3.0 AFFECTED ENVIRONMENT

The Pinedale Resource Management Plan Planning Area (RMPPA) is comprised of approximately 928,000 acres of BLM administered public land surface and 1,144,000 acres of federal mineral estate in portions of Sublette and Lincoln Counties in southwestern Wyoming. The towns of Pinedale, Boulder, Cora, and Daniel are located in the northern portion of the RMPPA, Big Piney and Marbleton in the central area, and La Barge in the southern portion. The RMPPA is located about 100 miles south of Yellowstone National Park. Teton and Bridger National Forests bound the RMPPA on the north and west, and Bridger National Forest and Bridger Wilderness Area bound the area on the east. The Gros Ventre Range is north of the RMPPA, the Wind River Mountains are on the east, and the Wyoming and Hoback Ranges are on the west. The area varies in elevation from about 6,500 feet in the southwestern corner up to 9,500 feet along some of the mountain fronts. Mesas and buttes form the most common topographic expressions across most of the RMPPA.

Most of the RMPPA lies within the Upper Green River and New Fork River watersheds. An estimated 300 miles of stream and riverine habitat and 2,500 acres of lake and reservoir habitat support diverse wildlife populations. The dominant semiarid steppe climate creates cold winters and short summers. Sagebrush and mountain shrub communities dominate the RMPPA, with some riparian-, saltbush-, and woodland-dominated areas. The diverse natural communities support a wide variety of game and nongame wildlife and fish species, including several special status species. Hunting and fishing opportunities abound, and other types of recreational opportunities, such as river recreation, camping, and wildlife viewing, are also abundant. The RMPPA supports a variety of uses, including agriculture, recreation (including commercial outfitting), and increasingly, oil and gas development.

This chapter describes environmental characteristics, conditions, and trends that influence the resolution of planning issues or that would be affected by the management actions presented in Chapter 2, or by other action alternatives to be defined later in the planning process. Environmental components that would not be affected or that are not essential to the resolution of planning issues are not covered in detail. No new environmental data collection efforts were conducted on Bureau of Land Management (BLM)-managed lands specifically for this Management Situation Analysis (MSA).

3.1 AIR RESOURCES

Climate

The climate of the Pinedale RMPPA is classified as semiarid steppe with areas of mid-latitude highland or alpine (Trewartha and Horn 1980, Martner 1986).

Steppe climate is characterized by large seasonal variations in temperature (cold winters and warm summers) and precipitation that is slight but still sufficient for the growth of short sparse grass. The aridity of the area is caused by its distance from the Pacific

Ocean and by the Sierra Nevada and Rocky Mountains that block the eastward flow of humid coastal air. Annual rainfall amounts vary greatly from year to year.

Mountainous areas within the Pinedale RMPPA are classified as alpine. Alpine climate is characterized by large varieties of local climates, depending on altitude and slope exposure, but is a similar and cooler version of nearby lowland climate (Trewartha and Horn 1980). Temperature and precipitation vary as a function of several factors, including season, time of day, and elevation.

Weather stations in the Pinedale RMPPA include stations located in Pinedale and Big Piney in Sublette County, Wyoming. Pinedale's elevation is 7,175 feet, and it is in the northern part of the Pinedale RMPPA. Big Piney is at an elevation of 6,820 feet and is in the central part of the Pinedale RMPPA. Meteorological data are available for Pinedale from 1948 through 2000 and for Big Piney from 1948 through 2001.

Temperature

Diurnal (morning to night) and seasonal (summer to winter) ranges in temperature are greater in valleys than on slopes (Martner 1986). Mean annual temperatures range from 52 degrees Fahrenheit (^{o}F) in Pinedale to 53 ^{o}F at Big Piney. Mean maximum summer temperatures of 75 ^{o}F and 76 ^{o}F, and mean minimum winter temperatures of 0 ^{o}F to 3 ^{o}F occur in these two towns, respectively, as reflected in the mean monthly and mean monthly maximum temperatures illustrated in Figures 3.1-1a to 3.1-1c (Western Regional Climate Center).

Precipitation

High elevations experience greater amounts of precipitation than lower elevations. The mean annual precipitation is 11 inches in Pinedale and 7.5 inches in the lower elevation Big Piney. The mean annual precipitation ranges from 5 inches in dry years to 19 inches in wet years in Pinedale. The mean annual precipitation in Big Piney ranges from 5 inches in dry years to 12 inches in wet years (Western Regional Climate Center).

Figure 3.1-2 illustrates precipitation in the Pinedale RMPPA based on data from Pinedale and Big Piney. Figure 3.1-2a shows that mean monthly precipitation varies from 0.5 to 1.7 inches throughout the year in Pinedale and from 0.3 to 1.1 inches in Big Piney (Western Regional Climate Center). Trend data across three decades are shown monthly (Figures 3.1-2 b and 3.1-2c) and annually (Figure 3.1-2d). These trends show a slight precipitation increase in Pinedale and a slight decrease in Big Piney.

The mean total snowfall is 5 feet in Pinedale and 2.4 feet in Big Piney, with most snow occurring from November through April. Figure 3.1-2e shows the mean monthly winter snowfall to range from 6 to 12 inches in Pinedale and from 2 to 4 inches in Big Piney (Western Regional Climate Center).

Dispersion

Atmospheric stability is a measure of the atmosphere's capacity to disperse pollutants. The stronger the dispersion, the more likely the atmosphere is to disperse pollutants so that their concentrations diminish and have less potential to do harm. Stability data are not available for the Pinedale RMPPA. The closest data to the RMPPA are from Rock Springs, Wyoming (about 100 miles south of Pinedale), and show mean annual dispersion to be fair more than 60 percent of the time and strong to moderate less than 20 percent of the time (Figure 3.1-3). Although these data may or may not be indicative of conditions within the Pinedale RMPPA, they are the most pertinent data available.

Wind Velocity

Windspeed and direction are highly variable resulting from the effect of local topography in the Pinedale RMPPA. Figure 3.1-4 shows the occurrence frequency of windspeeds and wind directions for Pinedale, Wyoming.

Air Quality Characterization

Elements of air quality addressed in this analysis include concentrations of air pollutants, visibility, and atmospheric deposition. Appendix V provides a summary of applicable air quality regulations.

Pollutant Concentrations

Pollutant concentration refers to the mass of pollutant present in a volume of air, and can be reported in units of micrograms per cubic meter ($\mu g/m^3$) and parts per billion (ppb). Air quality in the Pinedale RMPPA is considered excellent; however, current and complete criteria air pollutant concentration data for the RMPPA area are not available. The State of Wyoming has used monitoring to determine that the Pinedale RMPPA region is in compliance with Wyoming and National Ambient Air Quality Standards (NAAQS). The best available data on concentrations of criteria air pollutants relevant to the Pinedale RMPPA region are shown in Table 3.1-1 and discussed below.

- **Carbon Monoxide.** Because carbon monoxide (CO) data are collected mostly in urban areas where automobile traffic levels are high, recent data are often unavailable for rural areas. CO concentrations measured in Colorado in conjunction with the proposed oil shale development in the 1980s were 15 percent or less of the Wyoming and NAAQS.
- **Nitrogen Dioxide.** Nitrogen dioxide concentration data collected at the Green River Basin Visibility Study site from January 1 to December 2001 were only 3 percent of the Wyoming and National air quality standards. Monitoring of other nitrogen-containing pollutants shows concentrations at Centennial and Rocky Mountain National Park of nitric acid (HNO_3), nitrate (NO_3), and particulate ammonium (NH_4) are fairly low and are not increasing over time.

- The two Clean Air Status and Trends Network (CASTNet) stations most pertinent to the Pinedale RMPPA (Pinedale and Yellowstone National Park) have data available for 1989 through 1999, and 1997 through 1999, respectively (Figures 3.1-5a and 3.1-5b). Mean annual concentrations of HNO_3 are less than 0.5 ppb at Pinedale, and less than 0.3 ppb in Yellowstone National Park. HNO_3 concentrations typically range from 0.02 to 0.3 ppb in remote areas, and from 3 to 50 ppb in urban areas (Seinfeld 1986). Although HNO_3 concentrations in Pinedale are well below urban levels, but concentrations are slightly above levels typical in remote areas. Mean annual concentrations of NO_3^- are less than 0.2 ppb at Pinedale and Yellowstone National Park. NO_3^- concentrations are typically about 0.2 ppb in remote areas and 1 ppb in urban areas (Stern 1973). Mean annual concentrations of NH_4^+ are less than 0.3 ppb in Pinedale and Yellowstone National Park. NH_4^+ concentrations are typically 0.3 ppb in remote areas and 1.4 ppb in urban areas (Stern 1973).
- Weekly concentrations of nitrate and particulate ammonium measured by the Wyoming Air Resources Monitoring System (WARMS) at Pinedale are below 1.5 $\mu g/m^3$ for NO_3^- and below 0.5 $\mu g/m^3$ for NH_4^+ (Figures 3.1-6a and b).
- Because the chemistry of nitrogen-containing pollutants is complex, it would be inappropriate to infer NO_2 concentrations from concentrations of HNO_3, NO_3^-, and NH_4^+. But it would be unlikely that high NO_2 concentrations would occur with low concentrations of other nitrogen-based pollutants

- **Sulfur Dioxide.** Sulfur dioxide (SO_2) concentrations measured at the LaBarge study area in the 1980s were less than 20 percent of the Wyoming Ambient Air Quality Standards (WAAQS) and NAAQS. More recent SO_2 data, as well as sulfate (SO_4^{--}) data, were collected by CASTNet in Pinedale and Yellowstone National Park, and by WARMS in Pinedale (Figures 3.1-7a and b). Concentrations of SO_2 are less than 0.6 ppb in Pinedale and Yellowstone National Park. SO_2 concentrations typically range from 1 to 10 ppb in remote areas, and from 20 to 200 ppb in urban areas (Seinfeld 1986). Thus, SO_2 concentrations in the Pinedale RMPPA region are consistent with concentrations typical of remote areas. Mean annual concentrations of SO_4^{--} are below 0.75 ppb in Pinedale and below 1.2 in Yellowstone National Park. SO_4^{--} concentrations are typically about 0.6 ppb in remote areas and about 2.5 ppb in urban areas (Stern 1973). Thus, SO_4^{--} concentrations in the Pinedale RMPPA region are well below urban levels, but above levels typical in remote areas.

- Figures 3.1-8a and b show weekly WARMS concentrations of SO_2 in Pinedale from mid-1999 through 2001 to be about 1.5 $\mu g/m^3$ or less. It would be inappropriate to compare weekly WARMS concentrations directly with mean annual concentrations.
- Although it would not be appropriate to compare mean annual CASTNet SO_2 concentrations with national or Wyoming standards, the CASTNet and WARMS concentrations do suggest that SO_2 concentrations in Pinedale and Yellowstone National Park are still well below the NAAQS and WAAQS.

- **Ozone.** Ozone concentration data were collected at the Green River Basin Visibility Study site from June 10, 1998 to December 31, 2001. O_3 concentrations were 94 percent of the Wyoming and National air quality standards. O_3 data were also collected by the CASTNet stations at Pinedale and Yellowstone National Park. Figure 3.1-9 shows mean annual O_3 concentrations in Centennial and Yellowstone National Park have remained steady from 1989 through 1999, and are typical for remote areas in the western United States (Singh, et al. 1978).
- **Particulate Matter.** Mean annual PM_{10} concentrations collected from the Carbon County Underground Coal Gasification site in 1994 and 1995 (PM_{10}) were 32 percent of the NAAQS and WAAQS and mean annual $PM_{2.5}$ were 33 percent of the NAAQS and WASQS (Table 3.1-1).

Visibility

The Interagency Monitoring of Protected Visual Environments (IMPROVE) has measured visibility in national parks and wilderness areas in the United States since the 1980s. Six IMPROVE aerosol monitoring stations are located in Wyoming. The closest station to the Pinedale RMPPA is in the Bridger Wilderness. The best visibility monitored in the contiguous United States is at this station.

Visibility can be expressed in terms of deciviews (dv), a measure for describing perceived changes in visibility. One dv is defined as a change in visibility that is perceptible to an average person, about a 10-percent change in light extinction. Monitored aerosol concentrations are used to reconstruct visibility conditions for each day monitored, ranked from cleanest to haziest, and divided into three categories:

- 20 percent cleanest: mean visibility for the 20 percent of days with the best visibility
- Average: the annual median visibility
- 20 percent haziest: mean visibility for the 20 percent of days with the poorest visibility.

Figure 3.1-10 shows annual visibility in the Bridger Wilderness from 1988 through 1998. Visibility on the 20 percent cleanest days varies from 3 to 5 dv (visual range of about 136-168 miles). Average visibility varies from 6 to 8 dv (about 96-114 miles). Visibility for the 20 percent haziest days varies from 10 to 12 dv (about 56-76 miles). Trend analysis of Bridger Wilderness visibility data reveals no significant trend of worsening visibility from 1989 through 1998.

Atmospheric Deposition

Atmospheric deposition, which refers to the processes by which air pollutants are removed from the atmosphere and deposited on terrestrial and aquatic ecosystems, is reported as the mass of material deposited on an area (kilogram per hectare). Air

pollutants are deposited by wet deposition (precipitation) and dry deposition (gravitational settling of particles and adherence of gaseous pollutants to soil, water and vegetation). The following substances are deposited:

- Acids—such as sulfuric acid (H_2SO_4) and HNO_3; this acid deposition is sometimes referred to as acid rain
- Air toxics—such as pesticides, herbicides, and volatile organic compounds (VOC)
- Nutrients—such as NO_3^- and NH_4^+.

The estimation of atmospheric deposition is complicated by contribution to deposition by rain, snow, cloud water, particle settling, and gaseous pollutants. Deposition varies with precipitation, which, in turn, varies with elevation and time. Overall deposition rates at Pinedale are low.

Wet Deposition

The National Atmospheric Deposition Program (NADP) assesses wet deposition by measuring the chemical composition of precipitation (rain and snow). The natural acidity of rainwater is considered to be represented by a range of pH values from 5.0 to 5.6 (Seinfeld 1986). The mean annual pH in Pinedale (Figure 3.1-11) from 1980 to 2000 has shown cyclical variation, with especially low pH values (close to or below 5.0) occurring between 1994 and 1998, indicating acidification of precipitation during that period.

Figures 3.1-12a and b show the mean annual wet deposition of NH_4^+, NO_3^-, and SO_4^{--} at Pinedale and Yellowstone National Park NADP stations, respectively, from 1980 through 2000. These values are generally low for both Pinedale and Yellowstone National Park, although wet deposition of sulfate was as high as 5.5 kg/ha in 1981 and 3.5 in 1982 at Yellowstone.

Dry Deposition

Dry deposition refers to the transfer of airborne gaseous and particulate material from the atmosphere to the Earth's surface. The CASTNet measures dry deposition of SO_2, HNO_3, SO_4, NO_3, and NH_4. These data for Pinedale and Yellowstone National Park (Figures 3.1-13a and b) show dry deposition values in Pinedale and Yellowstone National Park to be low and steady for all pollutants, although HNO_3 deposition ranged from 1.2 to 2.2 kg/ha/year in Pinedale.

Total Deposition

Total deposition refers to the sum of airborne material transferred to the Earth's surface by both wet and dry deposition. Total deposition guidelines have been estimated for several areas, including the Bridger Wilderness in Wyoming (USFS, 1989). Estimated total deposition guidelines include the "red line" (defined as the total deposition that the area can tolerate) and the "green line" (defined as the acceptable level of total

deposition). Total nitrogen deposition guidelines for Bridger include the red line (set at 10 kg/ha/year) and the green line (set at 3-5 kg/ha/year). Total sulfur depositions guidelines for Bridger include the redline (set at 5 kg/ha/year) and the green line (set at 20 kg/ka/year).

Figures 3.1-14a (nitrogen) and 3.1-14b (sulfur) compare total deposition monitored near Pinedale, Wyoming with the total deposition guidelines set for the Bridger Wilderness. Total deposition for both nitrogen and sulfur have been well below the Bridger Wilderness red lines and green lines from 1982 through 2000[1].

Summary of Existing Air Quality

Air quality monitoring and dispersion modeling show that air quality in the Pinedale RMPPA region is generally excellent (Table 3.1-2).

3.2 CULTURAL RESOURCES

An estimated 5,000 cultural resource sites have been identified and/or recorded within various topographical and ecological settings across the entire Pinedale RMPPA. The recorded sites range from large, complex sites covering hundreds of acres to single, isolated artifacts. Cultural resources date from 12,000 years Before Present (B.P.) to the 1950s and 1960s. Most of these sites were documented during cultural resource inventories for compliance-related projects. The Pinedale RMPPA contains many more cultural resources beyond those inventoried to date. BLM manages the cultural resources on public lands in accordance with the legal and policy mandates and directives outlined in the previous chapter.

Cultural History

Within the set of known or recorded resources, sites can be divided broadly into prehistoric archaeological sites and landscapes, ethnohistoric (protohistoric) sites and landscapes, historic sites and landscapes, and historic trails. Several archaeological sites containing the remains of early trappers and Native American do not fit neatly into this scheme. Each period of use has left distinct signatures on the landscape of the upper Green River Basin.

Prehistoric Period

To date, prehistoric sites have been the most prevalent cultural resources recorded in the Pinedale RMPPA. Although some sites are limited to surface manifestations, including the extensive secondary lithic procurement areas, archaeologists have documented intact, stratigraphic remains of multiple camps and processing areas within alluvial and eolian soils.

[1] Please note that wet deposition data are available from 1982 through 2000, while dry deposition data are available only from 1990 through 1999.

Archaeologists have developed a detailed chronology and land use models based on information obtained from the thousands of previous cultural resource management and research studies conducted in the Green River Basin in general, and the Pinedale RMPPA in particular. These investigations have resulted in the recordation, evaluation, and excavation of thousands of prehistoric archaeological sites in a variety of ecological and topographical settings across the prehistoric landscape, including that portion of the landscape managed by the Pinedale Field Office staff.

The portion of the prehistoric landscape within the Pinedale Anticline project area can be broken down into at least three archaeological subregions. First, the southern sagebrush steppe is an area of complex soils and geomorphology and dense Archaic period-aged occupations. Prehistoric sites dating between 4,000 and 7,000 years B.P. are common in the southern sagebrush steppe. Second, the Mesa interior upland itself is dominated by a quartzite- and chert-armored surface containing thin "A" horizon soils. This subregion contains extensive casual lithic procurement but diminished buried site potential overall. Third, the breaks around the Mesa (including the New Fork and Green River high terraces) are a subregion of high site potential, especially of rock alignment sites and complex geomorphology.

Site types in the Pinedale RMPPA include open and sheltered campsites, housepits, stone circle and rock alignment sites, lithic scatters, kill/butchering sites (e.g., large mammal kill sites, such as Wardell Buffalo Trap; game processing sites, such as Trappers Point site), rock shelters, floral processing locales, human interment sites, sacred or respected sites, extensive lithic procurement locales, lithic quarries, Traditional Cultural Properties (TCPs) (including vision quest areas), trails and markers, rock art sites (petroglyphs and pictographs), and archaeological landscapes.

Open campsites, which are one of the most common site types present in the study area, are defined by not only the remains from stone tool production, such as flaked stone tools and debris, ground stone tools, and cores, but also the remnants of domestic activity, including fire-cracked rock from fire hearths, housepits, stone circles, ceramics, or ground stone. Sites containing lithic debitage and/or heat-altered rock are numerous in the Pinedale RMPPA, accounting for a high percentage of the total sites. Similarly, lithic scatters contain the same lithic remains as open campsites, but without occupational or domestic artifacts such as fire-cracked rock, ground stone, stone circles, or housepits. Several brush structures are found in the RMPPA; however, mass large mammal kill sites (e.g. the Wardell Buffalo Trap, the Barnes Site, the Harrower Site) are rare. These sites are interpreted as reflecting communal hunting activities.

Housepit sites, identified only within the past 15 to 20 years, are another class of prehistoric habitation sites. Housepits are large circular depressions that had a superstructure (or roof) over them. Some housepit floors appear to have been excavated, whereas others represent a shallow, unmodified floor below the roof. Most housepits have internal and peripheral cooking and storage pits or basins. Within recent years, archaeologists have identified and excavated a number of housepits within the Pinedale RMPPA as a result of these features being identified during construction monitoring and data recovery excavations. Excavated housepit sites in the planning area include the

Birch Creek Site, dating to 4200 radiocarbon years ago, the LaBarge area in Jonah, 48SU2094 at 6,660 years ago, 48SU2317, dating to 6,000 to 7,00 years ago. In 2002, excavations at 48SU4479, the C. David Love Site, identified nine housepits on a two-acre study area. A radiocarbon date from hearth in which human remains were found dated the burial at 7260_+ 50 years before present. The Jonah housepits are Early Archaic Great Divide/Opal phases in age, i.e., from 6,600 to 6,000 radiocarbon years ago.

In the vicinity of Yellow Point Ridge, weathered, surficial quartzite cobbles used by prehistoric occupants for stone tool manufacturing, cooking, and as hearth lining define one archaeological landscape in the PFO area (Site 48SU1334). The prehistoric inhabitants casually used these extensive deposits covering the area. In 1992, the name Yellow Point Archaeological Landscape was applied to the casual use and reduction of secondary deposits of quartzite cobbles near Yellow Point Ridge. Similarly, the Mesa Archaeological Landscape (Site 48SU2928) represents the casual use and reduction of similar deposits of quartzite cobbles in the vicinity of the Mesa south of Pinedale. Because of their limited data potential, neither landscape is eligible for listing on the National Register of Historic Places (NRHP).

