most recent data tabulated for the tracts of the WRIR, but these data are from 2000 and do not correspond exactly to the data provided above for the WRIR from

2005 though 2007. Also, note that the table does not provide data for Tribal Census Tract 9876 because, according to the U.S. Census Bureau, only one person lives in that tract.

Table 3.82. Population, Racial and Ethnic Groups, and Poverty for Tribal Census Tracts of the WRIR, Year 2000

Data Item	WRIR	Tribal Census Tract 9401	Tribal Census Tract 9402	Tribal Census Tract 9403	Tribal Census Tract 9404	Tribal Census Tract 9405
Total Population	23,245	3,483	7,548	5,103	4,751	2,364
Non-Hispanic, White (percent)	66	15	59	79	88	86
Non-Hispanic, Black (percent)	0	0	0	0	0	0
Non-Hispanic, American Indian/Alaska Native (percent)	27	81	35	10	4	5
Non-Hispanic, Asian, Native Hawaiian, or Other Pacific Islander (percent)	0	0	0	0	0	0
Non-Hispanic, some other race, or two or more races (percent)	2	1	2	2	2	2
Hispanic or Latino (of any race) (percent)	5	3	3	8	5	7
Percent of Population in Poverty (percent)	21	34	23	19	10	21

Source: U.S. Census Bureau 2000a
Note: Data for Tribal Census Tract 9876 are not shown because, according to the U.S. Census Bureau, only one person resides in this area.

WRIR Wind River Indian Reservation

3.8.5. Tribal Treaty Rights

The WRIR is located within the Lander Field Office planning area. The WRIR is Wyoming's only Native American Indian Reservation. The WRIR is home to the Eastern Shoshone and Northern Arapaho and was established by the 1868 Treaty of Fort Bridger, as amended.

Judicially established lands are defined based on information provided by the Indian Claims Commission and approximating tribal lands that are determined by the ethnographic and historic literature. The National Park Service (NPS 1993) indicates that the judicially established Crow lands are within the planning area. The Shoshone have judicially established Indian Lands adjacent to the Lander Field Office. Other tribes have judicially established land nearby, but outside the planning area boundaries.

There are no trust lands or tribal properties outside the WRIR in the planning area. Tribal roles and responsibilities are not well defined in the existing plan, although BLM land use plans must address the protection of any treaty rights. The BLM works closely with the WRIR regarding planning issues. Because of the fiduciary responsibilities the BLM holds for tribal mineral rights, the agency is particularly cognizant of tribal and treaty obligations.

In compliance with the AIRFA of 1978, the NHPA of 1966, the Archaeological Resources Protection Act of 1979, the NAGPRA of 1990, and other Executive and Secretarial Orders (BLM Manual 8120), the BLM consulted with Native American tribes during the RMP revision process. The intent of tribal consultation is to help the BLM identify and design management for significant religious or cultural properties (TCPs); to understand tribal concerns; to identify public land places, resources, uses, and values important to the tribes and/or tribal members; and to identify land management decisions and procedures that conflict with Native Americans' religious observations. Tribal consultation during the RMP revision process is in accordance with BLM guidance, and the BLM has considered information resulting from tribal consultations in the impacts analysis. The *Consultation and Coordination* section of Chapter 5 identifies the tribes involved in consultation efforts for this RMP revision. It is BLM policy to keep in trust confidential information received through tribal consultations.

Treaty Rights and Trust Responsibilities Policy

A treaty is a formal agreement between the United States government and a Native American tribe or tribes that cedes land or reserves rights to the tribe(s). Executive Order 13084, Consultation with Indian Tribal Governments, and Executive Order 13007, Indian Sacred Sites, provide the framework for involving Native American tribes in the BLM planning process. BLM Manual 8120, Tribal Consultation provides additional guidance.