Sheltered camps include caves and rock shelters with evidence of extended and multiple human occupations. Typically, rock shelters and caves were used and reused as domestic or temporary structures for long periods. The dry, protected setting contributes to the preservation of the archaeological remains within these sites, providing a long and comprehensive record potentially extending far into the past. A cultural inventory in one area of the Jonah Field resulted in the recording of the first Archaeological District formally documented in the planning area. Site 48SU4000 (Vlcek's Archaeological District) with extensive rock shelters and associated occupations (Miner 2001). This inventory also recovered ceramics, obsidian, lithic sources, stone circles, and a number of artifact types critical to further understanding the prehistory of the area. In addition, subsurface testing suggests that archaeological sites in the district contain intact, subsurface archaeological deposits. Subsurface deposits range from isolated features to hearth-tethered activity areas to stratified, mulitcomponent sites. Recommendations include preservation as the preferred action and data recovery excavations and long-term monitoring through the establishment of photographic control points for sensitive archaeological deposits (Miner 2001).

In 1997, geoarchaeological field investigations were undertaken in the Burma Road Soil Survey Area/Jonah Natural Gas Field. During this study, several archaeologically sensitive areas were identified, including a broad area of low fans and terraces in the middle reaches of sand wash characterized by the presence of the San Arcacio soil (Eckerle and Taddie 1997). This soil type has produced numerous radiocarbon dates older than 4,000 years B.P. Many of these sites were undetected by surface inventory and only discovered during the process of pipeline, road, or well pad construction. The management of these subsurface sites in areas with San Arcacio soil, coupled with energy extraction activities, presents major conflicts (Vlcek 2000).

The regional prehistoric chronology is divided into three major periods based on technological developments and adaptive strategies: Paleoindian, Archaic, and Late

Prehistoric. These three periods are further divided into phases, based on such characteristics as artifact assemblages, features, or shifts in settlement or resource procurement patterns.

Paleoindian Period

At a minimum, human beings have lived in the Green River Basin since the end of the Pleistocene geologic epoch, based on occasional surface finds of Clovis and Folsom projectile points and sites such as the UP Mammoth (Irwin 1971) and Pine Springs (Sharrock 1966). Dating of the Paleoindian Period in the study area ranges between 11,500 and 8,500 years B.P. However, evidence of the big game foraging tradition, which has formed the definition of Paleoindian adaptations, is rare. Only a few sites containing true Clovis, Goshen, Folsom, Agate Basin, Hell Gap, or Alberta techno-complexes have been discovered in the area, mostly as fragmented surface finds. In the Planning Area, Folsom points have been located at Boulder Lake, Trappers Point, along Green and Big Sandy rivers, at two locales on the Mesa, at two localities in the Jonah field, near the Exxon Dehydration facility and on U.S.F.S. lands near Water Dog Lakes. Numerous surficial finds of Folsom material strongly suggest that true Folsom components may be preserved in the deeper sediments of the planning area. Agate Basin or Agate Basin-like lanceolate projectile points appear to be the most prevalent of the early Paleoindian projectile point types found in the study area. Only the Cody Complex Finley site, dated to around 9,000 years B.P. (Moss et al. 1951), shows evidence of the utilization of big game and a classic Paleoindian adaptation.

Kelly and Todd (1988) suggest that early Paleoindian groups (Clovis through Hell Gap) practiced a big game foraging adaptation, as opposed to a collector adaptation, oriented toward big game procurement. The latter adaptation is what big game hunters used on the Plains during the Late Prehistoric Period. Kelly and Todd suggest that big game forager adaptations shifted in North America after the Pleistocene. These early Paleoindian big game foragers seemed to have had little investment in place. Presumably, they were not winter-storage dependent, they moved wherever the game was, even during the winter. Eckerle and Hobey (1995) believe that as the environment changed (dried) and populations grew in the Green River Basin, a collector adaptation emerged (possibly around Cody time) in response to a greater need for winter storage. By the late Paleoindian Period, evidence suggests the emergence of groups that seemed to not only be dependent on lower return rate resources than those used during Clovis through Agate Basin time but also be using a broad-spectrum collector strategy that evolved into an Archaic adaptation.

Some sites in western Wyoming have yielded radiocarbon dates contemporaneous with early Paleoindian traditions. These sites typically yield no temporally diagnostic artifacts and very limited faunal assemblages. Projectile points, if present, are not easily fit into the traditional Plains Paleoindian typologies. For example, the Porter Hollow site yielded a date of 10,090 years B.P. (Hoefer 1987) and contained only a single feature, a sparse lithic assemblage, and no faunal material.

Late Paleoindian components show evidence of the utilization of smaller game animals and plant resources, suggesting that broad-spectrum hunting and gathering was established by no later than 8,600 to 8,400 years B.P. Although some of these observations are undoubtedly a function of preservation factors, a collector strategy oriented toward broad-spectrum hunting and gathering began in late Paleoindian Period in the Green River Basin. By no later than the end of the Paleoindian Period, the Green River Basin population had an intimate familiarity of the local environment and was able to manipulate resources. Portions of the planning area, specifically the Jonah Field, have produced sites and data pertinent to this rare period. For example, 48SU2980 in the Jonah Field dates to ca. 8400 radiocarbon years ago and nearby, 48SU2979 contains a 7200 year old occupation. Archeological investigations ancillary to the energy development in the area may indeed provide the key to understanding this rare, transitional prehistoric period.

Paleoindian components in the Green River Basin as a whole can be expected to take various forms. These could potentially include localities in which Pleistocene and early Holocene animals were killed and/or processed, campsites or residential areas, special purpose lithic scatters, isolated hearths, and isolated surface artifacts. Sites will also vary from deeply buried components with no surface exposures to artifacts that have been exposed on the surface for thousands of years.

Early Paleoindian occupations have been documented from just south of the Pinedale Anticline area and within the Jonah II area. Sites 48SU389, 48SU907, 48SU908, and 48SU909 indicate extensive Paleoindian occupations associated with an assumed perennial water source. This site complex has produced diagnostic artifacts from the Folsom, Hell Gap, Agate Basin, Scottsbluff, and Cody complexes spanning a time period from 12,000 to 8,000 years B.P. (Frison 1991a). Site 48SU1421 is the first documented Paleoindian presence within the Pinedale RMPPA. Several diagnostic projectile points tentatively date two components at the site from 9,000 to 8,500 years B.P. This site is situated adjacent to an ancient playa. A site complex in the Jonah II area—Sites 48SU2662, 48SU3087, and 48SU3090—is located in a similar setting and has produced Paleoindian material. The numerous isolated occurrences of Paleoindian points that have been documented in the study area suggest that the area was used during this period and that site preservation is the major factor affecting the number of known sites.

Archaic Period

The Archaic Period (8,500 to 1,800 years B.P.) represents the majority of the occupation of the Green River Basin, constituting the period from the end of the Paleoindian and ending with the Late Prehistoric Period. Beginning with the Archaic Period, increasing numbers of sites were created as a result of more intensive use of the basin by the indigenous population, including a large number of sites in the LaBarge and Jonah Fields that have been excavated as a result of oil and gas development.

Based on the archaeological record, archaeologists have suggested that native groups practiced a generalized seasonal round within the upper Green River Basin. All environmental zones from the high montane areas to the basin interiors were inhabited.

This basic pattern remained largely unchanged throughout the entire Archaic, and part of the Late Prehistoric Period. The Archaic exhibits some variability in the spatial and temporal distribution of various types of archaeological remains, guided by environmental conditions. Environmental conditions ranging from the dry, hot Altithermal to the wetter, moister Neoglacial affected floral and faunal communities that had obvious effects on the human population.

The seasonal movement model is framed in terms of the types of resources that would have been exploited year round and the size and organization of the human groups that procured those resources. The basic residential unit as the core group has been defined as necessary for socioeconomic stability, though not necessarily reproductive survival. Individual residential units functioned as the core with which other human groups aggregated and dispersed and from which most subsistence-related decisions were made. A specific set of kinship relationships is not implied for the basic residential unit. Much of the ethnographic data suggests that a residential unit would likely consist of a small, multigeneration, extended family ranging from 8 to 20 individuals. It also could be composed of a few unrelated or loosely related nuclear families.

Ethnographic evidence (e.g., Steward 1938) suggests reduced residential mobility during the winter for broad-spectrum hunter-gatherers. Winter occupations were likely to have occurred in areas with access to ample fuel, permanent water, and food resources. These resources occurred in the immediate site area or were transported to the winter camp location. Cold weather dwellings and associated facilities would have been constructed by the inhabitants.

Archaeologists have postulated that Archaic inhabitants of the Green River Basin used a series of camps throughout the winter months, spending perhaps one to several weeks at any one given camp. The location of winter camps was determined by not only the availability and accessibility to critical resources, but also the locations of cached winter stores across the area. Use of these criteria indicates that winter camps were located in foothill areas with abundant fuel, food, and water, or in sheltered locations along the Green River and its major tributaries. Prehistoric people probably established most of their winter camps outside the Green River Basin, although it is difficult to determine seasonality from the Archaic archeological record and winter (Birch Creek house pits) or early spring (Trappers Point site) use of some sites has been suggested. Browns Park, Manila, extreme eastern Idaho, and the Lander/Riverton area are likely candidates for winter camps outside the Green River Basin because of their milder climates.

Some archaeologists have hypothesized that the winter camping unit could have been a highly variable population aggregate, ranging from individual or several residential units camping and moving together during the winter months, to larger population aggregations approaching village size. The specific size of the winter unit and the duration of occupation at any one spot probably varied annually, depending on resource productivity and availability throughout the entire annual round. At this point, clear-cut winter villages have not been identified in the Green River Basin interior, possibly resulting from of seasonal indicators. The Taliaferro site, located along Slate Creek (Smith and Creasman 1988), is a candidate for a short-term winter camp. Some

investigators have interpreted the large, substantial housepits at the Maxon Ranch site as possible winter dwellings (Harrell and McKern 1986). Other area sites surrounding the Green River Basin that are strong candidates for winter camps include Split Rock Ranch on the Sweetwater River (Eakin 1987). Although the paucity of evidence for winter sites may be a product of post-depositional (i.e., burial) factors, it has been suggested that small winter camps might have been a more common pattern than larger winter sites.

Spring climatic conditions (including onset, duration, and intensity) can vary drastically from year to year. Characteristics of the winter had a major effect on spring; late, cold, wet storms could have delayed the onset of spring conditions for 3 to 4 months. On the other hand, a milder, drier winter might have caused an earlier onset of spring conditions. One reason it is important to understand the timing of spring in high-altitude arid regions, like the Green River Basin, is its effect on the availability and abundance of floral and faunal food resources. Elevation and latitude affect the timing of the initial appearance of plant greens. The earliest occurrence would have been in the basin interiors, followed by a progression toward increasing elevation and latitude.

Spring was a critical time for the prehistoric hunter-gatherers of the Green River Basin. Locating new food resources was of paramount importance. Of secondary importance was the need to replenish supplies depleted during the winter, including material for various tools (toolstone, bone, and wood). During the spring months, ethnographic evidence indicates that many hunter-gatherer groups used interior basin areas for procuring newly sprouted edible greens and roots (Steward 1938; Shimkin 1946, 1986). This ethnographic observation is reinforced by archaeological evidence from the upper Green River Basin that indicates that intensive root procurement in surplus quantities occurred throughout the Archaic and Late Prehistoric Periods (Francis 2000). Other areas of the upper Green River Basin supported similar concentrations of critical spring and early summer resources. Roots, such as wild onion, sego lily, and wild parsley, tend to favor wet meadow or subirrigated floodplain settings. Historic cultivation has removed most, if not all, evidence of prehistoric use of these areas. Floodplains of the Green River and its major tributaries, such as the Smiths Fork, Hams Fork, and Blacks Fork, were intensively used for root procurement during spring and summer. The evidence from the upper Green River Basin suggests that procurement and processing of roots was a special-purpose activity conducted by task-specific groups, not conducted in the context of a residential site. Material correlates for root processing sites in the upper Green River Basin include earth ovens in various stages of preservation and fire-cracked rock scatters with few or no associated artifacts on the high terraces overlooking floodplains and wet meadows.

The Trappers Point site (Site 48SU1006), located in the Pinedale RMPPA, offers some of the best archaeological evidence concerning use of the upper Green River Basin during the Archaic. An analysis of the faunal assemblage suggests that procurement of pronghorn was important during spring (Miller et al. 1999). Based on the presence of lithic raw materials that originated in the southern portions of the Green River Basin in the chipped stone assemblage, prehistoric people appear to have congregated in the upper Green River Basin during the spring months for the purpose of procuring communal antelope. Data from the Trappers Point site also suggest occupation by a special-purpose

hunting party. Partially butchered and processed game was transported to a different location away from the primary kill and processing area. The special-purpose, yet communal, aspects of the site suggest that multiple residential groups cooperated for purposes of the spring hunt. The cooperating residential units could have dispersed into several different types of task-specific groups based out of one or more residential sites in the upper Green River Basin.

Evidence from Trappers Point site also suggests that antelope seasonal migration routes have great antiquity, at least as much as 6,000 years. As is the case at Trappers Point site, communal procurement of pronghorn should have occurred in other locations where local topographic features acted to confine winter and summer migration routes within a narrow corridor. Other known pronghorn procurement and processing sites appear to be associated with migration routes between winter and summer ranges (Miller et al. 1999).

Group size would have been highly variable. Small, dispersed groups foraged across basin interiors, gradually aggregating in larger groups to take advantage of resources in a communal setting. After aggregation, task-specific groups would move out from logistic base camps to access resource patches. Residential sites should reflect a wide variety of activities. Residential sites consisting of single residential units or aggregates of residential units also can be expected to occur near antelope procurement and processing sites.

Later in summer, a variety of choices would have been available regarding subsistence resources available to prehistoric hunter-gatherers. Resources would have been available in nearly all environmental zones in the region, and prehistoric people would have engaged in encounter hunting of small and large animals; utilizing birds, reptiles, and amphibians; collecting bird eggs; and gathering a variety of plant resources. Archaeological evidence of fish as a food resource has only recently been recognized in the Green River Basin (McKibbin 2000). Currently, archaeologists believe that fishing occurred as a late summer activity in conjunction with lower water levels in the major rivers. Though archaeological evidence is lacking, historic records document the abundance of fish in smaller streams along the base of the mountains (Wind Rivers, Uintas, and Wyoming Range). Ethnographers discuss fish as an important resource during Reservation times. Methods of taking fish were relatively efficient: weirs, dams, and fishtraps were the major devices (Shimkin 1946).

The elevational dimension in the subsistence system cannot be ignored. Although little archaeological information exists from higher elevation sites, the prehistoric population exploited resources in higher elevation locales during the summer after the snow melt. Root and other plant foods would have ripened later than in lower elevations. Ungulates (deer, mountain sheep, elk, and moose) would be targeted species, along with small mammals. In addition, fish were available in the lakes and streams.

Residential units would have broken up into much smaller groups during mid to late summer to take advantage of resources available in different places. The frequency of summer moves between resource patches should be expected to be much greater than during the winter. Some archaeologists have hypothesized that people would have

tended to move into higher elevations as resources in the interior basins were depleted or burned up in hot weather and as the higher elevation resources matured. Summertime would also have been an important time for monitoring resource availability throughout the region. Consequently, the residential unit would have dispersed into smaller units for the purposes of gathering information about the availability of food and spouses. This pattern of summer travel could also account for the presence of nonlocal lithic raw materials in archaeological assemblages throughout the Green River Basin.

Fall would have been a time of conflict regarding the availability of important food resources. Berries ripen in the mountains at about the same time that grass and weedy seeds mature in the interior basin. In addition, herd animals congregate for the fall rut. The basic residential units would have aggregated into larger camps that were centrally located between critical environmental zones for information sharing, acquisition and exchange of resources, and putting up stores for the winter months. Material cultural correlates of fall occupation may include big aggregation sites with dense and diverse artifact assemblages and a high frequency of small, special purposes sites—like the occurrence of ground stone in nonresidential contexts.

Although the hypothesized model of seasonal usage of the Green River Basin is thought to characterize the entire Archaic Period, there is clearly some variability in cultural adaptations throughout this time range. For example, most known housepits date to the early portion of the Archaic, although some housepits have been documented recently from the latter portion of the period (Thompson and Pastor 1995). There is also variability in the size and complexity of domestic architectural features, suggesting differing uses, length of occupation, and size of the groups using the site. The use of slab-lined hearths also appears to peak between 5,500 and 3,500 years B.P. (Smith and McNees 1999). This suggests different patterns of residential mobility, resource use, and processing through time, and perhaps of local group size through time. How this variation relates to changing paleoclimatic conditions and the onset of the Neoglacial climatic period is presently unknown.

Most archaeologists divide the Archaic Period into Early and Late Periods, each of which is subdivided into two phases.

Early Archaic Period

The Early Archaic (8,200 and 4,200 years B.P.) is divided into the Great Divide and the Opal Phases. The first 2,000 years of the Archaic Period, the Great Divide Phase within most chronological frameworks, are poorly understood in comparison to the remainder of this period. There are only a few recorded sites in the Pinedale RMPPA that date between 8,500 and 6,500 years B.P. during the Great Divide Phase. Early Holocene occupations present are present in areas adjacent to the Green River and its permanent tributaries, particularly in alluvial soils.

In contrast to the Great Divide Phase, there is a robust (and growing) set of well-documented and well-dated sites dating to the Opal Phase. Archaeological excavation and monitoring efforts have documented more than 50 housepits from about 30 sites in

the region, including a large number of sites from the Jonah and LaBarge areas of the Pinedale RMPPA (Larson 1997).

Early Archaic Period components in the Green River Basin include camps and residential areas; localities where animals were killed or processed; special use lithic scatters; isolated hearths; and isolated surface artifacts. Sites may also vary from deeply buried components with no surface exposures to artifacts that have been exposed on the surface for thousands of years.

After 6,500 years B.P., there is an explosion of sites and dated components in the Green River Basin. This may be partly a function of preservation of sediments of the appropriate age, as well as cultural factors such as population increase or settlement and mobility patterns. The Archaic Period after 6,500 years B.P. appears to have been a time of slow population growth, reflected by an increased diversity of architectural features, an increased emphasis on place, more intensive exploitation of resources within defined settlement ranges, and increased complexity of social and organizational strategies used to obtain resources.

Late Archaic Period

The period from 4,200 to 1,800 years B.P. is termed the Pine Springs Phase and from 2,800 to 1,800 years B.P. as the Deadman Wash Phase. The transition from Early to Late Archaic is defined primarily by a decrease in radiocarbon dates between 4,600 and 4,300 years B.P., attributable to differential preservation, population fluctuations, changes in settlement and mobility patterns, or other factors (Metcalf 1987).

The Late Archaic is distinguished by a decreased reliance on plant foods and a corresponding increase in large animal use. The climate improved from the xeric conditions typical of the Altithermal to more mesic conditions. Bison remains in archaeological contexts become more common in the Green River Basin as a result of improved forage. Late Archaic Period sites from the Green River Basin typically yield stemmed, indented-base projectiles attributed to the McKean complex on the Plains and called Pinto in the Great Basin, and large corner-notched points usually termed Elko in the basin. Similar corner-notched points from the Plains are usually called Pelican Lake. Corner-notched Elko series points in the Great Basin are common throughout the Archaic, whereas the similar Pelican Lake point on the Plains is limited to between 3,000 and 1,500 years B.P. Cultural affiliation of the large corner-notched points found in the Green River Basin is problematic in light of the varied sources for the material and archaeologists' inability to attribute assemblages with specific culture areas.

Seasonality data, primarily from pollen and faunal assemblages, are lacking from many Archaic sites. Late Archaic components contain more bison remains than earlier ones, while still yielding large quantities of antelope, rabbits, and other small game. Ground stone becomes common during the Late Archaic, but large-scale seed processing, common to the subsequent Late Prehistoric Period, does not appear to have occurred with any consistency.

Late Archaic-aged sites, such as Sites 48SU1328, 48SU1561, 48SU1562, 48SU1751, 48SU1778, and 48SU1779, are common in the study area. These sites have produced McKean complex artifacts, later corner-notched Archaic period dart points, and lithic and ground tools.

Late Prehistoric Period

Archaeologists think that the basic patterns of seasonal usage and broad-spectrum hunting and gathering continued from the Archaic into the Late Prehistoric Period (1,800-300 years B.P.). However, the Late Prehistoric Period exhibits many important differences from the Archaic. The early portion of the Late Prehistoric, or Uinta Phase, exhibits a peak in the number of radiocarbon dated components, and the introduction of new technology in the form of the bow and arrow and ceramics (Thompson and Pastor 1995). More intensive exploitation of several important subsistence resources, including weedy seeds, pronghorn, and occasionally bison, occurs during this period. However, by 600 years B.P., or the Firehole Phase, the number of dated components drops radically.

Although the peak in radiocarbon dates in the Uinta Phase may partially be a function of preservation factors, as well as cultural practices, it appears that slow population growth during the Archaic reached a peak during the Uinta Phase. In addition, population may have also increased through an influx of people from outlying areas such as Utah or the Great Plains.

Rose Spring projectile points offer an intriguing potential for gauging population movement. The increased population within the Green River Basin would have resulted in many changes for broad-spectrum hunting and gathering groups in the area. First, the range of the seasonal round may have been far more restricted in size than during Archaic period. Consequently, hunter-gatherers more intensively exploited resources within that range. This action may have necessitated a greater number of residential moves by the local group within the restricted settlement range as resources began to be depleted around campsites. This would also result in an increased archaeological visibility of Uinta Phase sites and an increased number of sites and components.

In addition, groups may have practiced seed broadcasting and manipulation of plant species around campsites to artificially increase the resource base (Smith 1988), and hunting of large game may have intensified. For example, a dual seasonality in the hunting of pronghorn has been observed, with both spring and fall kills being recorded (Frison 1991a; Miller, et al., 1999). Except for one Paleoindian bison kill (the Finley site), the only known bison kills in the region date to the Uinta Phase. Known Late Prehistoric bison kills include the Wardell site (Frison 1991a), Bessie Bottom site (McKern 1988), Woodruff site (Shields 1978), and Barnes site.

With decreased home range, more marginal areas of the Green River Basin would have been occupied more intensively, and winter occupations may have been established in areas that were used only during the summer and fall seasons throughout the Archaic Period. Finally, with decreased access to resources beyond the home range, the establishment of long-distance interaction and exchange systems would have been

facilitated.With increased population density, decreased size of the settlement range, the introduction of new weaponry (i.e., bow and arrow), possible incursions of groups from the Eastern Woodlands, Northern Plains, Great Basin, and northern Colorado Plateau, and possibly resource stress, the Uinta Phase would also have been a time of increased interpersonal tensions and stress, based on the recovery of several burials showing direct evidence of violence. These include Robbers Gulch, the Bairoil burial, and the Deer Butte burial (Gill 1991).

The paucity of cultural components during the Firehole Phase does not appear to be a result of wholesale abandonment or depopulation of the Green River Basin. However, there may well have been some decrease in population density and a change or reversion to land use patterns more similar to the Archaic Period. This shift in the Uinta Phase subsistence system may be related to climatic changes associated with the dry interval (termed the Little Altithermal or "Little Ice Age") at 900 to 500 years B.P., before the Little Ice Age, which dates 500 to 150 years B.P., and the inability of marginal arid environments to support relative high population densities and intensive hunting and gathering strategies (Thompson and Pastor 1995).

In the Pinedale RMPPA, archaeologists have recorded a large number of sites dating to these two phases. Sites such as Site 48SU1563 have produced both Rose Springs Series arrow points and ground stone, suggesting both hunting and vegetal food collecting as subsistence strategies. An important site containing prehistoric Intermountain ware ceramics is Site 48SU1443, located in the Pinedale Anticline area. At this site, brown-gray pottery sherds containing sand tempering may relate to similar ceramics recovered from the Wardell site, located to the west. At the Raven Nest site in the Jonah Field, prehistoric ceramics look remarkably similar to the Wardell site material. Ceramic analysis can shed light on shared cultural affiliation with adjacent groups, such as the Fremont regions within Utah to the west and south, or the sedentary villagers to the south and east in Colorado. Distinctions between Uinta Phase peoples and the later Firehole Phase occupants in the area can be drawn by ceramic analysis. In addition, archaeologists have identified evidence of a Fremont presence (a Late Prehistoric archaeological complex typically associated with the Great Basin and Colorado Plateau) at the Calpet site (Site 48SU354) in the Pinedale RMPPA (Francis and Walker 2000).

Stone circle sites, typically believed to date to the Late Prehistoric period, are known from the Mesa and Blue Rim, probably representing preserved prehistoric dwelling or residence sites suggesting seasonal existences. Recent extensive inventory along the flanks and bluffs of the Green River and the Rygrass uplands has identified any dozens of stone circle sites, rock alignments, cairns and other (presumably) late Prehistoric stone archeological sites. To some, a complex of hunting strategies (drive lines, game observation points, blinds) involving prehistoric manipulation of game within tens of thousands of acres is suggested. Many of these types of sites are considered sensitive, "respected areas" by traditional, modern day Native Americans.

Ethnohistoric Period

The Ethnohistoric (or Protohistoric) Period begins sometime after 300 years B.P. with the first European trade goods to reach the area, and it ends with the development of the Rocky Mountain fur trade 150 years ago. Problems have arisen in identifying the transition between the Firehole Phase and the Protohistoric Period. Some researchers prefer to use dates indicating the earliest possible contact as the beginning of the Protohistoric Period. Others have chosen the distinction based on assemblage content, including the presence or absence of European trade items. Modern ethnic affiliations to archaeological assemblages can be assigned with only moderate certainty. The Wyoming Basin was the heart of Shoshone territory during this period, with occasional forays into the area by other groups such as the Crow and Ute (Smith 1974).

The most profound influence on native cultures during this period was the introduction of the horse in the early 1700s, primarily from the Spanish settlements in Texas and New Mexico (Haines 1938, Secoy 1953). Horse culture and its attendant mobility enabled the resident Shoshone peoples to expand their range east into the Powder River Country (Shimkin 1946, 1986). Hunting, especially of bison, became more efficient with a consequent increase in average group size and change in social organization. Material culture became easier to transport with the horse, and sites of this period often contain diverse assemblages, including metal knives and projectile points, glass beads, copper implements, and other European goods. Metal projectile points have been recovered from surface and subsurface contexts in the Green River Basin.

Although not as prevalent as within some areas of the Green River Basin, a number of rock art sites have been recorded within the Pinedale RMPPA, including protohistoric/early historic panels with horses and at least one panel that has Fremont affinities. Both petroglyphs and pictograph panels are in the Pinedale RMPPA. Known panels include Site 48SU354 (Calpet site), Names Hill site, Chevron site, South Piney site, Fontenelle site, Site 48SU1443 (Birch Creek Overlook site), Bird Draw, Site 48SU1786 (Western Camp site), and Alkali Creek Petroglyphs.

Native American tribes, including the Ute, Shoshone, Crow, Arapaho, and Cheyenne Tribes/Nations, have been identified with specific tribal territories located in or within proximity to the Pinedale RMPPA (see Map 3.2-1).

Historic Period

Including historic trails, a large number of all recorded cultural resources date to the Historic Period. Some of these nontrail sites are directly or indirectly associated with trails. A number of sites related to various themes or contexts are present in the Pinedale RMPPA, from the early fur-trapping industry to the recent oil and gas development. Historic site types include Rendezvous-related sites (48SU28), portions of the Sublette Cutoff and the Lander Trail and Emigrant Trail related sites (such as 48LN 300), wagon roads such as Opal and Rock Springs to New Fork, various trails, early townsites; early homestead/ranchcomplexes dating from the 1880s to 1920s; early 20th-century automobile routes (including bridges); irrigation ditches; open camps dating to the Fur-

Trapping Period; several rendezvous sites; line camps; corrals and windmills; burials; historic inscriptions (on both wood and rock); trails and stock driveways (including the "Drift"); tie hack and other logging remains such as flumes; Civilian Conservation Corps camp remains; and the ubiquitous tin/trash scatters associated primarily with the livestock industry. Several potential Rural Historic Districts that might be eligible for listing on the NRHP are located within the planning area. The complex of emigrant trail historic resources near Names Hill is one; sites relating to early oil field development in the LaBarge oil field are another. A third (privately-owned) Historic District might include the early ranches and ranching complexes located along the Green and New Fork Rivers.

Spanish and British colonial interests claimed the area. The United States' claims arose from Captain Gray's discovery of the mouth of the Columbia in 1792. The Adams-Onis Treaty of 1819 removed Spain's claims in favor of the United States, based on Louisiana Purchase (1803) boundaries. An 1846 compromise set the Canadian boundary at its current position. The Treaty of Guadalupe Hidalgo in 1848, following the Mexican American War, removed Mexican claims from additional territories, establishing the current Pinedale RMPPA in the Oregon Territory. As territories divided, the Pinedale RMPPA was in Washington Territory from 1859 to 1863, between the Idaho and Dakota Territories from 1864 to 1868, and in the Wyoming Territory after 1868. Wyoming became a state in 1890. Lincoln County split from the larger Uinta County in 1911, and Sublette County separated from Lincoln and Fremont Counties in 1921.

Geographically, the Pinedale RMPPA is characterized by the headwaters of the Green River system, which the local Native Americans called Seeds-Ke-Dee-Agie (or Sage Hen River). When fur trappers and traders came to the Green River Basin, they took advantage of the drainage systems to trap abundant beaver and to trade with the Native peoples. The upper Green River country was the select northern Emigrant Trail route because it offered a practicable route over the Continental Divide, a route that eliminated the necessity of ferries over the major rivers of the region (i.e., Green and New Fork rivers). Fredrick Lander's Road, built with government funding in 1852, may have included the highest mountain passages in Wyoming Range, but it did contain abundant water and game. Early guides and trails led emigrants *through* the region because early settlers were intent on finding moister lands on the coast.

Open range livestock ranching became the primary industry of permanent settlement in the upper Green River country as a result of difficult farming, attributed to aridity, altitude, and a short growing season. Open range ranching on the upper Green was adjusted to seasonal cycles and central ranches stationed strategically to take advantage of major water sources and drainages. Later extraction of oil from Pinedale RMPPA lands ultimately followed geologic divisions in establishing formal field boundaries. These mineral reserves were placed under tighter federal control in 1915, following previous reserve of forest lands and reclamation enactments to make arable lands in the arid West.

Early Exploration

Early exploration was marked by the expansion of the fur trade, opening American frontiers. It was also manifest in various expeditions both to survey access and explore the extent of resources offered by expansion of United States' territories.

Fur Trade

The Fur Trade Era in the Pinedale RMPPA began with the Astorian Expedition in 1811 and ended with the last organized Rendezvous in 1840 on Horse Creek in the RMPPA. The first wagons across South Pass were attributed to Captain Bonneville's party in 1832 and the first Euroamerican missionaries (including the first Euroamerican women) crossed South Pass in 1836—the famous Whitman/Spaulding party. Fur trade in greater North America began with colonization and contact in the early 1500s and declined with the end of beaver-felt hat popularity in the 1830s. The fur trade was focused across the Pinedale RMPPA by competition with an expanding British/Canadian fur trade (McKenzie's North West Company and later the Hudson Bay Company) and the location of the mouth of the Columbia River by American ship captain Robert Gray in 1792 (representing Bostonians in the sea otter fur trade of 1780s–1815 with China).

The mouth of the Columbia River gave Lewis and Clark a known destination in their exploration of Louisiana Purchase lands after 1803. It provided known territory for extension of the Astor's American and Pacific Fur Companies by the 1811 William Price Hunt Expedition. In 1806, John Colter split from Lewis and Clark, and Robert Stuart returned from Fort Astoria in 1812, both providing more information about this region. Robert Stuart is credited with "discovering" South Pass when he, following a Native American travois trail, crossed the Continental Divide from the upper Green River to the Sweetwater River, and later to the North Platte River.

In 1842, John C. Fremont of the U.S. Army Corps of Topographical Engineering, explored the planning area, camping near Fremont Butte and Boulder Lake. He is credited with the first ascent of Fremont Peak, and renamed Stewart Lake after himself, Fremont Lake. Fremont's map opened the RMPPA to the Westward Migration, which began in 1843. (The point of this section is to set the stage for the fact that Fremont Butte, Boulder Lake and other Fremont camp sites and trails are on BLM-administered lands).

The War of 1812 caused a lull in exploration, but 1824 brought William Sublette and Jedediah Smith back through South Pass. By 1825, the mountain men of William Ashley and Andrew Henry's Rocky Mountain Fur Company were working the upper Green River Basin. In 1832, Captain Benjamin Bonneville brought wagons over South Pass and established Fort Bonneville on the Green River (near current Daniel Junction). From 1833 to 1840, rendezvous were held intermittently on the Green River within the Pinedale RMPPA. After the decline of the beaver trade, mountain men were left mainly to guide emigrants on the Oregon Trail, operate trail trading posts and ferries, or work the buffalo hide trade on the Plains.

Expeditions

The era of expeditions in the northwest Wyoming region basically began when John Colter left the Lewis and Clark corps in 1806 and ended with the last of the larger formal survey parties, when the Hayden expedition passed through Wyoming and the Pinedale RMPPA around 1877. Early Expeditions were connected to national expansion, and later expeditions tended to be working toward the expansion of settlement, industry, and transportation. All expeditions were characterized by objectives to open new access and explore exploitable resources. Many of the significant early overland expeditions were integral to the expansion of the American fur trade.

The first survey party in the Pinedale RMPPA, the Fremont Expedition, was surveying what became the Oregon Trail in 1842. Beginning in 1857, Frederick Lander began further road surveys across the Pinedale RMPPA in developing what would be known commonly as the Lander Road, an alternate route on the Emigrant Trail system. In 1869, down the Green River from the Pinedale RMPPA, John Wesley Powell conducted the geological survey of the Colorado and Green River canyons that left a lasting policy legacy affecting the entire West. The Hayden Geological Survey that came through in 1877 was important for producing road and trail system maps.

Transportation

The history of the West is marked by mobility. The transportation system in the West is composed of networks spanning long distances to connect remote and scattered places. History of western transportation is marked by a series of progressive changes in transport systems that shortened the time it took to traverse wide areas. These changes did not fully result in the replacement of preceding systems, but augmented them; the railroad supplanted the Emigrant Trails, and the automobile road supplanted first the wagon road (early Expansion-Era roads) and then, to a large extent, the railroad.

Emigrant Trails

Use of the Emigrant Trail system began with the first organized wagon trains from Missouri to Oregon in 1843, following routes and guides established in the Fur Trade era. The trails saw a decline of usage with the connection of the Transcontinental Railroad in 1869, although the trails did receive continued use after 1869, especially as part of the stage and freight routing. The Lander Trail in the Pinedale RMPPA was used by emigrant wagons as late as 1912 (BLM and USFS 1998).

The Sublette Cutoff is another Oregon/California Trail segment in the southern Pinedale RMPPA. Names Hill and its environs are an important historic site (historic district) associated with the Sublette Cutoff. Listed on the National Register, Names Hill includes Mountain Man Jim Bridger's Mountain Man Ferry, the Moron Ferry, and Green River Ford. The earliest Oregon Trail inscriptions at Name Hill date to 1845, although the site was occupied earlier. After the Mormons settled Salt Lake in 1847, they built and ran many ferries at various river crossings along trail alternates and they set up trading posts. With the California Gold Rush of 1849, traffic over the trail system increased

substantially. As a result of the potential for encounters with Native Americans, traffic shifted toward more southerly alternatives during the Civil War years when local military troops were called east.

More than 50 miles of Frederick W. Lander's Road are found within the planning area. First planned in 1857, it was the first engineered road west of the Mississippi. Its purpose was to create an efficient travel route between Fort Kearny and Fort Hall, with fordable Green River crossings, and better water and forage access. At the urging of John C. Fremont, the Lander Road was funded by Congress as a result of increased Emigrant Trail traffic associated with the Gold Rush of 1849 (BLM 1987).

Railroad

The Transcontinental Railroad, completed in 1869, was capable of providing for western shipment of people and goods that previously used the Emigrant Trail system. The railroad followed a path similar to (and often overlapping) the Emigrant Trails. The railroad did not just provide alternative transportation. Included in the railroads' promotional offers, to create their own market in the expanses of the West, was free transport for anyone wishing to settle/buy railroad lands. Railroad lands usually had been preempted to private companies by Congress to help finance railroad expansion. The Oregon Shortline Railroad branch was added to the Union Pacific Mainline in 1882, bringing railroads even closer to the Pinedale RMPPA on their way through Opal, 30 miles to the south.

In general, the railroad permitted easier access for shipment of inland western products to eastern and pacific coastal markets. The railroad served to open up the Wyoming Territory and the Pinedale RMPPA by allowing these lands to become economically viable for ranching.

Expansion Era Wagon Roads

Expansion Era Wagon Roads are those that came after the connection of the Transcontinental Railroad and tended to network from railroad arteries. Named main artery wagon roads include the Opal and the New Fork Roads. The Lander Cutoff of the Emigrant Trail system was used in part as a stage and freight route during the Expansion Era. Use of these roads created networks accessing local resources instead of simply channeling traffic across the region as the Emigrant Trails originally did.

The Opal Wagon Road connected the Oregon Shortline railhead at Opal, Wyoming, to the ranches of the upper Green River Basin. Freight, mail, foodstuffs, manufactured goods, and people were transported along this lifeline to the railroad. (Rosenberg 1984). Once constructed, the Oregon Short Line Railroad to Opal was less than half the distance of the older Union Pacific mainline corridor from the Pinedale RMPPA. The Opal Wagon Road replaced previous preferences for travel to the mainline at Green River City, and it became the premier freight and cattle drive route for the region after 1882. The New Fork Wagon Road formed to serve the east side of the upper Green River Valley.

The New Fork Wagon Road accessed the Union Pacific Mainline at Rock Springs, providing ranchers with a direct market for their products.

Automobile Roads

If the railroads increased the ease with which goods could be freighted in and commodities shipped out, the auto roads increased the speed with which places beyond the rails could be reached by people and transported goods. Like the transportation networks that preceded the automobile route, the auto road used arterial ways, eliminating the need for peripheral sidetracks and back roads. Auto roads began along the same major transportation corridors as the Emigrant Trails system and railroads before. The first transcontinental highway (the Lincoln Highway or U.S. Highway 30) passed proximate to the first Transcontinental Railroad route, south of the Pinedale RMPPA, allowing tourist auto traffic to connect to Yellowstone from the south across the Pinedale RMPPA. The construction of Interstate 80 in the 1960s increased the volume of traffic diverging through the Pinedale RMPPA.

In the Pinedale RMPPA, development of highway routing roughly paralleled development of the Opal and New Fork Wagon Roads in route and sequence. In 1924, the current Highway 189 corridor was first constructed on the west side of the Green River Basin, mostly following the corridor of the Opal Wagon Road. Highway 191 arose from the Rock Springs auto road, but it does not totally overlap that earlier auto road. The auto road to and from Rock Springs was in use in 1907 when an auto road was established south of New Fork across 70 miles of waterless desert that proved challenging for horse and wagon use. Before this time, improvements were being made along the road from Rock Springs to Pinedale around 1906, following some of the same points as the New Fork Wagon Road. The direct route from the Lincoln Highway at Rock Springs to Yellowstone was completed through Hoback Canyon in 1920, increasing the access through the area for tourists to Yellowstone.

Settlement and Industry

Settlement and industry are intertwined in the Pinedale RMPPA. The cattle ranching industry is largely responsible for the ultimate settlement of the upper Green River region, with many communities growing from ranch centers. The growth of these ranching centers was supported by railroading and logging activities. The oil industry came later, adding much to the community development that started in the initial ranching era.

Homesteading

Homesteading laws were very important for the settlement of the West and the Pinedale RMPPA. They provided a principal means of transfer of federal lands to private individuals. Most area ranch lands were patented because of one or another of the various homestead laws.

The *Homestead Act* has its foundations in the Free-Soil Party of 1848, later subsumed in the new Republican Party in 1854. The southern states were opposed to the homestead

movement because it tended to be antislave. Concluding the Mexican-American War in 1848, the United States had acquired western lands that had to be designated "slave" or "nonslave." The Free-Soil Party advocated free land, and the Republicans used this homestead platform in electing Abraham Lincoln in 1860. The Civil War allowed the North to pass the *Homestead Act* of 1862. By then, emigrant travel had traversed the Emigrant Trails system for 20 years. The *Homestead Act* encouraged new satellite settlements of Mormons from Salt Lake, many in southeastern Idaho and some in southwestern Wyoming. Other laws presenting opportunities to expand homestead holdings followed: *Timber Culture Act* of 1873, *Desert Land Act* of 1877, *Enlarged Homestead Act* of 1909, and *Stock Raising Act* of 1916. Laws concerning reclamation were also passed, such as the *Carey Act* of 1894 and the *Reclamation Act* of 1902. Ironically, these reclamation acts were followed by the *Dry Farming Homestead* of 1910, which encouraged development without irrigation through advancement of soil management techniques. In short, all of the laws held in common a requirement of use and improvement, usually biased toward farming.

Ranching

Ranching has been the traditional industry in the Pinedale RMPPA, with its roots in the Fur Trade Era. Ranching can be divided into two eras: 1800s and 1900s. Wyoming cattle ranching may have begun with Fort Bridger on the Green River in 1843 when Jim Bridger bought and sold stock from emigrants. It expanded when William Carter of Fort Bridger drove Texas cattle to be fattened in Wyoming and shipped east after the Civil War.

Although ranching in the upper Green River Basin began 9 years earlier when John "Sheep" Smith began a sheep operation near the mouth of Fontenelle Creek, the completion of the Transcontinental Railroad in 1869 allowed permanent ranching settlement to begin in the Pinedale RMPPA. Central ranches tended to be established on good riparian bottomlands, with natural grass pastures, and good permanent water sources. Outward from this center, ranches needed wide rangelands to support their cattle. Patenting under the various homestead acts was a usual way of establishing ranchland, while the open range was left public. As with much of the West, area ranches tended toward consolidation into large ranches as a way to more sustainably maintain profitable herd sizes. Cattle were the chief stock type on the range. The Star Ranch was one of the first cattle operations in the region.

Cattle herds in the Pinedale RMPPA were decimated by the winter of 1889–1890. Afterward, range management techniques changed. Perhaps most significantly, hay meadows were intensively developed and more feed put away to supplement winter feeding. Some area ranchers were also led to run sheep as a means to help cheaply reestablish their ranches. In the scheme of things, sheep sold for about one-tenth of the cost of a cow and could browse poorer range. On the other end of the spectrum, horse raising could bring several hundred dollars per head for a quality horse, and horses did not necessarily have to be run in the same numbers as cattle to be profitable. With more sheep on the range beginning in the 1890s, cattleman-sheepman conflicts increased. In

1895, cowboys slaughtered sheep herds and forcefully deported herders at what was to be known as Raid Lake, northeast of the Pinedale RMPPA (BLM 1987).