3.9. Climate Change

A growing body of evidence indicates that the Earth's atmosphere is warming. Records show that surface temperatures in the Wyoming region have risen approximately 1.5°F since the 1960 to 1979 baseline years (GCRP 2009a). The largest increase in average temperature has occurred in the winter months in the northern portions of the region. Relatively cold days in the region are becoming less frequent and relatively hot days are becoming more frequent (GCRP 2009a). Globally, observed changes in oceans, ecosystems, and ice cover are consistent with this warming trend (National Academy of Sciences 2006). Ongoing scientific research has identified the potential impacts of GHG emissions, including CO_2, methane (CH_4), nitrous oxide (N_2O), water vapor, and several trace gases on global climate change. Through complex interactions at regional and global scales, these GHG emissions cause a net warming of the climate by increasing the amount of heat energy absorbed by the atmosphere. Although GHG concentrations in the atmosphere and climatic conditions have varied throughout the Earth's history, recent industrialization and burning of fossil fuels has caused global atmospheric CO_2 concentration to increase; this most recent CO_2 increase is likely to contribute to overall climatic changes (National Academy of Sciences 2006).

Global atmospheric concentrations of CO_2, CH_4, and N_2O have increased as a result of human activities since 1750 and now exceed pre-industrial values (as determined from ice cores spanning many thousands of years). The global increase in CO_2 concentrations is due to fossil fuel use and land use change, while those of CH_4 and N_2O are due to agricultural soil management, animal

manure management, sewage treatment and mobile and stationary combustion of fossil fuels (IPCC 2007a, EPA 2009b).

According to climate change research, the impacts of climate change are expected to vary by region, season and time of day (National Academy of Sciences 2006, GCRP 2009a). Computer model forecasts indicate that increases in temperature will not be evenly or equally distributed, but are likely to be accentuated at higher latitudes. Warming during the winter months is expected to be greater than during the summer, and increases in daily minimum temperatures are more likely than increases in daily maximum temperatures (National Academy of Sciences 2006). Within a given region, increasing temperatures may also affect the amount of soil moisture and atmospheric water vapor, the timing and amount of precipitation and snow melt, and the intensity of storm systems. All of these factors may affect the climate, day-to-day weather conditions, water quality and quantity, soil conditions, vegetation, fire intensity and frequency, air quality, and other resources in the planning area.

All of North America is likely to experience an increase in average temperature during the next 100 years, and the annual mean warming in most areas is likely to exceed the global mean warming (IPCC 2007a). Temperatures in the planning area are projected to increase by the end of the current century (GCRP 2009a). Summer temperatures in the planning area are expected to increase between approximately 3°F and 10°F by 2080-2099 (GCRP 2009a, GCRP 2009b). Overall, the temperature in the region that includes the planning area is projected to increase between 2.5°F to more than 13°F compared with the 1960 to 1979 baseline, depending on future GHG emissions (GCRP 2009a). This range of temperature increases reflects the current uncertainty in climate change modeling and represents the likely range of model projections, though lower or higher outcomes are possible.

The lack of scientific tools (models with sufficient spatial and temporal resolution) to forecast climate change at even regional scales limits the ability to quantify current and future impacts of climate change in the planning area. Potential future impacts of climate change that can be reasonably anticipated for the planning area are described below; however, some of these impacts may already be occurring in the area.

Increasing temperatures in the planning area are likely to contribute to increased evaporation, drought frequency, and declining water quantity and quality, which will add additional stress to water resources in the region. The planning area is also dependent on temperature sensitive springtime snowpack to meet demand for water from municipal, industrial, agricultural, and recreational uses as well as BLM-authorized activities. Higher temperatures are causing more winter precipitation to fall as rain rather than snow, which is reducing snowpack and contributing to earlier snowmelt. Continuing declines in snowmelt associated with climate change are projected, which would reduce the amount of water available during summer months (GCRP 2009b). As glaciers in the Wind River Mountains continue to recede, annual spring runoff will occur sooner and could have smaller discharges. Lower levels of water would likely result in degradation of water quality including temperature increases, loss of high flows need to mix and flush pollutants, increased sedimentation, and degradation or loss of habitats.