Dude or "guest" ranching, including hunting resorts and outfitting, was also formally established on the upper Green River in 1897. The Billy Wells' Gros Ventre Lodge was the first, north of Cora, although technically William Sublette became the first outfitter when he was hired to sportingly take Scotch Captain William Stuart's party to the 1834 Rendezvous.

The killing winter of 1889–1890 also demarcates the change of cattle ranching practices in the upper Green River country. Soon, the aggregation of ranches that gathered to sort their brands from ranging cattle was reformed into formal grazing associations. These organizations addressed concerns about drift fencing and federal grazing permits for lands withdrawn for federal forest reserves in 1891. The *Stockraising Homestead Act* of 1916 finally divided U.S. Forest Service grazing allotments and initialized fencing of public rangelands. Grazing associations gave ranches the foundation they needed to maintain their operations in the face of change in federal land use policies, not only from the 1905 institution of the U.S. Forest Service and the 1916 grazing laws, but also from the later *Taylor Grazing Act* (TGA) of 1934.

The TGA was legislated in the Great Depression. The TGA permitted the Secretary of the Interior to place public lands chiefly valuable for grazing and forage crops into grazing districts. After the TGA was signed, President Franklin Roosevelt withdrew all vacant, unreserved, and unappropriated public land in the West from nonmineral entry. This allowed the grazing district to be set aside for that purpose. It restructured the remaining General Land Office lands into grazing allotments managed by the Federal Grazing Service, and later combined to form lands managed by the BLM. The same year of TGA enactment, the Pinedale RMPPA experienced a range disaster similar to the winter of 1889–1890. Prolonged drought and a falling Depression-era cattle market caused an emergency culling and forced slaughter programs to be implemented on regional herds.

The *Taylor Grazing Act* resulted in grazing practice changes. Further restrictions were placed on open range grazing, and cattle moved along narrow driveways between summer and winter range. The system of animal units per month was set in 1937, restricting cattle density in grazing allotments based on estimated natural forage production. The law also increased seasonal restrictions on range use, in part resulting in a greater need for water development and catchments on desert lands. The Civilian Conservation Corps assisted in many of these range improvements during the Depression (1934 through 1942). In 1935, the National Soil Conservation Service was also created, assisting ranchers with range improvements and erosion control. After 1946, the BLM began building stock tanks, water wells and pipelines, and stock ponds on its lands to serve the cattle industry and wildlife.

The BLM began a policy of granting grazing allotment permits to individual ranchers rather than associations. These individual allotments were being separately fenced through the 1950s. When the highway corridors were fenced off from the range in the

1950s, the open range was further restricted. In the 1960s, the institution of active technical range management policies had increased, particularly under the auspices of the BLM.

Timber Industry

Logging occurred on public land within and adjacent to the Pinedale RMPPA on lands in the vicinity of Miller Mountain, LaBarge Creek/Deadline Ridge, Piney Creeks, Scab Creek, and East Fork. The main mode of logging was the cutting of railroad ties, or "tie hacking," mine spars and later, coalmine stays. Tie hack camps used the timber, and small, locally operated sawmills and portable sawmills were established to supply lumber. Area streams and the Green River were used to transport ties to the railhead at Green River City. Ties were collected in the winter and stockpiled along the streams of the upper Green River, creating temporary logjams and dams. When spring snow melt occurred, the ties would hold back large quantities of water, then the logjam would break loose, sending ties, water, and sediment rushing downstream. One of the results of this system was extreme damage to riparian systems of feeder streams and to the Green River itself. It is estimated that between 300,000 and 500,000 ties were transported to Green River City during peak tie hack time. The era of the tie hack ended in the late 1910s when the United States Forest Reserves was established. The United States Forest Service prohibited the tie hack practice as described above.

Mining

No significant precious metal extraction occurred in the Pinedale RMPPA, although prospectors traversed the vicinity. However, two small coal mines are known for local fuel production. The Salli Mine (Site 48LN2045) and Twitchell Mine have been recorded. Other coal mine remains, adits, and prospects are known in the Hogsback area. The Transcontinental Railroad passed to the south of the Pinedale RMPPA on a route similar to that of the Emigrant Trail because sources of coal were available, as at Kemmerer, to mine for locomotive fuel. As the railroad was being built, the gold strike at South Pass occurred, resulting in an influx of people into the region.

Oil and Gas Industry

Oil was located in the Pinedale RMPPA as early as 1892 (Rosenberg 1984). The Pinedale RMPPA oil industry was in its infancy when Congress passed the Mineral Leasing Act of 1920. The Act changed the acquisition process for oil development on federal lands from oil land patents based on placer mining claims to leases. Nearly all federal oil and gas development in the Planning Area has occurred through leasing process. Note: The oil and gas industry is typically one of "boom and bust" cycles depending on the level and economy of supply and demand. Charles Lackey, Charles Budd, and W.D. Newlon were responsible for pioneering field development out of LaBarge and Big Piney.

The Pinedale RMPPA oil industry was forming in 1919 on the cusp of the 1920 legal change from oil land patents based on placer mining claims to federal leasing of recently

(1915) withdrawn public mineral reserves. The Department of Interior was given administration of United States oil reserves following the Teapot Dome federal graft scandal. The 1920s legislation also sought more responsible development of market supply and supply conservation to halt the rapid short-term exploitation practices encouraged by the 1840s Rule of Capture. President Coolidge formed the Federal Oil Conservation Board in 1924 to advise on regulating the industry. It was followed in 1929 by the nongovernment Interstate Oil Compact Commission that would be ratified by states in 1935, followed by the *National Industrial Recovery Act*. Lack of implemented regulation came to a head in the 1930s, causing the Hoover administration to mandate that the oil fields be united for cooperative management of oil and gas deposits, mostly by geologic division/extent. After the Great Depression, World War II caused a great upsurge in demand for oil. The oil and gas industry is typically one of "boom and bust," depending on level and economy of supply and demand.

Formation of Towns and Communities

Settlement spread from transportation corridors and drainage networks important for the establishment of ranches. As later stage and freight routes formed to service ranches and ranch communities, settlers often followed ranch wagon roads or bent to pass directly by ranch headquarters. Early ranches often supplied their own schools and started post offices to service their vicinity. From these ranch centers, towns such as Viola developed. Other towns formed at strategic points on trade routes where businesses like the Vible Store opened to service a local area along a main road. Both ranch communities (and later oil development communities) were also the subject of speculators who sought to subdivide lots and attract residential and commercial town growth. Many rural communities consolidated or shifted with change in markets and the shortening of distances by improved roads and the arrival of automobile transportation.

Some small communities arise during booms and do not survive busts. Ranching has persevered, supporting the development of and being the sustenance for many local communities. Like the ranches themselves, many of the small "in between" communities have faded, consolidating with or becoming the rural base of those surrounding communities that have persisted.

Cultural Resource Concerns

Existing cultural resource concerns within the Pinedale RMPPA involve prehistoric archaeological sites, Traditional Cultural Properties (TCP) rock art, trails, and other places or properties that are considered to be traditional cultural properties.

Prehistoric Archaeological Sites

Prehistoric sites can potentially have scientific, conservation, and traditional values and uses. The time period, location, integrity, and structure of a particular site influence the degree of its scientific value. For the same reasons that these sites have high scientific values, they can also have high conservation values. Conservation of prehistoric archaeological sites also may result in better determination of areas of traditional cultural

importance to affiliated tribes, or TCPs. A TCP is defined as a place or property of traditional or religious importance that is eligible for inclusion in the National Register because of its association with cultural practices or beliefs of a living community that are rooted in that community's history, and are important in maintaining the continuing cultural identity of the community (Parker & King 1998). TCPs, which manifest as prehistoric archaeological sites, may include petroglyphs, archaeological ancestral sites, gathering/procurement areas, and human burial areas, and/or places that hold sacred or religious importance to the affiliated tribe or tribes. Traditional significance is placed on or is derived from ideological beliefs about the residing of human spirits in given locations. As detailed below, the BLM consults with all Native American tribes that have aboriginal territories within the Pinedale RMPPA as part of the Sections 106 and 110 processes to identify places of traditional cultural significance and determine potential impacts that could adversely affect areas within a proposed project area. Several TCPs are known for the RMPPA. Native American consultation has resulted in a Tribal desire to preserve the physical integrity of TCPs as much as possible. Native Americans stress the interrelatedness of many of these locales and emphasize that BLM should consider them more holistically, as cultural landscapes. Frequently, the disturbances resulting from energy development, especially associated with wildcat exploration in heretofore undeveloped areas, creates direct conflict with the Tribal position of preserving unspoiled cultural landscapes associated with TCPs and other sites and locales considered sensitive, sacred or of concern to modern day traditional Native American practitioners.

Within the Pinedale RMPPA, archaeological sites are subject to intense, unauthorized collecting and are susceptible to incidental or accidental damage through actions such as off-highway vehicle use or camping. Illegal artifact collecting and vandalism is prevalent in the Trapper's Point area, as well as disturbance of rock alignment sites at 48SU275, Mesa and Rygrass. In cases where heavy equipment and other construction activities affect archaeological sites, existing procedures (inventory, evaluation, and avoidance/data recovery for significant sites) are usually adequate to avoid adverse impacts, and can be accommodated by the Wyoming Protocol, which usually includes avoidance, special construction stipulations, or data recovery excavations. Nonetheless, unintentional damage occurs at an increasing rate as development projects impact buried sites in sensitive archeological areas. Causal secondary lithic procurement landscapes continue to be treated as not significant or not eligible for listing on the NRHP as a result of their limited data potential and lack of intact, subsurface archaeological deposits. Specific site concerns are as follows:

- **Wardell Site.** The Wardell Site, a possible Avonlea bison bed/kill site that is listed on the NRHP, is being severely affected by erosion.
- **Boulder Lake District.** A Draft Cultural Resource Management Plan was developed in 1991 for this property, which is being affected by shoreline action, unauthorized collection, and vandalism. This district is managed for the preservation of cultural and historical values, including periodic patrolling by law enforcement personnel to prevent the collection of artifacts and site vandalism.

However, the plan has never been finalized and a report of preliminary district investigations has not been prepared.

- **Jonah/Pinedale Anticline/LaBarge Gas and Oil Fields.** Compliance-related efforts in the Jonah/Pinedale Anticline/LaBarge oil and gas fields will continue to be performed under the National PA/Wyoming Protocol. Site 48SU4000 is a large, complex archaeological district consisting of about 25 archaeological locales. Most locales are small rock shelters with features and associated artifact scatters. Because the area is currently part of a lease that cannot be withdrawn, this site may be threatened by development sometime in the future. The BLM is working with industry officials to develop a program in which the industry will sponsor data recovery excavations at the pace of one site for each well they develop in the area. Development of a specific cultural resource synthesis for the Jonah/Pinedale Anticline is called for in the RODs for these oil and gas fields.

Traditional Cultural Properties

Nonarchaeological site types are distinguished from archaeological site types because they are not necessarily associated with prehistoric or historic artifacts assemblages and collections but may include vision quest areas, vegetal and mammal processing areas, ceremonial areas, and other types of areas. These sites are often referred to as TCPs and are typically identified by tribal representatives during the government-to-government consultation process that is required of federal agencies. However, TCPs can also be identified by representatives of other culture groups, such as historic culture groups associated with the Euroamerican migration to the western United States. Several TCPs (Sites 48SU285, 48SU2019, and 48SU4100) have been identified and recorded within the Pinedale RMPPA. Numerous sites (including additional archaeological sites) of this type exist in the area. Fewer than 10 prehistoric/Native American burial sites, mostly of single individuals, are known in the upper Green River Basin region. Both scaffold burials and shallow pit burials have been reported for the area.

The BLM is mandated to consult with Native American tribes concerning the identification of cultural values, religious beliefs, and traditional practices of Native American people that may be affected by actions on federal lands. Places that may be of traditional cultural importance to Native American people include locations associated with the traditional beliefs concerning tribal origins, cultural history, or the nature of the world; locations where religious practitioners go, either in the past or the present, to perform ceremonial activities based on traditional cultural rules of practice; ancestral habitation sites; trails; burial sites; and places from which plants, animals, minerals, and waters possessing healing powers or used for other subsistence purposes may be taken.

BLM consults with all Native American tribes with aboriginal territories within the Pinedale RMPPA as part of the Sections 106 and 110 processes to determine the presence of nonarchaeological site types, which are usually identified as TCPs sensitive sites, sacred areas and areas and sites considered special or of concern to modern day Native American practitioners. BLM makes every effort to keep any information concerning these site types confidential to the extent possible. Typically, a tribe is not comfortable

giving any information about these site types. The federal government will not be able to protect these sites if no locational information exists. These site types can be further protected if a tribe is willing to provide traditional use information that can be used to determine significance to tribal individuals. Integration of Native American concerns in overall project planning, especially in areas not developed for oil and gas, has proven to be difficult in recent years. Efforts to balance the rights of energy developers holding valid lease rights and Native Americans trying to preserve intact landscapes will be made between BLM, Shoshone and Ute tribes.

Prehistoric/Native American Burials

Fewer than 10 prehistoric/Native American burial sites, mostly of single individuals, are known in the upper Green River Basin region. Some individual burials are located within rock shelters or cave sites. Both scaffold burials and shallow pit burials are reported for the area. Burials and burial sites are recognized by Native Americans as sacred places that should not be disturbed. The most important concerns of Native Americans are the discovery, protection, and cultural affiliation of burial sites. Many Native American groups, including groups that claim cultural affiliation within the Pinedale RMPPA, maintain the following beliefs:

- The spirits of deceased ancestors remain associated with the burial for an undeterminable length of time and should not be disturbed. Disturbance interrupts the journey the spirit must make.
- Disturbance may also anger the spirit and cause harm to the living.
- Disturbance is disrespectful.

The Native American Graves Protection and Repatriation Act and the American Indian Religious Freedom Act are laws that focus on issues of protection and repatriation of Native American burials; associated cultural artifacts; and access to and use of these sites by tribes that claim cultural affiliation. Human burials located in the RMPPA are subject to the management prescriptions identified by NAGPRA and its implementing regulations; however, these sites also require significant protection because of particular legal issues related to burials.

Avoidance of archaeological sites containing graves is encouraged, as are intensive surveys to identify such sites. Archaeological investigations for planning or research purposes on federal and tribal lands, and other land-modifying activities on federal lands that inadvertently discover such items, are required to comply with the procedures identified in NAGPRA and its implementing regulations.

Rock Art Sites

Prehistoric rock art sites include petroglyphs (inscriptions incised or carved into a rock surface, usually sandstone) and pictographs (painted imagines on a rock surface). To protect rock art sites, the BLM may consider fencing, interpretive signs, barriers, and project relocation, or other protective measures, as appropriate. Because rock art sites are

among the most fragile of all cultural resources, their location is considered proprietary, and their location is not divulged. One exception is 48SU354(check), the Calpet Rock Shelter, because this site has been completely recorded, all panels professionally documented, the National Register nomination is complete and the shelter has been excavated. Therefore, the scientific information has been recovered. This site may be available for limited, controlled public use. Surface disturbing activities in the immediate vicinity of rock art sites can be restricted, and such activities near rock art sites constitute a reason to consult with Native Americans concerning the appropriateness of the proposed undertaking. Off-highway vehicle (OHV) travel, including vehicles used for geophysical exploration activities, and the use of fire retardant chemicals containing dyes may be restricted in the vicinity of rock art sites. Representatives from the Shoshone and Ute tribes have stated during onsite meetings with BLM personnel that all rock art sites in the Green River Basin are significant to contemporary groups. All other rock art sites (specifically, historic, Euroamerican rock art) are managed on a case-by-case basis according to resource values.

Historic Trails

Within the RMPPA, congressionally designated historic trails include portions of the Sublette Cutoff and Lander Road, both components of the Oregon/California National Historic Trail system. Protection of the Oregon and Mormon Pioneer National Historic Trails and the Pony Express and California historic trails involves cooperation with the National Park Service in implementation of the Comprehensive Historic Trails Management Plan for the Oregon and Mormon Pioneer National Historic Trails. Although many protection measures are in place, development activities (e.g., roads, pipelines, and power lines) can cross trails in areas where the trail has lost its NRHP characteristics and would no longer be considered a contributing segment to the trail because previous disturbance has occurred. Visual management of the Lander Trail landscape from U.S. Highway 191 to the Green River Crossing is addressed in the ROD for the Pinedale Anticline Oil and Gas Exploration and Development Project EIS, which states that well pads, access roads, and pipelines can be located on public lands and minerals in a manner that minimizes their visibility from the trail to the extent practicable and that any visibility analysis can use the viewshed analysis maps published in the ROD for the Pinedale Anticline Oil and Gas Exploration and Development Project EIS and that any developments proposed within the viewshed sensitivity area (as published as the viewshed analysis maps in the PAEIS) will be subject to viewshed analysis, with mitigation developed as a result of this analysis. In addition, the Pinedale RMPPA staff is conducting a Condition Assessment for the Lander Trail from Buckskin Crossing to near Big Piney.

Historical Sites

Historic sites, which are defined as sites 50 years or older, include architectural sites, trash scatters, fur-trapper sites, irrigation structures, early oil and gas fields, and potentially historical landscapes. As highly visible sites, they are subject to vandalism, but several methods can be used to protect these sites. In addition, the architectural elements for some of these sites (walls, floors, etc.) are also subject to weathering and

deterioration. When time and money allow, efforts are taken to stabilize such sites. Efforts are made to balance development and preservation and to determine a means of protecting them from human and natural harm, except in the Scab Creek and Lake Mountain WSAs. In WSAs, historic sites are allowed to deteriorate naturally as part of the WSA cultural resource management policies. Trash scatters, in general, are not considered significant or eligible for inclusion on the NRHP because they are not likely to produce information that would significantly further our understanding of the region's history. Archeological investigations and other land modifying activities inadvertently discovering archaeological sites containing graves are required to consult with the Native Americans and the SHPO.

3.3 FIRE

Fire in the Pinedale RMPPA falls under two categories: unplanned and planned. Unplanned fires are those that occur as the result of an act of nature, such as lightning, or occur either as human accident or by intent to cause damage. Planned fire is used for beneficial purposes, such as fuels reduction under a specific prescription or planned effort. Over the past 100 years, fire has been suppressed extensively in the PFO area, causing the general buildup of vegetative fuels and deadwood. Also, extremely dry conditions over the past few years have made some vegetation communities more susceptible to wildfire.

Lightning accounts for most fires within the region. Human-caused fires can be ignited by fireworks, wood cutting, or camping. No pattern exists to predict future unplanned fire problems.

Vegetative communities that would be most susceptible to fire include sagebrush and grassland communities in the lower elevations, and conifer species, such as lodgepole and limber pine, in wooded areas. In wooded areas, fuel sources include dead and down timber or standing timber with high loading value because of the lack of fire in the past and dry weather conditions. Aspen is not as susceptible to fire as conifers and shrub communities.

Review of available historic fire data for the Pinedale RMPPA indicates that the frequency of wildfires has been low. This is true, even though the buildup of fuel in some areas has increased the probability that any wildfire that did occur would be intense. Of the roughly 30 historic wildfire locations identified within the RMPPA, about half of the wildfires have been caused by lightening and half by human activity. Of these wildfires, only five have burned more than 100 acres. Responses to wildfires, including suppression through containment, confinement, or control, would be implemented as needed, if wildfire were to occur in the area. The response to wildfire and the size of the area in which BLM would attempt to confine or contain a fire vary by fire management area.

Prescribed fire actions include unplanned ignitions and planned ignitions. Unplanned ignitions can be managed as prescribed fires if fire effects are favorable to the resource managed and ignitions occur under a specified set of environmental criteria

(prescriptions). Planned ignitions imply a planned fire intended to enhance the resource that is targeted for treatment (e.g., vegetation). Since 1988, ten prescribed fires have been used to burn a total of 8,700 acres.

3.4 FORESTRY

The RMPPA contains approximately 31,590 commercial conifer acres and an additional 15,280 woodland acres for a total forest acreage of 46,870. Commercial conifer acres are those acres of conifer species capable of sustaining lumber and other forest product production and for which a commercial/economical demand exists. They include the following species or species groups: lodgepole pine (Table 3.4-1 lists scientific names for this and other species), Douglas-fir, and the Engelmann spruce-subalpine fir community. It also includes nonstocked stands that have supported or are capable of supporting one or more of the commercial conifer species. The primary woodland species are aspen and limber pine.

Table 3.4-2 shows acreage and volume distributions by species. The acreages and volume figures in this table were derived from intensive forest inventory data collected from 1980 through 1983 using the Forest Service Stage II forest inventory method. Based on the inventory data, the planning area could sustain an annual unrestricted timber harvest of approximately 3.2 million board feet (mmbf) from the commercial conifer forest type. The 3.2 mmbf level is based strictly on timber harvest potential and does not consider other resource requirements and therefore was not considered implementable. Because of a general lack of demand for aspen and limber pine, timber harvest projections do not include those woodland species. Timbering techniques can be utilized, in the current vegetative situation, to meet various objectives, including wildlife habitat improvements. Conifer cutting within aspen stands can be a significant treatment for conifer encroachment, especially if followed by prescribed fire.

Much of the forest acreage is concentrated along the northern, eastern, and western boundaries of the RMPPA and occurs on north and east slopes as narrow, stringer-like stands that originate from larger blocks of timber at higher elevation on Forest Service lands. For analysis, the area has been divided into four individual management units:

- The Deadline-Pinegrove Unit, which lies between South Piney Creek and LaBarge Creek, includes the Graphite elk winter range, Riley Ridge elk winter range, and Rock Creek ACEC. The unit contains an estimated 13,448 conifer and 3,510 woodland acres of which 1,322 conifer and 180 woodland acres are in the Rock Creek drainage, 2,117 conifer and 840 woodland acres are in the Graphite winter range, and 1,028 conifer and 153 woodland acres are in the Riley Ridge winter range. In addition to the forest resource, the Deadline-Pinegrove Unit provides a spring, fall, and winter habitat for 400 to 600 elk, receives roughly 90 percent of the RMPPA's oil and gas development in forested areas, and contains a pure strain of Colorado River cutthroat trout in the Rock Creek drainage and a nearly pure strain in the Beaver Creek drainage.

- The North Piney Unit, which lies between the Maki Creek drainage and South Piney Creek, includes two elk feedgrounds: Finnegan and North Piney. The unit contains approximately 5,158 acres of commercial conifer and 4,451 woodland acres, of which 708 conifer and 354 woodland acres are in the feedgrounds. In conjunction with state, private, and U.S. Forest Service lands, the North Piney Unit provides year-long habitat for up to 1,500 elk; however, most use of BLM-administered public land occurs during summer, fall, and winter. The unit also contains about 10 percent of the RMPPA's oil and gas development in forested areas. Past management activities, timber harvesting, and oil and gas development, as well as wildfires, have removed conifer/wildlife cover from about 680 acres or roughly 15 percent of the conifer acreage.
- The Miller Mountain Unit, which lies between LaBarge Creek and Fontenelle Creek, includes the Fort Hill-Fontenelle elk winter range. The unit contains 8,191 forested acres (4,241 commercial conifer and 3,950 woodland) of which 277 conifer and 145 woodland acres are in the elk winter range. In addition to the forest resource, the Miller Mountain Unit provides yearlong habitat for 200 to 400 elk. Most of the winter use is confined to the elk winter range, but spring and summer use occurs throughout the unit. Additional discussion of the elk winter range can be found in the Section 3.19. Forestry and wildlife are the predominant uses in the unit; however, it also contains a moss rock sale area and some oil and gas exploration (three dry holes to date). Past management activities have removed conifer/wildlife cover from about 209 acres or roughly 5 percent of the conifer base.
- The Eastside-Hoback Unit consists of scattered parcels and blocks of forested land along the eastern and northern boundaries of the RMPPA. The unit contains the Scab Creek area and the Franz elk feeding ground. The unit is composed of 8,743 commercial conifer and 3,369 woodland acres. The Franz feeding ground has roughly 127 acres (75 conifer and 52 woodland). The Scab Creek area has 184 and 271 woodland acres. The Eastside-Hoback Unit provides a winter habitat for up to 800 elk, of which roughly one-fourth use the forested portions on a yearlong basis. Forestry, wildlife, and wilderness are the dominant uses; there has been no oil and gas development in the forested areas.

Forest conditions vary from young, healthy, relatively insect- and disease-free stands to those that are quite old with high levels of insect and disease activity and high mortality rates. Most stands in the planning area are starting to exhibit a reduction in vigor and wood fiber production and increases in disease and insect susceptibility as well as mortality. Inventory data indicate that current mortality rates vary from zero volume loss in young seedling and sapling stands to 18.4 cubic feet per acre per year in the spruce-fir sawtimber stands. The average mortality rate for all stands is approximately 7.7 cubic feet per acre per year or a total yearly loss level of nearly 1.64 mmbf. About 98 percent (1.61 mmbf) of the mortality is occurring in the commercial conifer. Primary insects or diseases include bark beetles, dwarf mistletoe, and several varieties of rusts.

All forested lands have been classified into one of four management categories. Timber harvest and thinning projections are based on the forested lands available in management Categories 1 and 2 (lands available for intensive forest management and lands available for restricted forest management). No harvesting is projected from forested lands in Categories 3 or 4. In addition, several forested areas, including the Rock Creek drainage and ACEC, the Scab Creek campground, the Beaver Creek drainage, riparian zones, elk winter ranges, and elk feedgrounds, are affected by categorization/acreage allocations, which either restrict the use of specific practices or totally preclude forest management activities. Primary resource values resulting in restrictions to the forest management program include:

- The Scab Creek WSA is forested on most of its 7,636 acres. Active forest management practices are prohibited in WSAs to avoid changing the character of the area until a decision is made on its status as a wilderness.
- The Lake Mountain WSA is forested on most of its 12,970 acres and active forest management practices are prohibited here as well.
- The Rock Creek drainage and ACEC contains 1,899 forested acres in both the commercial conifer and woodland forest types, of which 397 acres are outside the actual drainage. The significance of the Rock Creek area is that it harbors a pure strain of Colorado River cutthroat trout, a state-listed sensitive species.
- The Scab Creek campground is a semideveloped campground constructed adjacent to the Scab Creek WSA. The identified campground area contains 30 forested acres.
- The Beaver Creek drainage contains 1,655 acres in the two forest types and, like Rock Creek, supports a pure strain of Colorado River cutthroat trout.
- The riparian buffer areas include those forested acres within a specified distance of existing riparian zones. The buffers would be used to maintain shade over live water sources and as sediment filters from upslope sources.
- Three elk winter ranges provide crucial elk winter habitat. The Graphite winter range includes portions of deadline Ridge, Lake Mountain, and all of the Rock Creek drainage. Excluding the forested acreage in the Rock Creek drainage, the Graphite winter range contains 2,957 forested acres (commercial conifer and woodland). The Riley Ridge winter range occupies portions of Riley and Reed ridges and contains 1,181 acres in both forest types. The 422 commercial conifer and woodland acres on Fort Hill provide the primary source of thermal cover in the Fort Hill-Fointenelle winter range.
- In addition to the natural elk winter ranges, several elk feedgrounds exist within the planning area, of which the Finnegan, North Piney, and Franz will affect forest management potentials. Collectively, these three feedgrounds contain 783 commercial conifer and 406 woodland acres.

3.5 HEALTH AND SAFETY THREATS AND HAZARDOUS MATERIALS

Health and safety threats within the Pinedale RMPPA may affect workers, recreationists, or wildlife. Personal injury and exposure to hazardous materials are the common threats to health and safety in the Pinedale RMPPA.

As described in Section 3.3, wildfires remove existing vegetation and pave the way for new forests. However, even though wildfires are a natural process, large-scale wildfires could cause undesirable ecological impacts if they occur in areas where fire has been precluded for so long that fuel buildup has become excessive, causing unnaturally hot and extensive fires that sterilize the soil and remove all seed sources over large areas. In addition, socioeconomic impacts from wildfires are often undesirable. Therefore, commercial timber harvesting and occasional prescribed burning are conducted by the BLM as a means of replacing existing forest stands. A program of timber harvesting followed by prescribed fires mimics natural wildfires to some extent, although it returns fewer nutrients to the soil. However, such a program has a reduced potential for negative effects, such as health and safety threats to nearby residents, destruction of homes and communities, and harm to wildlife. Prescribed burning of sagebrush communities removes decadent stands; produces diverse age stands; and renews forage production in sagebrush, grassland, and forbs. At the same time, excessive fuels are removed, thus reducing the chance of fire that becomes out of control and endangers health and safety.

Drilling for oil and gas has many of the safety threats and hazards associated with heavy industrial or construction work. These hazards are most dangerous to the employees working on or near the oil and gas facilities during the actual drilling of the well. The large vehicles and extremely heavy equipment used on and/or near the drilling rigs present significant safety hazards to the employees during drilling. During certain phases of the drilling operation employees work within the derrick and may be as much as 90 feet from the ground. There have been serious accidents and fatalities within the RMPPA as a result of falls from the derrick during drilling operations. After the well has been drilled, the safety hazards to employees are reduced, however the risk to the general public would be higher at this time because they have greater access to the producing well. Although producing wells would not be considered inherently dangerous there has been at least one serious accident to a member of the general public associated with facilities on a producing well. Increased traffic and increased speeds on roads within gas fields has also resulted in serious accidents and fatalities. These risks would be shared by both workers within the gas field and the general public that use those roads.

Another dangerous hazard associated with the exploration and development of oil and gas is exposure to hydrogen sulfide gas (H_2S). Leaks of hydrogen sulfide, a toxic byproduct of oil and gas drilling have the potential to injure or kill people, animals and plants. Hydrogen sulfide gas poses a greater risk to workers in the gas field because they are working very near the facilities that contain and transport the gas, but it does pose some threat to the public that uses the lands near these facilities. Although hydrogen sulfide gas is potentially very dangerous, there have been no serious accidents related to this gas within the RMPPA.

Water discharges from oil and gas wells can be point sources of water pollution. Groundwater with increased metals and other constituents is pumped and sometimes disposed to the surface in pits, creating increased runoff and contaminated sediment that can potentially reach local waterways. Hazardous materials, (e.g., petroleum hydrocarbons, caustics, and methanol) could possibly be released during exploration and development for oil and gas or coalbed methane. Hazardous materials potentially used or produced during construction, drilling, production, and reclamation operations associated with the oil and gas and coalbed methane industries are listed in Table 3.5-1. Accidental hazardous material spills or pipeline ruptures could adversely affect air, soils, and surface water and could pose an exposure threat to nearby humans and wildlife.

Activities associated with livestock grazing operations include moving cattle, horses, or sheep through the area, along with upkeep of range improvements, such as corrals, fencing, water developments (e.g., reservoirs, spring developments, pipelines, and wells), and land treatments (e.g., prescribed fire burns, herbicide treatments, and mechanical treatments). To accommodate livestock grazing and repair of range improvements, permittees travel throughout the Pinedale RMPPA in vehicles including ATVs, horseback, or on foot. Health and safety hazards associated with livestock grazing operations on BLM-managed land within the Pinedale RMPPA are primarily related to the potential for accidents during travel within the area, and typical construction-related hazards associated with repair of range improvements. Many rancher related injuries on public land involve the use of horses for moving cattle.

Recreational activities commonly pursued in the Pinedale RMPPA include hiking, fishing, hunting, camping, and sightseeing. OHV travel is the primary method for accessing recreation areas, and it is increasingly considered a recreational activity in itself. Health and safety threats from recreational activities include the potential for vehicular accidents during OHV travel. The steep slopes found in some OHV areas create especially hazardous driving conditions. Additional health and safety hazards associated with recreation on public lands are the threat of injury associated with hunting accidents, drowning, and exposure to severe storms and/or temperatures.

3.6 LANDS AND REALTY

Most of the Pinedale RMPPA is BLM administered public land and federal mineral estate. The public lands are used for a wide variety of purposes, and it is common for conflict among competing uses to occur. See Appendix W for listing of types and numbers of lands and realty actions in the planning area.

Surface and Mineral Ownership

The land ownership and jurisdiction was previously summarized in Table 1.1-1. Land status is also shown in Map 3.6-1. The Pinedale RMPPA addresses only those lands within Sublette and Lincoln counties that are administered by the BLM (about 928,000 surface acres and 1,144,000 acres of federal mineral estate). The BLM also administers the leasing of the mineral estate underlying Forest Service and Bureau of Reclamation (BOR) withdrawn lands, although mineral management decisions on these lands are

made by the appropriate surface agency. Much of the private lands had the mineral estate (either all of the minerals or portions of the minerals) reserved to the U.S. Government. In these cases, the mineral estate is administered by the BLM, although the surface estate is administered by those respective agencies and private landowners. The total BLM-administered federal mineral estate covered by this RMPPA is approximately 1.14 million acres (Map 3.6-2).

Land and realty program objectives are to (1) manage the public lands to support goals and objectives of other resource programs; (2) respond to public demand for land use authorizations; and (3) acquire administrative and public access where necessary.

Methods of Public Land Management

Several methods of public land management must be considered in the RMP process, including Land Tenure Adjustments (e.g., disposals, acquisitions, withdrawals), rights-of-way (ROW), and permits/leases. Issues relating to access are discussed under Transportation and Access (Section 3.14).

Land Tenure Adjustment

There are several categories of land tenure adjustment with the purpose of disposal, acquisition, or withdrawals.

Disposal

Public lands have potential for disposal when they are isolated and/or difficult to manage. Disposal actions are usually in response to public request or application that results in a title transfer, wherein the lands leave the public domain. All disposal actions are coordinated with adjoining landowners, local governments, and current land users.

Public sales are managed 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. The lands are not sold at less than fair market value. Public lands classified, withdrawn, reserved, or otherwise designated as not available or subject to sale are unavailable. Any lands to be disposed of by sale that are not identified in the current RMP require a plan amendment.

Land exchanges are initiated in direct response to public demand or by the BLM to improve management of the public lands. Lands need to be formally determined suitable for exchanges. In addition, lands considered for acquisition would be those lands that meet specific land management goals identified in the RMP. Non-federal lands are considered for acquisition through exchange of suitable public land, on a case-by-case basis, where acquisition of the non-federal lands will contain higher resource values than the public lands being exchanged.

In all land exchanges, keeping the surface and mineral estate intact on both the lands disposed of and acquired, would benefit the future owners and their use of the land. However, the Wyoming BLM policy of retaining the mineral estate when surface

ownership is exchanged has the potential to create split estate situations that are problematic.

Acquisition

In addition to acquiring non-federal lands through land exchanges, BLM Pinedale Field Office (PFO) could acquire lands, water, and interest in lands by direct purchase and by donation.

Withdrawals

Withdrawals are parcels of land that are taken out of the available acreage open to resource use and/or extraction. This is done to protect a threatened or endangered species, a cultural site, or a developed recreation area from mining laws. A withdrawal provides the maximum protection in terms of land uses and protection from mining claims. These withdrawals are relatively small in terms of acreage and are site specific (Map 3.6-3).

Right of Way (ROW)/Corridors

Corridors established to contain ROWs are preferred routes for transportation and transmission facilities. ROWs in the Pinedale RMPPA are for pipelines, roads and electrical and telephone lines. To the extent possible, linear ROWs such as roads and pipelines are routed where impacts would be least disturbing to environmental resources, taking into account point of origin, point of destination, and purpose and need of the project. Although established corridors exist, this does not preclude the location of transportation and transmission facilities in other areas, if environmental analysis indicates that the facilities are compatible with other resource values and objectives. Further identification of corridors may not necessarily mandate that transportation and transmission facilities will be located there if they are not compatible with other resource uses, values, and objectives in and near the corridors, or if the corridors are saturated. ROWs are issued with surface reclamation stipulations and other mitigating measures. Restrictions and mitigating measures may be modified on a case-by-case basis, depending on impacts to resources. Areas closed to mineral leasing, having a no surface occupancy (NSO) restriction, or otherwise identified as unsuitable for surface disturbance or occupancy are generally avoidance or exclusion areas for ROWs.

Leases and Permits

Section 302 of FLPMA states that public lands may be authorized to state, local, and private citizens to use, occupy, or develop. These uses of public lands include agricultural development, residential (under certain conditions), commercial, advertising, and National Guard. Permits are usually short-term authorizations not to exceed 3 years. Leases are long-term authorizations that usually require a significant economic investment in the land. Temporary use permits are considered for areas to be used only during construction or for other short-term needs.

3.7 LIVESTOCK GRAZING

History and Setting

By the early 1900s, the BLM Pinedale RMPPA was settled by ranchers and pioneers who recognized how useful the area would be for livestock grazing. The ranchers settled in the valleys because of the availability of water from rivers and streams for domestic and irrigation purposes. Many meadows were irrigated to provide hay for the livestock through the winter.

In this area, cattle and some limited sheep ranching became well established on both private and public lands. Initially the public lands were grazed in common on a first-come, first-serve basis. With passage of the Taylor Grazing Act in 1934, the use of the public lands for grazing was regulated and ranchers were given an authorization for a certain number of livestock and season of use. This grazing use was limited to a certain geographical area or allotment.

Following the initial authorizations, the grazing service began to fence smaller allotments, and completed surveys to determine the total amount of forage within each allotment. During this period (1934-1960) many grazing permits were reduced and the majority of the allotments boundaries were fenced. There were also numerous water projects authorized and constructed during this time period to improve the livestock distributions within these allotments.

Rangeland Condition

The last ecological condition inventory occurred in the mid-1980s. Results for the Pinedale RMPPA indicated that 5,609 acres were at the potential natural community; 479,170 acres were in late seral stage; 420,571 acres were in mid seral; 16,751 acres were in early seral stage; and 9,529 acres were undetermined. In many cases these seral stages are currently stable, and may require an event (i.e. fire, or mechanical treatment) to change the current seral status. About 65% of the Pinedale RMPPA has been evaluated using the Standards for Rangeland Health. These assessments indicated that 58 allotment involving 348,131 acres are meeting all standards, 17 allotments involving 283,508 acres are not meeting one or more standards, and 12 allotments involving 27,404 acres are not meeting one or more standards but the cause is not related to livestock grazing. Map 3.7-1 identifies those allotments that have been evaluated and the results of those evaluations. Riparian areas within the Pinedale RMPPA create a particular problem for grazing management. The riparian areas can receive heavy use by livestock because water is available, and the vegetation remains green throughout the grazing season. Shrub wetlands also provide shade. The Proper Functioning Condition (PFC) method is one method used to assess riparian areas within the allotments. All known streams on public land within the Pinedale RMPPA have been reviewed. These reviews indicated that 60% of the streams are in proper functioning condition, 39% are functioning but are at risk of degradation, 1% are not functioning. This method is further discussed in Section 3.15, and the results of the PFC assessments by allotment are identified in Table 3.15-2.

Livestock Grazing Allotments and Usage

Management Categories and AMPS

Three selective management categories for allotments have been developed: Custodial (C), Maintain (M), and Improve (I). Twenty-six allotments, which encompass 20,878 acres of public land, were determined to be in the C category; 147 allotments (475,802 acres of public land) were determined to be in the M category; and 40 allotments (556,966 acres of public land) were determined to be in the I category (BLM 1988). C allotments in this area are small parcels of public land intermingled with larger tracts of private and/or state land. Due to the small amount of public land involved these allotments significant investments of time or money are not justified. In M category allotments we are either satisfied with the current conditions, or the allotment does not contain many sensitive resources. Although some investment in time or money would be justified in these allotments, they are not as high a priority as I allotments. I category allotments are either in unsatisfactory condition, or contain significant sensitive resources that would justify investments of time and money. These allotments are our highest priority for monitoring and range improvement development. Further information on the M, I and C categories can be found in Appendix K.

Allotment management plans (AMP) have been developed to improve management on selected allotments. Roughly 40 percent of the acres involved with grazing are managed through an AMP. Currently, there are 13 completed AMPs for the Pinedale RMPPA. Since 1988, two AMPs have been created and implemented, and three AMPs have been revised.

Licensed Use

The total permitted use for the Pinedale RMPPA is 107,536 AUMs.

Season of Use

There are 213 livestock grazing allotments in the RMPPA. Seventy-three (73) allotments include small and scattered federal acreages fenced in with larger tracts of private land. Annual grazing authorizations for these allotments contain a stipulation that states: "seasons of use and livestock numbers are not restricted as long as over-use of forage and range deterioration do not occur". All other allotments have defined seasons of use and these are designated in the conditions of 10 year grazing permits.

Of the 213 grazing allotments, 2 allotments (containing approximately 200,000 acres) have a 5-month season of use. The majority of the allotments in the Pinedale RMPPA would be considered lower elevation allotments, and typically livestock turnout occurs in these allotments anytime from May 1 to June 1. After 4 to 6 weeks, the livestock on these allotments are moved to higher elevation pastures. The higher elevation pastures could be entirely private land, Forest Service administered allotments or other BLM administered allotments. There are several BLM administered allotments at higher elevations where grazing does not begin until late June or early July. The season of use for these allotments is typically 2 to 3 months.

Because of variations in weather and range readiness, the turn-in dates for the Forest Service allotments are sometimes delayed. This delay sometimes causes an extended period of use on some of the BLM-administered allotments. The Forest Service and BLM cooperate in determining range readiness for the allotments and coordinate movement of livestock from BLM allotments to Forest Service allotments.

Many of the early turn-in dates (May 1 to May 16), are often too early for grazing. In most years there is very little growth in the majority of the Pinedale RMPPA allotments by that time. In addition, the majority of the grazing allotments are grazed intensively during May and June, which is the peak plant growth period. Intensive grazing during this critical growth period has affected range conditions on many of the allotments within the RMPPA.

Livestock Use

The Pinedale RMPPA is grazed by cattle and horses. Of the 213 allotments, 197 are cattle operations and 15 have either only horses or both horse and cattle use. Most AUMs are allocated to cattle, which use 97 percent of the available AUMs. Horses are allocated the remaining 3 percent of available AUMs.

Although the majority of the ranches in this area would be considered cow/calf operations, many ranches retain their yearlings and graze them a second year before selling them. There are a few ranches in this area that run exclusively yearlings.

Livestock in the Pinedale RMPPA are trailed across BLM-managed land and highway ROWs as a result of the distance between private land and the allotments managed by BLM and Forest Service. Trailing activities are authorized on a case-by-case basis. There are two stock driveways on BLM-managed land: the Cora stock driveway (SDW) and the Silver Creek SDW. The Cora SDW goes from the Cora Y west of Pinedale to the Forest Service lands on the upper Green River area north of Pinedale. The Cora SDW is used during a 2-week period in June when about 28 permittees drive roughly 7,000 cattle to summer pasture, and during a 1-month period in the fall when the cattle are driven back to home ranches. Essential components of this SDW are “Trapper’s Point” and the holding pasture at the Cora Y. The Silver Creek SDW is within the Cottonwood common allotment (No. 02097). The Silver Creek SDW provides a trail from the BLM-managed lands to the Forest Service allotments to the east.