Shifting precipitation patterns are projected across the Rocky Mountain region as a result of climate change (NPS 2010). It is estimated that in the region, precipitation could increase 2 to 5 percent in winter, and decrease 0 to 4 percent in summer (NPS 2010). While increases in winter precipitation could result in heavier snowpack in the mountains, reductions in summer precipitation and warmer temperatures that result in early spring snowmelt would couple to reduce

the water availability during the dry summer season. These predicted changes in precipitation can affect the distribution of flora and fauna across the landscape and combine with other stressors to increase the risk of wildfire and insect outbreaks.

Increases in average summer temperatures and earlier spring snowmelt in the planning area are also expected to increase the risk of wildfire occurrence by increasing summer moisture deficits (GCRP 2009a). Drought and the resulting stress on vegetation is likely to increase the frequency and intensity of mountain pine beetle and other insect infestations. Increases in insect infestations and tree mortality can also result from fluctuations in climatic patterns, such as warmer and drier summer conditions and warmer winters. Forest communities are resilient when responding to normal variations in weather to which they are adapted; however, climate change may alter precipitation patterns and extreme weather events too rapidly for forests and other vegetation to adapt. The synergistic impacts of drought, insect infestations, fluctuations in precipitation and climate, fire frequency and occurrence, and other factors would likely require specialized management in forests and other vegetated areas, especially where stands are currently overstocked.

Climate change is likely to combine with other human induced stress to further increase the vulnerability of ecosystems to pests, invasive species, and loss of native species. Breeding patterns, water and food supply, and habitat availability would all likely be affected by climate change to some degree. Sensitive species in the planning area such as the greater sage-grouse, which are already stressed by factors such as declining habitat and increased development, could experience additional pressures as a result of climate change. If glacial retreat or early snowpack melt continues, perennial waterbodies may become intermittent and unable to support fish populations. Increasing temperatures and shifting precipitation patterns may also increase the prevalence of plants with C4 photosynthetic pathways, such as cheatgrass and other invasive plant species, in higher elevations, which typically prefer warmer temperatures (Skillman et al. 2010).

A variety of activities in the planning area generate GHGs. Direct GHG emissions result from the combustion of fuels and industrial processes, as well as from any number of other activities that occur on public lands. Direct emissions occurring in the planning area include those related to oil and gas and other minerals development, fire events, motorized vehicle use (e.g., OHVs), livestock grazing, facilities development, and fugitive emissions. Indirect GHG emissions and other contributions to climate change in the planning area include the use of electricity generated outside the area, heat and steam, land use changes (conversion of land to less reflective surfaces that absorb heat, such as concrete or pavement), and soil erosion (which can reduce snow's solar reflectivity and contribute to faster snow melt).

BLM-administered land and public lands in general also play an important role in combating further climate change. Vegetation and soil provide carbon sequestration, which is the storage and removal of CO_2 or other forms of carbon from the atmosphere. Management strategies to improve vegetative and soil health provide opportunities for increased carbon sequestration. For example, the need to maintain and improve vegetative condition required by the Wyoming Standards for Healthy Rangelands (Appendix J (p. 1437)) can result in increased carbon sequestration. Prescribed fire can also be a tool to counter the impacts resulting from climate change. Fire is a trigger mechanism for seral stage regeneration and post-burn revegetation can restart carbon sequestration.

Adaptive management is a useful management approach to appropriately anticipate and respond to the uncertainty of impacts resulting from climate change. Adaptive management is useful for

complex processes and where potential impacts are large and could affect multiple resources. Adaptive management strategies are iterative processes where monitoring and assessment refine management. This document is based on current scientific knowledge and understanding, which in the case of climate change, is still emerging. Adaptive management provides for new information to be evaluated and incorporated into project level management decisions, BMPs, mitigation and the decision-making process. Adapting management to reflect emerging science, projections, and impacts of climate change allows the BLM to adjust management to best meet the challenges of climate change. Additional information on adaptive management can be found in Chapter 2 of this document.

Additional and up to date information on climate change projections, impacts, and other related issues can be found through the U.S. Global Change Research Program (http://www.globalchange.gov/) and the Intergovernmental Panel on Climate Change (http://www.ipcc.ch/).