Range Improvement Projects

Range improvements in the Pinedale RMPPA include water developments (wells, springs, and reservoirs), livestock management facilities (fences, cattle guards and corrals), and vegetation manipulation projects (prescribed burns, herbicide sprays, and mechanical treatments). Range improvements help distribute the livestock and prevent unauthorized use. The range improvements by allotment are documented in the PFO allotment files. In most cases, the permittees are responsible for the structural improvement maintenance. Range improvements are designed and constructed to minimize adverse environmental impacts and maximize function and cost effectiveness

(BLM 1988). The allotments in the I category typically receive the most monies for new improvements.

Water Developments

Water projects are the most numerous and beneficial to livestock distribution. Most water developments were put into place in the 1960s and 1970s. Currently, there are 492 water developments, 45 springs, 113 wells, 308 reservoirs, and 26 others. There have been 43 new water developments installed since the 1988 RMP. Springs are improved as water sources by exposing the aquifer and collecting the water in a head box or central point. Many existing springs are already developed and need regular maintenance. Wells are typically drilled in areas where other water sources can not be feasibly developed. Reservoirs are constructed by using the native soils to form a dam or dike across drainages. They are designed to catch the permanent or seasonal runoff. Rain catchments are part of the other category. Many rain catchments were installed in the past to collect rainwater into stock tanks. Few of the catchments worked, and most have been removed.

The condition of many water developments is unknown. The majority of the wells are in good condition. In many cases, reservoirs are washed out or silted in.

Vegetation Manipulation

Vegetation treatments are conducted to improve forage production, reduce water runoff and improve wildlife habitat. Many projects were conducted in the mid-1960s to early 1970s. Most of these vegetation treatments were focused on decreasing the sagebrush and increasing grass cover. Most of the sagebrush treatments in the 1960s and 1970s involved herbicide spraying. The life expectancy for vegetation treatments varies from 10 to 30 years or more. Most of the treated areas are older than 20 years, so sagebrush has reestablished.

The purpose for each of the vegetation treatments since 1988 involved breaking up even aged stands of sagebrush and improving conditions for big game winter range, as well as temporarily increasing forage for livestock. Since 1988, 8,700 acres have been burned, 3,660 acres have had herbicide applied for brush control, and 4,440 acres have been treated mechanically (see Table 3.7-1 for locations).

Fences

Fences are used to control livestock movements. The majority of the allotment boundaries within the Pinedale RMPPA have been fenced. Most of the major highways in this area have also been fenced. In some cases there are pasture division fences within the allotments boundaries. New fences are designed to reduce the impacts to big game animals. Since the 1988 RMP, 17 new fences have been constructed. These fences were pasture division fences designed to improve the management of livestock and reduce grazing impacts, or were reconstruction of existing allotment boundary fences.

3.8 MINERALS, GEOLOGY, AND TOPOGRAPHY

Geologic resources affect the topographic features, soils, and minerals content/extent in the area, and topographic features play a major role in determining land uses and also affect hydrologic resources.

Geology

This section describes the existing geologic environment of the Pinedale RMPPA. Components discussed in detail include the geologic history, structure and tectonics, geologic hazards of the area, and the geologic origin of oil and gas.

Geologic History

The rocks in the Pinedale RMPPA range in age from Precambrian to Holocene (approximately 2.6 billion to present day). The total thickness of sedimentary rock above Precambrian igneous and metamorphic rocks is about 32,000 feet (Law et al. 1995). Tertiary and Quaternary deposits dominate the surficial units, with subordinate exposures of Precambrian, Paleozoic, and Mesozoic rocks. Precambrian rocks are exposed on the southwest slope of the Wind River Mountains on the eastern edge of the area. Paleozoic and Mesozoic rocks are exposed in the southwest corner of the area and in sporadic outcrops near the eastern boundary. Mesozoic rocks crop out along the western boundary and in the northern portion of the area. Geologic history is discussed further in Section 3.10 in conjunction with paleontological resources.

Structure and Tectonics

The Pinedale RMPPA, located in the northwest extension of the Green River Basin, lies between two major structural provinces. To the west, thrust faulting and associated folding characterize structures formed during the Sevier Orogeny, of Cretaceous age, and is referred to as the Overthrust Belt. On the eastern side of the basin, Precambrian rocks have been thrust over younger sedimentary rocks characteristic of the Laramide Orogeny of late Cretaceous to Early Tertiary age.

The western side of the RMPPA is bounded by the Darby and Prospect Thrusts (Blackstone 1977) of the Overthrust Belt, which mark the eastern boundaries of the Wyoming and Hoback Mountain Ranges. The mountains were formed by north-south trending thrust faults that involved kilometer-scale movement of Paleozoic and Mesozoic

rocks, which reflects the thin-skinned deformation characteristic of the Sevier Orogeny. The eastern side of the Pinedale RMPPA is bounded by the Wind River thrust fault system, which reflects the "thick-skinned" deformation characteristic of the Laramide Orogeny.

Major structural features within the RMPPA include the LaBarge Platform and the Pinedale Anticline. The LaBarge Platform is the northern extension of a structural feature known as the Moxa Arch. The Moxa Arch-LaBarge Platform is a structural high that extends from southwestern Wyoming to the LaBarge area where it is truncated by thrust faults from the west. The Pinedale Anticline is found in the northeastern part of the area and generally parallels the Wind River thrust fault system. The asymmetric (steeper on the west side) anticline is 35 miles long and 6 miles wide (Law and Johnson 1989). The Pinedale Anticline was probably formed by compression on the Wind River thrust fault system. The axis of the northern Green River Basin parallels the trend of the Pinedale Anticline.

Geologic Hazards

Landslides and earthquakes are the two most likely geologic hazards. In the Pinedale RMPPA, landslide hazards are most commonly located on the western margin in the Overthrust Belt where steep slopes and variable lithotypes combine to produce significant landslide hazards. The region contains many interbedded shale units that may form significant landslide glide-planes when saturated or subject to seismic shaking. The Green River and Wasatch Formations found throughout the area contain a significant amount of weakly consolidated fine-grained material that is subject to slumping and sliding. In particular, the Wasatch Formation contains bentonite clays known to swell, contract, and fail with varying moisture input. Wyoming is classified by the Federal Emergency Management Agency (FEMA) and the U.S. Geological Survey (USGS) as having a very high seismic hazard and most of its seismic activity is in the northwestern portion of the state. Although seismic records show no major earthquakes within the Pinedale RMPPA, nearby earthquakes could be a significant geologic hazard.

Topography

The Pinedale RMPPA is located in the northern portion of the Green River Basin. The Green River Basin, a portion of the Wyoming Basin Physiographic Province, consists of a 40,000-square-mile area bounded by the Middle Rocky Mountains, Southern Rocky Mountains, and Great Plains Provinces (Howard and Williams 1972). It is composed of structural or topographic basins bounded by mountain ranges or other physiographic features on its periphery. Major basins within the Wyoming Basin Province include the Green River Basin, Wind River Basin, Powder River Basin, Bighorn Basin, Laramie Basin, and Hanna Basin, which each contain numerous sub-basins.

The Pinedale RMPPA is bounded on the north by the Gros Ventre Range, on the east by the Wind River Mountains, and on the west by the Wyoming and Hoback Ranges. The Green River Basin comprises most of the RMPPA and extends beyond the southern boundary of the Pinedale RMPPA, which has no readily discernible topographic

boundary. Relief in the area is moderate, with elevations ranging from approximately 6,500 feet in the southwestern corner up to 9,500 feet along some of the mountain fronts, which are to the east, west, and north. Mesas and buttes form the most common topographic expressions across most of the RMPPA.

Two major drainage systems traverse the area: the Green River drains from the Wind River Mountains in the northeast through the area to the south; and the Hoback River drains a small northwestern portion of the RMPPA to the northwest and eventually joins the Snake River. A topographic feature known as "The Rim" divides the Hoback and Green River drainages (Lageson and Spearing 1988). One major reservoir, the Fontenelle Reservoir, is located on the Green River on the extreme southern border of the Pinedale RMPPA.

Minerals

The RMPPA contains approximately 1,144,000 acres of federal mineral estate underlying 928,000 acres of federally-owned surface and 245,000 acres private and state lands. As part of this Pinedale RMP planning effort, a Mineral Occurrence and Development Potential Report, hereafter referred to as the Mineral Report, has been prepared. That study has confirmed that the most important potential mineral resources in the Pinedale RMPPA are hydrocarbon resources. The long history of natural gas production and developments in the last decade document the presence of source rocks, reservoir rocks, and trapping mechanisms that provide a significant hydrocarbon resource. Gas from geologic formations other than coalbeds has the greatest development potential; gas from coalbeds (coalbed methane [CBM]) is of lesser importance in the Pinedale RMPPA. Refer to the Mineral Report for a thorough description of the hydrocarbon resources within the Pinedale RMPPA. The following is a synopsis of the hydrocarbon discussion in the Mineral Report.

Federal Oil and Gas Leasing

BLM-managed lands are offered for lease on a regular basis. Between 1996 and 2001, 287,230 acres were offered for lease. As of April 2002, 1,189 federal oil and gas leases were covering 1,023,186 acres in the Pinedale RMPPA, an average of about 860 acres per lease. Overall, about 77 percent of the BLM-managed land in the Pinedale RMPPA is leased.

Current Oil and Gas Development Areas

Based on statistical data in the Mineral Report, the hydrocarbon resource within Pinedale RMPPA occurs in one of the following categories for potential development: high, moderate, low, and no potential. More detailed information concerning the oil and gas resource, as well as other minerals can be obtained from the Mineral Report. This includes information on the potential for CBM and non-CBM development.

Oil and gas drilling activity in Pinedale RMPPA geologic formations other than coalbeds is concentrated in three regions, as shown in Map 3.8-1 (ENSR and Booz Allen Hamilton 2002):

- **Greater Big Piney-La Barge.** A number of fields in this vicinity have coalesced into one large producing area, with a cumulative completion of more than 1,300 wells within the RMPPA. To date, these fields have produced most of the oil and gas in the RMPPA. Production of carbon dioxide for use in oil production operations to enhance oil recovery also occurs in this region.
- **Jonah Field.** As of February 2002, 384 wells have been completed in this field, with 368 of those on federal lands. Most of these wells were producing.
- **Pinedale Anticline.** As of February 2002, 21 active production wells and 12 shut-in wells were on the anticline. Production is increasing rapidly, with production from this field nearly doubling from the end of 2000 to February 2002.

As of April 1, 2002, oil and gas drilling activity in the Pinedale RMPPA, based largely on these three regions, can be partially characterized as follows:

- Total number of wells—3,264 (includes all status of wells [i.e. drilling, producing, plugged & abandoned, etc.])
- Total oil production—31.9 million barrels
- Total oil production over the last 10 years—12 million barrels
- Annual average oil production over the last 10 years—1.1 million barrels
- Total gas production—3.9 trillion cubic feet (TCF)
- Total gas production over the last 10 years—3.14 TCF
- Annual average gas production over the last 10 years—286 billion cubic feet (BCF)
- Total value of oil production between 1995 and 1999—estimated at $116 million ($ 2001)
- Total value of gas production between 1995 and 1999—estimated at $2 billion ($ 2001)
- Total oil and gas royalties—estimated at $256 million ($ 2001)
- Total taxes generated to county, state, and federal governments—estimated at $533 million ($ 2001)
- Annual average governmental taxes from oil and gas over the last 5 years—estimated at $107 million ($ 2001)
- Average mining employment (includes oil and gas) over the last 10 years in socioeconomic study area of Sublette, Lincoln, and Sweetwater Counties—5,700 (predominately Sweetwater County)
- Peak mining employment (includes oil and gas) over the last 10 years in socioeconomic study area—6,378

- Trend in mining employment (includes oil and gas) over the last 10 years in socioeconomic study area—19-percent decline between 1990 (5971) and 1999 (4808).

Outside these three areas, little exploratory drilling and development activity for gas in geologic formations other than coalbeds has occurred within the Pinedale RMPPA. Many townships have not been tested with a single well. However, increased interest, in terms of new exploratory wells, is occurring in areas north and west of the Big Piney-LaBarge, Pinedale Anticline, Jonah and Merna areas.

Development of gas from coalbeds (CBM) in the Pinedale RMPPA is at a very early stage. To date, five gas wells have been drilled in coalbeds and are producing. These wells, in the Riley Ridge Field area of T29 and 30N, R114W, are between 3,400 and 4,100 feet deep. The equipment and methods used to drill and complete wells in coalbeds are the same as those used to drill and complete wells to shallower or deeper zones/formations for oil and other gas production. The CBM well pads are slightly smaller, but otherwise very similar to pads constructed for deeper wells.

The extraction of CBM gas often involves the pumping of large amounts of water in the initial stages of development to lower hydrostatic pressure. The quality of the extracted water resource varies, and options for its disposal are highly dependent on its quality and economics. The disposal method currently used in the Pinedale RMPPA is to re-inject water produced, in conjunction with methane extraction from coal, into deeper formations with poorer water quality. Exceptions could be granted on an individual well basis if the water in question contained less that 500 parts per million (ppm) total dissolved solids; had a defined beneficial use associated with a responsible party; met all Environmental Protection Agency (EPA), Department of Environmental Quality (DEQ), and other agency standards; and had an approved disposal plan for excess water beyond that required for the beneficial use. Discharge into surface water features, including ephemeral channels, would not be allowed. All disposal options require DEQ permits.

A significant percentage of nonhydrocarbon gas is produced from the Madison Limestone. Carbon dioxide, nitrogen, hydrogen sulfide, and helium are separated from the hydrocarbon gas during processing at the Shute Creek Gas Plant. These products are marketed independently or are disposed of. Hydrocarbons and associated carbon dioxide gas have also been encountered in other formations. The presence of associated nonhydrocarbon gases limits the economic potential of these formations for natural gas production (BLM 2002).

Other Minerals

The development potential of nonfluid minerals within the Pinedale RMPPA (e.g., minerals other than oil and gas) may be limited as a result of a variety of factors. First and foremost, the surficial geology of the area, being of a primarily sedimentary nature, limits significant occurrences of mineralized zones. Secondarily, mineralized zones that have been discovered exhibit characteristics such as limited or discontinuous mineralization, inherent impurities, and/or low percentage content of the target mineral.

Those nonfluid minerals that are known to occur within the Pinedale RMPPA and are simultaneously or projected to be in demand are limited to aggregates (e.g., sand and gravel) and decorative stone (both moss rock and boulder). Each commodity is considered to be an industrial mineral by definition, and each has a relatively low per-unit valuation. With low per-unit value commodities, the market area for consumption is generally highly localized and, therefore, sensitive to transportation costs. So long as the development potential remains limited and the unit valuation remains low, nonfluid minerals are not expected to be significant contributors to the minerals extraction industry. These factors could change in the future. Increased oil and gas exploration and development has resulted in the need for several all season gravel pits to be strategically located throughout the RMPPA.

3.9 OFF-HIGHWAY VEHICLE USE

OHVs are any motorized vehicle capable of travel on or immediately over land or other natural terrain. The varied landscape, the large areas of public land with roads and trails open to OHVs, and the numerous landforms along the northern, eastern, and western boundaries of the Pinedale RMPPA (composed of the foothills and approaches to the Wyoming Range and Wind River Range) provide numerous opportunities for OHV use. This varied landscape and the proximity of and access to the Forest Service-managed lands within the Bridger National Forest and Teton National Forest have contributed to the popularity of this type of vehicle use.

OHV Designations

The three OHV designations are open, limited, and closed, as described below:

- **Open**—an area where all types of vehicle use is permitted at all times, anywhere within the designated "open" area and, thus, refers to cross country travel both on and off roads
- **Limited**—vehicle travel is permitted only on existing roads and vehicle routes which were in existence prior to the date of designation in the Federal Register. Vehicle travel off of existing vehicle routes is permitted only to accomplish necessary tasks and only if such travel does not result in resource damage. Random travel from existing vehicle routes is not allowed. Creation of new routes or extensions and/or widening of existing routes is not allowed without prior written agency approval.
- **Closed**—an area where OHV use is prohibited. Use of OHVs may be allowed for certain reasons, subject to approval by the BLM authorizing officer.

OHV designations within the Pinedale RMPPA apply to all OHVs, with the exception of emergency vehicles, regardless of the purpose for which they are to be used. The designations were developed in cooperation with the USFS and the National Park Service. The designated OHV areas are depicted in Map 3.9-1.

OHV Use Description

OHVs are used within the area for recreational and nonrecreational use. Much of the nonrecreational OHV use is in the form of four-wheel drive (4WD) pickup trucks driven by local ranchers, oil and gas developers, land surveyors, and geological surveyors performing seismographic studies. During the winter months, nonrecreational use includes snowmobile use for these same activities. Recreational OHV use includes such nonwinter 4WD pickup activities as wood gathering, antler collecting, hunting, and sightseeing. Other OHVs, such as all-terrain vehicles (ATV) (e.g., four-wheelers) and motorbikes may be used for these same recreational activities. The use of OHVs as transportation while hunting is the most common recreational use of OHVs.

Snowmobiles are another common recreational OHV used within the Pinedale RMPPA. However, most recreational snowmobile use occurs within Forest Service-managed lands. The use season on BLM-managed lands runs from about December through April. The eastern side of the Pinedale RMPPA, along the lower slopes of the Wind River Range, has a segment of the Continental Divide Snowmobile Trail system that provides opportunities for spectacular, scenic views of the surrounding mountains and dense forests. To the west, there are many access points to the Wyoming Range that also provide OHV recreational opportunities for viewing scenery and enjoying deep snow. Motorcycles and ATVs designed for high speeds and racing use are becoming more popular within the area, but the use season is fairly short, running from May through September (BLM 1988; Wyoming Department of State Parks 2002).

OHV Use Trends

The majority of OHV use within the boundaries of the Pinedale RMPPA occurs on existing roads and trails. OHV use appears to have increased in some areas during the past 15 years as is evident by the expansion of trails by ATVs and motorcycles. Some localized trail expansion is related to the growth in use by racing type ATVs and motorcycles. As identified in the BLM's National Management Strategy for Motorized Off-Highway Vehicle Use on Public Lands (BLM 2001), the growth in OHV use can be attributed to the following:

- Greater public interest in unconfined, outdoor recreational opportunities
- A rise in the amount of disposable income, fostered by a healthy domestic economy, for use in recreational pursuits
- Advances in vehicle technology that enable motorized OHV users to reach previously inaccessible areas
- The rapid expansion and population growth of cities and suburbs in the western states, which has brought Westerners closer to once-remote public lands
- A population with an increasing median age and changing outdoor recreational interests.

The current demand for general OHV use is not exceeding the capacity of areas open to OHV use.

It is difficult to estimate the degree to which road expansion from OHV use will occur in the future, but roads and trails now extend to most areas of interest. Roads and trails on BLM-managed lands are frequently used as transportation routes to access Forest Service-managed lands. The Irish Canyon access to the Bridger National Forest is becoming extremely popular for snowmobile use since the route is part of the Continental Divide Snowmobile Trail System and extends onto the Bridger-Teton National Forest (Hudson 2002). Antler collecting, using OHVs, has become increasingly popular within the last decade.

OHV Use/Resource Conflicts

Increased OHV use over the past 10 to 15 years has created some identifiable concerns with the management of OHV activities. The most notable concern may be the occurrence of OHV use in some areas where repeated motorized travel on erodible soils and/or steep slopes may be causing a degradation of water quality, loss of vegetation, and contrasting changes to the visual landscape. Another identified concern is the affect of motorized activities on wildlife from motorized activities within critical winter habitat.

Some areas of concern within the Pinedale RMPPA where OHV use may be creating adverse effects on natural resources are as follows:

- Areas on the east side of the Wyoming Range in the vicinity of Red Canyon, Miller Mountain, Bald Mountain, and South Muddy Creek where hunting-related OHV use is creating trails on erodible soils, near riparian areas, and degrading visual quality.
- The Blue Rim Area within the Desert General Open Area where OHV use conflicts with resource values in an area containing sensitive resources which may be vulnerable to degradation.
- Some areas along the south and western slopes of the Wind River Range where the creation of trails is degrading visual quality.
- Ridgetops in areas that are heavily hunted and where multiple trails have been created where hunters drive up to look over the edge for game.
- Near the communities of Big Piney-Marbleton and Pinedale where the creation of trails on erodible soils is creating visual impacts.
- Throughout the Pinedale RMPPA in areas of intensive or important seasonal use by wildlife.

OHV Noise Considerations

OHVs can be noisy, and when OHV-produced noise becomes part of the recreational experience, noise is usually considered intrusive and unpleasant. Land uses within the

Pinedale RMPPA range from wilderness study areas and sparsely populated rural areas to more densely populated small urban communities and highways. As OHV use encroaches on other types of recreational areas within the area, noise produced by OHV use may become important to those who seek other, non-OHV recreational opportunities within the Pinedale RMPPA.

Typically, in wilderness areas, expected ambient sound levels would be about 30 to 40 decibels (dB). Small urban communities away from main highways and county roads typically experience outdoor sound levels that are lower than 50 dB (Cunniff 1977, Harris 1991). An approximate noise level range for the more popular brands of OHVs is between 80 and 108 dB (Oregon Off-Highway Vehicle Association [OOHVA] 2002). Approximate examples of other common sound levels are as follows: a bedroom at night, 30 dB; a residential area at night, 40 dB; a typical office, 50 dB; conversational speech, 60 dB; a vacuum cleaner at a distance of 6 feet, 70 dB; a concrete mixer at a distance of 50 feet, 80 dB; and a jackhammer at a distance of 50 feet, 100 dB (Bell 1973, Cunniff 1977, Harris 1991).

3.10 PALEONTOLOGY AND NATURAL HISTORY

A paleontologic resource is a site containing fossilized remains of life in the past. BLM manages paleontological resources for their scientific, education, and recreational values. The Department of the Interior has administratively determined that collecting vertebrate fossils requires a permit. Paleontological permits are issued under the authority of FLPMA, and such permits are generally issued to only qualified paleontologists.

Rock units representing more than 2.6 billion years of geologic time are present in the Pinedale RMPPA. The geologic units containing paleontological resources span from 544 million years old to 10,000 years old. Table 3.10-1 shows the paleontological resources contained within each geologic unit.

3.11 RECREATION RESOURCES

With a major river system (the Upper Green River) and several major mountain ranges, the Pinedale RMPPA is a popular recreation area, both nationally and locally. Outdoor recreational activity is steadily increasing in types of activities and intensity of use. This increase in recreational use is presenting challenges to managing outdoor recreation to accommodate the demands on recreational resources and simultaneously preserve those resources.

Resource Setting and Description

The Pinedale RMPPA is located in western Wyoming, approximately 75 miles south of the Yellowstone and Grand Teton National Parks. The area, which lies within the Upper Green River watershed, is bounded on the north and west by the Teton and Bridger National Forests and on the east by the Bridger National Forest and Bridger Wilderness Area. The Pinedale RMPPA possesses a diversity of landforms and topographical features capable of supporting many types of recreational opportunities. Visitors

participate in a wide variety of activities over a broad area. Recreational activities available within the Pinedale RMPPA include: big game hunting for elk, mule deer, and antelope; grouse, waterfowl, and small game hunting; river rafting and canoeing; lake boating; camping, backpacking, and horsepacking; cross country skiing and snowmobiling; dirt biking and other OHV use; rock collecting; sightseeing of historic trails and places; and wildlife and general photography.

Specific recreational resources in the RMPPA include SRMAs (discussed in Section 3.20), Extensive Recreation Management Area (ERMA), and developed recreation sites (Map 3.11-1). An SRMA is an area with a commitment to provide specific recreational activities and opportunities. These areas usually require a high level of recreational management. An ERMA is an area not specifically designated as an SRMA and includes all BLM-administered lands outside SRMAs where dispersed recreation activities generally occur. Five developed recreation sites are within the Pinedale RMPPA:

- **Warren Bridge Campground.** As part of the Upper Green River SRMA, this campground is located about 20 miles north of Pinedale, at a point where U.S. Highway 191 crosses the Green River. The site consists of developed campsites with water, picnic tables, restrooms and a waste dump station.
- **New Fork Campground.** This recreational area consists of camping and picnic sites and restrooms. The campground is located on Wyoming State Highway 351 where the highway crosses the New Fork River.
- **Stokes Crossing Campground.** Stokes Crossing campground is located 2 miles southwest of Boulder Lake along Boulder Creek. Recreational development at this site consists of several undesignated sites, picnic tables, and restrooms.
- **Scab Creek Campground.** This area is located near the Scab Creek WSA, approximately 12 miles northeast of Boulder. This recreational area consists of camping and picnic sites, restrooms, and a horse corral. The Scab Creek trail originates in this area.
- **Boulder Lake Campground.** Located on the north shore of Boulder Lake, this recreational development includes undesignated sites, picnic tables and restrooms.

Other designated recreational areas are the Continental Divide Snowmobile Trail system and the National Historic Oregon Trail (Lander Trail). Interpretive sites along the Lander Trail and at other locations inform visitors about the fur trapping era and western explorers and area settlement. Trapper's Point and the DeSmet Monument are two interpretive sites on public lands that depict significant information relative to the "rendezvous" of the mountain men on the upper Green River. Trappers Point and the DeSmet Monument are two notable interpretive sites that inform visitors about the area's history.

Recreational Use

Population growth in the western and southwestern United States and recent population shifts to these regions have produced an increasing demand for recreational uses on public lands. BLM administered public lands have become important destinations for those seeking outdoor recreational opportunities, given the diversity of resources found on public lands and the availability of these lands for recreational use. The BLM General Recreational Policy Statement supports BLM's goal of multiple use and sustained yield of BLM-managed public lands (BLM 1990). As recreational demand grows, along with economic pressures to develop these public lands, potential conflicts may arise among recreational activities, and between recreational activities and economic development of these public lands.

Visual resources (Section 3.16) are relevant to recreational activities in several ways. Sightseeing is a recreational activity that depends on the quality of visual resources. Some recreation activities are enhanced by a high degree of visual quality, such as river floating and hiking. Also, some activities, such as road building, landfills, oil and gas development, OHV use, and other surface disturbing activities, have an impact on visual resources and therefore on recreational opportunities and experiences.

Noise, as it affects recreational opportunities, is usually considered to be intrusive. As population growth and development within the Pinedale RMPPA continues to expand into undeveloped areas, the interface between urban and rural or primitive areas, noise becomes more evident.

The heaviest use of the developed recreation areas occurs during the summer months, between July and September. The most popular activities are hunting, fishing, sightseeing, float or raft trips, mountain/rock climbing, and hiking. Winter is a fast-growing use season for snowmobiling and cross-country skiing.

Hunting/Wildlife Viewing

Hunting and wildlife viewing are widespread throughout the Pinedale RMPPA. The best source of hunting data is from the Wyoming Game and Fish Department, which monitors hunting use within hunt areas that are fully or partially included in the BLM planning areas. The presence and variety of wildlife add to the recreation experience in this area. Most visitors using public lands in this area for camping, hiking, or floating, benefit from opportunities to observe wildlife.

Camping

Demand for camping opportunities within the Pinedale RMPPA appears to be stable. Most camping is unregulated and dispersed across the Pinedale RMPPA. Within developed camping areas, Warren Bridge campground is heavily used, as are the camping facilities within the Scab Creek SRMA. Scab Creek appears to be approaching capacity as a trailhead and campground to the Bridger-Teton Wilderness. Conflicts arise from inadequate parking and packstock staging facilities. A planning process will soon be initiated to address these issues and propose development plans.

Water-Related Recreation

The Upper Green River SRMA is very popular as a destination for those people seeking unrestricted access for scenic floating, fishing, camping and hunting. Wade and float-fishing is the major recreation activity associated with this segment of the river. Important boating access to downstream river segment is also provided. There has been a substantial increase in river recreation and access demand. River and lake recreation use and demand have increased substantially, prompting the need for additional access and better facilities. Approximately 187 miles of the Green and New Fork Rivers are floatable within the RMPPA. Float fishing and wade fishing are likely the most sought after recreational activities. An increasingly popular activity is long distance river floating and camping. Individuals and groups seek the opportunity to float the entire river or long segments, necessitating overnight campsites. This opportunity is somewhat limited since much of the middle portion of the Green River is absent of public lands. The lower Green River, south of Highway 351, is emerging as a portion of the river capable of providing additional river recreation opportunities. The New Fork River also provides significant boating and water lower reaches of this river. The need to address improved access, river use information, restroom and camping facilities is evident. Substantial commercial float and wade fishing, as well as adventure floating occurs in this area. Conflicts and resource protection issues are beginning to occur from increased public use. A plan to address these issues and maintain recreation opportunities is currently being developed.

Boulder Lake provides recreational opportunities for wade fishing, boating and camping (see additional discussion in section 3.20, Special Management Areas). Many segments of streams provide fishing and camping opportunities.

The increasing regional population and changing demographics as a result of fluid mineral development, retirement, new business and variety of recreation opportunities has contributed to the expanding demand for outdoor recreation access and use. As more oil and gas workers move into the area, they contribute to the increase in demand for additional recreational facilities. Additionally, the oil and gas industry affects large areas that have been used for semi-primitive recreation in the past.

Antler Collecting

Antler collecting is an increasingly popular recreational and commercial activity, and this activity may be affecting the wintering herds of elk and mule deer. Antler collecting in the winter on crucial winter ranges is becoming a problem because it stresses wintering deer and elk.

Special Recreation Use Permits

The BLM issues commercial permits to 43 operators serving clients for hunting big game and fishing on public lands within RMPPA. There is a growing interest in other types of commercial recreation use in the RMPPA. Examples of these activities include guided

backcountry horse touring, touring historic features such as the Lander Trail and observing wildlife.

The Recreation Opportunity Spectrum

The Recreation Opportunity Spectrum (ROS) is a method widely used by BLM for determining the level of development within a recreation area and provides BLM with a framework for determining the existing outdoor recreational opportunities and management potential. The classification of recreational opportunities ranges from primitive to developed types of recreation, based on a combination of activity, setting, and experience opportunities. BLM uses this classification as a management tool. The goals of the ROS system are to (1) establish outdoor recreation management goals and objectives for specific areas; (2) allow for modification of recreational opportunities when other resource management actions are proposed; and (3) establish standards for an area that would allow monitoring of the recreational experience and opportunities. The current ROS management system for the Pinedale RMPPA is depicted in Map 3.11-2. The ROS classifications are as follows:

- **Primitive**—characterized by a roadless, essentially unmodified natural environment. Activities might include camping, hiking, enjoying scenery or natural features, photography, hunting, swimming, diving, fishing, canoeing, sailing, and river running (nonmotorized craft).
- **Semiprimitive**—characterized by a roadless, predominantly unmodified natural environment. Activities might include camping, hiking, enjoying scenery or natural features, photography, hunting, swimming, fishing, canoeing, sailing, and river running (nonmotorized craft).
- **Semiprimitive (Motorized)**—same as semiprimitive, except that motorized use is permitted.
- **Roaded (Natural)**—characterized by a generally natural environment, with evidence of resource modification and utilization harmonizing with the natural environment. Motorized travel is permitted.
- **Rural**—characterized by a substantially modified natural environment. Activities might include camping, hiking, enjoying scenery or natural features, photography, swimming, fishing, canoeing, sailing, river running (motorized craft), power boating, picnicking, rock collecting, wood gathering, auto touring, water skiing and other water sports, interpretive services use, rustic resorts and organized camps, competitive games, spectator sports, bicycling, jogging, outdoor concerts, and modern resorts.

3.12 SOCIOECONOMICS

The Pinedale RMPPA is located in western Wyoming in portions of Lincoln and Sublette counties. Activities in the Pinedale RMPPA also have the potential to affect Sweetwater County, because it serves as an important economic center for several activities,

including oil and gas development. Therefore, the socioeconomic study area includes Lincoln and Sublette Counties (within the Pinedale RMPPA) and Sweetwater County (outside the Pinedale RMPPA), as shown in Map 3.12-1.

County Characteristics

Like much of Wyoming, the socioeconomic study area is quite rural in nature. All three counties have a rather large land area with a dispersed population, as summarized in Table 3.12-1. The number of persons per square mile ranges from 1.2 in Sublette County to 3.6 in Lincoln and Sweetwater Counties, below state and national averages.
The largest population centers in the socioeconomic study area are listed in Table 3.12-2. This table highlights the differences in population growth throughout the area. Many of the largest towns located in the southern part of the area are reporting declines in population, whereas smaller communities such as Afton and Pinedale in the northern part of the area increased in population during the 1990s. Public lands dominate this area with 67 percent of total land area being administered by federal agencies, including BLM.

Demographic Characteristics

Annual population estimates for each county in the socioeconomic study area for 1990 to 2000 show a population increase of 3.2 percent. However, as mentioned above, population growth varied across the area, with Sweetwater County reporting a decline in population but Lincoln and Sublette reporting an 11- to 20-percent increase.

During the 1990s, increases in population were attributed to natural changes (more births than deaths). Overall, the socioeconomic study area followed a statewide trend of declining population resulting from net migration. This trend varied throughout the socioeconomic study area with net migration resulting in an increase in population in Lincoln and Sublette Counties and a decline in Sweetwater County. Available data indicate that more individuals continue to leave the area than move in, in spite of the increases in total population during the last decade.

The socioeconomic study area mirrors the remainder of the state, which has a very small population of minority groups. The percentage of ethnic groups other than "white" or "American Indian" in the socioeconomic study area is quite small, which is common throughout Wyoming.

Personal Income Trends

Personal income data were obtained for each county in the socioeconomic study area from the U.S. Bureau of Economic Analysis (BEA). Total personal income increased to more than $1.5 billion in 1999 up from $1.2 billion in 1989, in inflation adjusted dollars ($ 2001). During this 10-year period, personal income grew by nearly 24 percent.

Personal income can be broken down into three categories: labor income, investment income, and transfer payments. Labor income is derived through wages, salaries, and self-employment income. Investment income includes rents, dividends, and interest

earnings. Finally, transfer payments are largely derived from Social Security benefits, Medicare and Medicaid benefits, and other income support and assistance.

The socioeconomic study area is showing signs of shifting patterns of income growth. For instance, labor income now accounts for 67 percent of total personal income, down from 72 percent in 1989. Income from nonlabor sources has grown from 28 percent in 1989 to 33 percent in 1999. This change in how individuals earn income is not unlike national or state trends.

The socioeconomic study area has started to lag behind state and national trends associated with per capita income. By 1999, per capita income for the socioeconomic study area was $26,019, which was below the national ($27,358) and state ($27,528) averages. This is a deviation from earlier periods when per capita income in the socioeconomic study area was comparable with state and national averages.

Economic Characteristics

This section focuses on trends associated with certain economic characteristics in the socioeconomic study area, including not only changes in the labor force and unemployment but also trends in employment and earnings by industry.

Labor Force and Unemployment

Change in the labor force and unemployment can provide information on the health of the local economy. As a whole, unemployment in the socioeconomic study area has been higher than unemployment for the State of Wyoming during the 1990s. The exception is Sublette County, which reported unemployment rates well below the state and national averages. Unemployment rates in the other two counties have consistently been higher than the state and national averages since 1995.

Changes in the civilian labor force during the 1990s are summarized for each county and Wyoming in Table 3.12-3. The civilian labor force is defined as all persons over age 16 in the civilian noninstitutional population who either had a job or were seeking a job in the last 12 months. Overall, the socioeconomic study area realized slower growth in the civilian labor force than for the state.

Employment and Earnings by Industry

The BEA estimates annual employment and earnings for counties nationwide. Total annual employment includes full- and part-time jobs; therefore, individuals with more than one job are counted twice. The employment estimates include those individuals who are employed by businesses and public entities as well as those who are self-employed. Data was obtained from BEA regarding total annual employment for each county, Wyoming, and the United States for 1990 to 1999 so as to examine employment trends by industry over this 10-year period.

Total employment in the socioeconomic study area increased by 12 percent over the 10-year period from 32,805 in 1989 to 36,841 in 1999. Compared with employment

growth in Wyoming and nationwide, this area lagged. For instance, over the same 10-year period, total employment grew by 20.4 percent in Wyoming and 19.3 percent nationwide.

Figure 3.12-1 shows employment by industry for 1999. Services, government, and retail trade comprise the largest percentage of total employment for this area, accounting for nearly 60 percent of total employment in 1999. However, growth in employment during the last decade varied by industry. For instance, services, government, and trade experienced the greatest increases in employment, adding 3,700 jobs to the local economy. This is in contrast to the mining sector, which realized a decline in employment of 1,100 jobs during the same period.

Counties in the socioeconomic study area are typical of many rural areas throughout the West and rely more heavily on traditional natural resource based industries, such as mining and agriculture. For instance, though mining jobs have declined in this area during the last decade, the sector remains an important employer. In 1999, mining jobs, including oil and gas operations, accounted for 13 percent of total employment in the socioeconomic study area, which is much higher than the state average of 5.5 percent. In addition, this area is slightly more dependent on farm employment then the remainder of the state. In 1999, farm employment accounted for 4.4 percent of total employment in the socioeconomic study area and 3.8 percent throughout Wyoming.

Figure 3.12-2 summarizes gross earnings by industry for the socioeconomic study area in 1999. The mining sector remains important in terms of earnings for this area, accounting for nearly one-third of total earnings in 1999. This category includes metal, nonmetallic, and coal mining and oil and gas operations. However, the importance of this industry in terms of earnings varies across counties, ranging from 15 and 16 percent of total earnings in Lincoln and Sublette Counties to 40 percent in Sweetwater County. In addition, oil and gas operations accounted for nearly all the mining earnings in Sublette County and roughly 40 percent of mining earnings in Lincoln and Sweetwater Counties, which also have significant coal and trona production, (trona production does not take place in Lincoln County).

Although mining remains important in terms of earnings for this area, the industry has reported a 12-percent decline in earnings between 1989 and 1999. Other industries reporting declines in earnings between 1990 and 1999 include farms, transportation, and utilities. Additional industries important to this area in terms of earnings include government and service sectors, whereas the greatest increase in earnings during the last decade occurred in the financial, insurance, and real estate (FIRE) and manufacturing sectors. The growth of earnings in other industries may represent a structural change starting to occur in the economy; however, mining still remains a dominant industry for this region.

Average Earnings Per Job

Important insights can also be gained by examining trends in earnings per job. For the socioeconomic study area, the average real earnings per job were estimated in inflation

adjusted dollars ($ 2001) for 1990 to 1999. By far the most important industry for this area in terms of average earnings was mining. Average earnings per job for this industry were $69,480 in 1999 and increased 9 percent during the 10-year period.

The manufacturing and transportation and utilities sectors have the second and third highest average earnings for this area at $41,251 and $42,984 in 1999, respectively. In addition, average earnings for manufacturing have increased by 58 percent during this 10-year period. Average earnings for government jobs increased by 4 percent over the last decade to $30,828.

Significant declines in average real earnings occurred in the construction and farm and farm services sectors during this time and averaged $26,848 and $7,736 in 1999, respectively. Three industries that have experienced significant gains in employment and relative low average earnings per job for this area are trade, services, and FIRE. All three industries have average earnings below $20,000.

Economic Base Analysis

An area's economic base is composed of industries that are primarily responsible for bringing outside income into the local economy. Certain sectors within the economy are thought to be "basic" in that most of their sales are tied to outside markets or customers. These industries include manufacturing, mining, and agriculture. In addition, certain government sectors, mainly federal and state governments, are considered basic because employees are paid from sources outside the local area.

Outside sources of income can also be derived from nonlabor sources (investment income and transfer payments). For instance, transfer payment income can become an "economic driver" for the area's economy because many transfer payment programs are sustained by sources outside the local area. Therefore, income of this type is received, spent, and respent in the area, which generates additional income for the local economy. This is also true for investment income, though it is not known for certain what percentage of investment income is generated from outside sources.

Using these definitions of basic industries and outside sources of income, an analysis was conducted on the components of the economic base of the economy in the socioeconomic study area. Table 3.12-4 provides a breakdown of the components of the area's economic base and outside sources of income for the counties in the socioeconomic study area for 1990 and 1999. Columns 5 and 6 show that the percentage of income earned from outside sources was above 70 percent throughout the 1990s. Examination of the sources of this outside income reveals that this area is very dependent on mining and nonlabor income as basic economic drivers to the economy. These two sources of income account for 75 percent of all outside income generated for this area. Mining has declined in importance for this area, but still remains a strong economic driver. In addition, manufacturing has grown in its importance as a basic industry, comprising nearly 10 percent of outside income in 1999.

Examination of these data indicates that the economy in the socioeconomic study area is now more dependent on nonlabor sources (transfer payments and investment income) of income than traditional basic industries for outside sources of income. These two sources now account for 45 percent of total personal income. This may be a sign that more individuals of retirement age, who are dependent on nonlabor sources of income, are moving to this region, as is common in other areas throughout Wyoming. However, these data do not reveal how the economy may be diversifying into other industries that are capable of bringing in outside income to the local economy. For instance, other industries such as real estate, and some service sectors will bring in outside income into the economy. It is likely that certain service sectors and the FIRE sector have brought in additional outside income to this area as a result of the nature of their business and modest growth during the study period.

Property Valuation and Taxation

Property valuation includes property assessed by the State of Wyoming and locally assessed property. The State of Wyoming assesses taxes on mineral and nonmineral property. Nonmineral property assessed by the state includes airlines, utilities, pipelines and gas distribution systems, railroads, and phone service. During fiscal year (FY) 2001, the valuation of property assessed by the state was $2.2 billion for the socioeconomic study area. Local government also assesses four categories of property: agricultural land, residential and commercial land, improvements and personal property, and industrial property. During FY 2001, the value of property assessed by local governments in the socioeconomic study area exceeded $568 million. The total value of assessed property in the three county socioeconomic study area was $2.8 billion in FY 2001, with the following shares:

- Lincoln County—about $ 575 million
- Sublette County—about $ 850 million
- Sweetwater County—about $1.4 billion.

Mineral production in the socioeconomic study area is a major source of tax revenue for government entities. For instance, during FY 2001, minerals accounted for nearly 74 percent of the value of property assessed in the socioeconomic study area. In addition, oil and gas production and operations provide a significant percentage of the assessed value of minerals. For 2001, oil and gas production accounted for 82 percent of all mineral valuation in the socioeconomic study area as assessed by the state. For Fremont and Sublette Counties, oil and gas production accounted for more than 85 percent of all assessed mineral production. In addition, physical assets of the oil and gas industry (property) comprised 26 percent of all property assessed by local governments. Of all property and production assessed by the state and local governments, oil and gas operations accounted for 67 percent of assessed value in the three counties in the socioeconomic study area during FY 2001.

Ad Valorem Taxes—Counties

Ad valorem taxes from mineral production have been estimated based on production level, assessed values, and effective tax rates. The counties generated $114 million in tax revenues from mineral production during FY 2001. Of this $114 million, $103 million, or 91 percent, was derived from oil and gas production, which highlights the importance of this industry to the fiscal conditions in the socioeconomic study area. Table 3.12-5 estimates the importance of oil and gas operations in terms of local government property tax revenues. The three counties in the socioeconomic study area generated $110 million in tax revenues as a result of oil and gas operations. This accounted for 63 percent of property taxes generated in this area for 2001.

Mineral Severance Taxes—State of Wyoming

Local government entities also benefit from severance taxes collected on mineral production throughout the state. While Severance taxes collected on mineral production do not go directly to the counties and towns of origin, they are redistributed across the state according to a formula published in the state statutes. Severance tax revenues are distributed to government entities, including the state general fund, water development account, state highway fund, counties, cities and towns. Therefore, the government entities within the socioeconomic study area will benefit from only a percentage of severance taxes collected on production within the study area. However, these entities will benefit from severance taxes collected on mineral production occurring in other parts of the state. Table 3.12-6 summarizes the total severance tax revenues that were distributed to the local government entities within the socioeconomic study area during fiscal year 2001. Table 3.12-7 estimates the severance taxes that are generated from mineral production originating within the socioeconomic study area. The estimated severance taxes for each mineral type are based on production and assessed values and the effective tax rates, all which were obtained from the Wyoming Department of Revenue, Mineral Tax Division. Natural gas production generated the most severance tax revenue in the socioeconomic study area, accounting for 73 percent of all severance taxes generated.

Federal Royalties

Mineral production occurring on federally owned public lands is also assessed a federal mineral royalty. Production is assessed at 12.5 percent of value after allowable deductions. The federal government returns 50 percent of the total royalties collected to the state where the mineral production occurred. In Wyoming, the distribution of the federal royalties is based on a formula promulgated by the Wyoming State Statutes. The state allows a percentage of these federal royalties to be distributed to cities and towns for planning, construction, and maintenance of public facilities, capital construction funds, and transportation projects. In addition, local school districts may benefit from federal royalty payments thorough advanced entitlement grants for capital construction funds. Therefore, local government entities will receive only a percentage of federal royalty payments generated from production within the Pinedale RMPPA.

Total federal royalties distributed to local government agencies in the socioeconomic study area for FY 2001 were $2.8 million.

Other Tax Revenue Sources

Other tax revenue sources that may be affected by management actions associated with BLM-managed lands include lodging taxes, sales and use taxes, and gas taxes. Lodging taxes are relatively small compared with other tax sources, earning about $325,000 per year for these counties. Sales and use taxes generate between $2.4 and $5.3 million for Lincoln and Sublette Counties and $19 to $22 million in Sweetwater County during the last 3 years.

Payment in Lieu of Taxes

Each county in the socioeconomic study area receives Payments in Lieu of Taxes (PILT) to compensate local governments for hardships caused by federal lands being exempt from local property taxes. PILT payments are allowed in addition to other revenue-sharing programs such as federal mineral royalties and U.S. Forest Reserve payments. The PILT payment made to each county is based on a complex formula that takes into account revenue sharing from the previous year, county population, and acreage of the county in federal ownership. PILT payments received by each of the three counties for the last 11 years are summarized in Table 3.12-8.

Economic Activities Attributable to BLM Lands

Activities on BLM lands can provide important economic stimulus to local economies. For the PFO, activities such as oil and gas production, grazing and recreation are important to the region. This section discusses the link between activities on lands within the Pinedale RMPPA and the local economy.

Historic oil and gas production data were used to estimate annual production for the Pinedale RMPPA between 1974 and 2000, as summarized in Figures 3.12-3 and 3.12-4. Sublette County was the largest producer of natural gas and the fifth largest producer of oil in Wyoming in 2000. Much of this production occurred on public lands highlighting the importance of oil and gas production in this area. This follows the data presented on earnings and employment within the economic study, which demonstrated the importance of the mining industry, including oil and gas operations. This industry remains an important driver for the socioeconomic study area.

Annual production data were then used in combination with the average taxable valuation per unit and average tax and royalty rates to estimate ad valorem taxes (county), severance taxes (state) and federal royalties from production on BLM lands within the Pinedale RMPPA. Oil and gas production in the Pinedale RMPPA generated an estimated $221 million in mineral tax revenues to the county, state, and federal governments during 2001. Oil and gas production in the Pinedale RMPPA accounted for 33 percent of the ad valorem taxes in the socioeconomic study area. However, for the two counties where the Pinedale RMPPA is located (Lincoln and Sublette), oil and gas production accounted for 91 percent of county ad valorem tax revenues. In addition,

production from this area resulted in 58 percent of the severance taxes generated in the three-county socioeconomic study area in 2000.

Livestock grazing is another important use of BLM lands within the Pinedale RMPPA. To understand the economic importance of livestock grazing on public lands, an estimate of the percentage of agricultural sales in the three-county socioeconomic study area attributable to grazing within the Pinedale RMPPA was made using data and information from BLM, the Wyoming Statistical Service, and the National Agriculture Statistical Service. The value of grazing on BLM public lands within the Pinedale RMPPA was estimated to be more than $3 million per year as summarized in Table 3.12-9. A comparison of total agricultural sales in the three-county socioeconomic study area with the estimated value of grazing within the Pinedale RMPPA indicates that livestock grazing on public lands accounted for 6.5 percent of all livestock sales and 5.9 percent of all agricultural sales for this area.

Recreational activity has important economic value in terms of the satisfaction it provides local residents and the economic activity it generates for the regional economy. Recreational activities in the Pinedale RMPPA are especially centered around the extensive fish and wildlife resources and scenic attributes of the area. In terms of economic activity, recreation generates additional spending in the local economy that supports jobs and income. Among the eight Mountain Region states surveyed by the USFWS, participation in fishing and, to a slight extent wildlife watching, was higher in 2001 than in 1991. Estimates of recreational use within the Pinedale RMPPA indicate that as many as 300,000 Recreational Visitors Days are spent in this area. In 2000, the Wyoming Business Council and the Wyoming State Office of Travel and Tourism published a study addressing the trends and the effects of tourism on the Wyoming state economy. The study showed that tax revenues generated from travelers within the state increased by 10 percent over a 3-year period (Wyoming Travel Industry 2000). As visitors come to this area to recreate, they spend money on goods and services to support their activities, such as lodging, eating and drinking, and gasoline. These expenditures can be an important economic stimulus to the local area. Thus, outdoor recreation is important to the region in terms of satisfaction to residents and economic stimulus for the regional economy. Successfully maintaining and managing the recreational opportunities within the Pinedale RMPPA is expected to have long-term, positive socioeconomic effects on those towns and cities that provide tourist-related services.

Social Characteristics

The social characteristics throughout the Pinedale RMPPA are similar to those in other small rural western communities. These areas are strongly tied to traditional natural resource based industries such as agriculture and extractive industries. Public lands are important in providing an important natural resource base for economic activities, and supporting a particular lifestyle. Public lands also provide scenic beauty, wildlife habitat, and world-class recreational opportunities. Because public lands comprise much of the land area within the socioeconomic study area counties, management decisions can affect the economic base of local communities and the lifestyles to which these local communities are tied.

Agriculture provided a historical basis for community development during much of the 19th century, and ranching and grazing are still viewed as a viable economic activity in addition to providing scenic beauty, protection of natural resources, and support of cultural and ecological diversity. Although agricultural activities have fallen in economic importance in recent years in the socioeconomic study area, this industry remains very important for its historic and cultural influences. Because the management decisions of the Pinedale RMPPA affect ranching operations beyond public land boundaries, communities are concerned about the social influences these decisions can have on local communities.

The oil and gas industry has also played a part in the social character of the socioeconomic study area. This industry has been an important part of the tax base for all three counties for nearly 50 years. The area has experienced several boom and bust cycles throughout its history, but there is now an increased population tied to this industry. These individuals are active members of local communities and directly affected by management decisions made by the PFO.

In spite of the traditional social characteristics throughout the Pinedale RMPPA, indications are that these views and beliefs are changing somewhat. Some parts of the socioeconomic study area have experienced an increase in population. The population increases are a combination of retirees and others attracted to this region for the abundant and high-quality air, water, and land resources that offer a rich quality of life and a western wilderness heritage. This new population is not tied to traditional natural resource industries and is more likely to support a conservation orientation for public land management.

Environmental Justice

Executive Order (E.O.) 12898, Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations, requires identifying and addressing disproportionately high and adverse human health and environmental effects of federal programs, policies, and activities on minority and low-income populations.

Relevant census data for counties within the socioeconomic study area were collected to determine whether the populations residing within the three study area counties constitute an "environmental justice population" by meeting either of the following criteria:

- At least one-half of the population is of minority or low-income status
- The percentage of population of minority or low-income status is at least 10 percentage points higher than for the entire State of Wyoming.

Population by Race

Table 3.12-10 summarizes the population distribution by race for all counties in the socioeconomic study area. For Lincoln and Sublette Counties, minority populations are well below the state average, whereas Sweetwater County has some minority populations

that are slightly above the state average. Further analysis will need to be conducted to determine if this minority population may be affected by BLM actions.

Population in Poverty

The poverty level is often used as a determination of low-income status. The U.S. Census Bureau estimates poverty levels using a set of money income thresholds that vary by family size and composition. If a household's income is below the money threshold, then the family and all the individuals of that household are considered to be in poverty. Using this criterion, the Census Bureau provides estimates of the percentage of individuals that fall below the poverty level for each county in the United States. Poverty estimates also are provided for not only the various regions of the United States, but also the United States as a whole.

Table 3.12-11 summarizes the estimated poverty rates for the three counties in the socioeconomic study area: Wyoming, the West, and the United States. For these three counties, estimated poverty rates over the last decade have been below the state, regional, and national averages. The median household income in Lincoln, Sublette, and Sweetwater Counties is above the state average, and poverty rates are lower than statewide poverty rates. This indicates the absence of low-income populations on a county-wide basis for the three counties that could be affected by BLM actions within the Pinedale RMPPA, even though small groups of low-income individuals may still be present and potentially affected.

3.13 SOILS

Soil types in the Pinedale RMPPA are of a wide variety. Many of the soils have developed from alluvium within the surrounding mountain ranges that were deposited over time by the Green River and its tributaries. Climate has had a significant influence on the types of soils that developed and their subsequent limitations. Impacts on the soil resource are the result of a wide variety of activities that include energy development and grazing. Soil resources support range and forest plant communities that stabilize the soil surface and protect the watershed. The potential for maintaining or restoring these communities and conserving the soil resource is dependent on the soil types and how the resource is managed.

Surveying of the soils in accordance with National Soil Survey Standards as part of the National Cooperative Soil Survey is incomplete in the Pinedale RMPPA. Soils information from individual surveys that were conducted has not been correlated and is published in hard-copy reports that are beginning to deteriorate with age. Inconsistencies exist among the soil surveys, and the availability of data is limited. Resource-area-wide and other large-scale planning is limited by the inconsistencies and incompleteness of the soils database.

Analysis of soil characteristics and potential limitations to development within the area is restricted by the incompleteness and current condition of the soil database. Identifying

the locations of highly erodible, saline, sodic, shallow, and sandy soils, along with other important soil features, is difficult and time consuming.

Soil Surveys

Mapped Areas

Portions of the Pinedale RMPPA have been mapped by five different soil surveys (see Map 3.13-1 for survey locations). These soil surveys date from 1982 through 1997. Two soil surveys were completed by private contractors as baseline data for the Riley Ridge Natural Gas Environmental Impact Statement (EIS). The BLM contracted two large areas to be surveyed during 1983 and 1987. The final area surveyed was completed by a BLM staff soil scientist in 1997. Three large areas, along with small, scattered parcels of BLM administered public lands, still need to be surveyed.

All of the soil surveys were conducted on an Order III intensity level. The soil lines and components are variable and designed for large-scale planning. Information about these soil surveys may be used to determine potential limitations for proposed projects, but site-specific investigations should always be conducted as part of the project development process.

Information about the surveyed portions of the Pinedale RMPPA from each of the completed soil surveys is summarized below:

- **Soapholes Survey.** Soils along the western flank developed from the Wasatch (e.g., shale, mudstone, and sandstone) and Green River (e.g., limestone) formations have an estimated precipitation range of 7 to 9 inches. The glacial outwash terraces, till terraces, and drainages on the eastern flank have an estimated precipitation range of 10 to 14 inches. Low areas within the Soapholes Basin were identified as having saline soils that may be the result of seepage from unlined canals and irrigation on private lands. The soil survey indicates that accelerated soil erosion by wind and water is a problem along the western part of the area, resulting in gullying on livestock paths and two-track roads. Drainage headcutting is also a problem, and pedestaling and deposition are problems in areas affected by wind erosion (BLM 1997).
- **Burma Road Soil Survey.** The climate in the Burma Road survey area is semiarid and continental with short dry summers and long cold winters. The estimated average precipitation is 7 to 9 inches based on soil development and vegetation (ERO 1988).
- **Big Piney—LaBarge Soil Survey.** Climate was separated into three zones based on temperature and precipitation for this survey. The 7- to 9-inch precipitation zone occurs at the lowest elevations (6,500 to 7,200 feet) and has an estimated growing season of 90 to 100 days. The mid-elevation zone has an average precipitation range of 10 to 14 inches and an estimated growing season of 75 to 90 days. The higher elevation zone has an average precipitation range of 15 to 19 inches and an estimated growing season of 70 to 85 days (ERO 198, BLM 1990).

- **Riley Ridge Soil Survey, North and South Areas.** The climate in this area transitions from 7 to 9 inches of annual precipitation at lower elevations at the east edge of the survey area up to approximately 15 to 19 inches along the west boundary with the Bridger-Teton National Forest. Effective precipitation amounts are very dependent on slope and aspect with steep north-facing slopes having a greater amount of effective precipitation than comparable south-facing slopes. This soil survey identified highly erodible soils, saline soils, sandy soils, and soils with a high percentage of rock fragments as being present and requiring special management. Most of the identified soil types were correlated to established soils series. Use and management limitations were correlated to those established as the range of characteristics for the soil series (Environmental Research Technology, Inc. 1983; BLM 1990).
- **Riley Ridge Soil Survey, Central Area.** The climate in this area transitions from 7 to 9 inches of annual precipitation at lower elevations at the east edge of the survey near Wyoming Highway 235 and increases to roughly 15 to 19 inches along the west boundary with the Bridger-Teton National Forest. Effective precipitation amounts in this area are very dependent on slope and aspect, with steep north-facing slopes having a greater amount of effective precipitation than comparable south-facing slopes (Bio/West 1982, BLM 1990).

Unmapped Areas

Soils in three large areas and in smaller areas in the north and east portions of the Pinedale RMPPA are not included in any of the existing Order III soil surveys. Some of the unmapped areas include portions of the area where oil and gas development is either under way or planned for the near future. No BLM plans exist for conducting soil surveys in these areas.

The digitized soil database for the area substitutes information from the Wyoming general soils map for unmapped areas. This soils information is based on remote sensing and aerial photography without field documentation and therefore is not recommended for site-specific planning. Soils are present in the Ross Butte ecosystem that are physically unstable and that provide habitat to special status plant species.

Soil Conditions and Characteristics

The soils in the Pinedale RMPPA are susceptible to several limitations that reduce the potential for establishing vegetation following a disturbance. Soils with limitations include highly erodible, saline, sodic, and sandy soils.

Soils considered susceptible to these limiting features are discussed in the following subsections.

Highly Erodible Soils

Highly erodible soils are characterized by the loss of valuable topsoil due to action by either wind or water. Erosion increases when the vegetative community is disturbed by

intense grazing, fire, road construction, and any other use that reduces the amount of vegetative cover.

Several soils in the Pinedale RMPPA are red and have a history of erodibility when disturbed. These soils include Almy, Chedsey, Cundick, Eighteen, Iyers, Jerry, Kismet, Nineteen, Redhill, and Stovho soil series. The Forelle soil is not red, but is considered highly erodible.

Saline Soils

Saline soils have calcium, magnesium, or other nonsodium salts dominating their ionic composition, although they may also contain some sodium salts. Soil salinity can have significant effects on soil erosion and reclamation potential. Because erosion of saline soils can also have significant effects on downstream water quality, saline soils are managed to minimize impacts in these areas and to promote revegetation of previously disturbed areas to the best extent possible. Cambarge, Chrisman, Dines, Fluvents-saline, Laney, Mone-saline, Sandbranch, and Tresano variants are some of the soils in the area that have high salt contents (BLM 2002, BLM 1990).

Saline sediments that originate in the area eventually flow into the Colorado River. Salinity levels in the Colorado River are a regional, national, and international issue. Control of sediment discharged from public lands is mandated by the Colorado River Basin Salinity Control Act of 1974. Proper land use is the BLM-preferred method of achieving salinity control with the planning process being the principal mechanism for implementation.

Sodic Soils

The ionic composition of sodic soils is dominated by sodium salts. Soils with sodium adsorption ratios (SAR) of 13 or greater are considered sodic. Infiltration of precipitation into these soils is reduced by the dispersion of soil particles caused by the higher levels of sodium. Reduced infiltration rates result in greater surface runoff rates and increased soil erosion and sediment yields. Many of these soils have a thin layer of suitable soil above the sodic horizon; therefore, when this layer is disturbed or removed, the resulting impact can be irreversible. Soil series in the Pinedale RMPPA with SAR values in excess of 13 include Blazon, Bosler, Bodorumpe Charlos variant, Coalmount, Cora, Dinnen, Foxcreek, Gelkie, Edlin, Haterton, Heath, Laney, Littsan, Millerlake, Maurice, Paulson, Rickman, Tineman, and Westvaco (BLM 2002, BLM 1990).

Sandy Soils and Sand Dunes

Sandy soils are highly susceptible to wind erosion, and efforts are made to avoid disturbing these areas. Sandy soil series include Crestman, Eightyfive A-B-C, Koonich variant, LaMarsh, Littsan variant, Ryan Park, and Space City soil series (BLM 1990).

Limitations on Specific Activities

With the exception of hard surface all-weather roads, most roads in the Pinedale RMPPA are constructed from local soils or improved with gravel. Soil properties that are limiting to construction of roads within the area include sodium content, gypsum content, soluble salts, low strength, shrink-swell potential, and frost action. The content of large stones, depth to hard bedrock, and slope are also important physical features that are considered when determining the suitability of soils for road construction. The fragile nature of native soil surface and biological crusts, especially in areas where erosion control and revegetation are difficult, can limit the appropriateness of off-road uses, as can such soil features as clayey soils, salinity, sodium content, slope, water erosion, and depth to saturated soils. Section 3.9 provides further discussion of off-road uses.

Many soils within the Pinedale RMPPA have limiting features that make reclamation and revegetation difficult. These limiting features include salinity, sodium content, clayey and sandy textures, droughty conditions, alkalinity, low organic matter content, shallow depth to bedrock, stones, and cobbles, and wind erosion. Sometimes the soil limitations are so severe that areas cannot be reclaimed after disturbance.

Analysis of Soil Trends

Soil surveys are a basis for determining the current condition and potential limitations of soils in the Pinedale RMPPA, but do not provide information or data about soil processes such as soil erosion and biological crusts. Information that can be used to evaluate trends within the area for either soil erosion or biological crusts is unavailable at present.

Reduction of sediment and salinity entering the Colorado River system continues to be an important issue for the area. Currently, the Pinedale RMPPA does not have any baseline data on soil erosion to address this issue.

3.14 TRANSPORTATION AND ACCESS

Transportation activity within the Pinedale RMPPA is associated with recreational and nonrecreational use of the land. This section describes the current transportation and access structure of this area.

Basic Transportation Structure

U.S. Highway 191 and 189 traverse the Pinedale RMPPA in a north-south direction (see Map 1.1-2). State Highways 235, 350, 351, 352, 353, and 354 are all within the area. State Highway 351 is a major east-west access through the Pinedale RMPPA. The road systems for Sublette and Lincoln Counties consist of limited paved roads and a network of unpaved roads.

The BLM-managed transportation system is extensive and complements the public road system. These roads are primarily improved dirt roads. Not all of the roads are maintained. Roadways managed by BLM are often used to access private interests. The functional classification of roadways, which also determines design speeds, is determined

by the BLM Manual Section 9113. BLM roads are classified as collector, local, or resource roads.

- **Collector Roads.** These roads normally provide primary access to large blocks of land and connect with or are extensions of the public road system. Collector roads accommodate mixed traffic and serve many uses. Within the BLM-managed system, collector roads receive the highest volume of traffic.
- **Local Roads.** These roads normally serve a smaller area than collector roads, and connect to collector roads or public road systems. Local roads receive lower volumes, carry fewer traffic types, and serve fewer uses. Commonly, local roads in mountainous terrain are single lane.
- **Resource Roads.** Normally, these roads are spur roads that provide point access and connect to local or collector roads. They carry very low volume and accommodate only one or two types of use.

Design for these roadways follows the standards set by the American Association of State Highway and Transportation Officials (AASHTO) "Policy on Geometric Design of Highways and Streets." Maintenance is primarily BLM's responsibility; however, some roads are jointly maintained with the Forest Service.

A network of roads built and maintained most extensively by the oil and gas industry, provide access to public lands.

Access

Access across private land to public lands is a continuing issue within the Pinedale RMPPA. BLM's policy is to acquire access only where needs are identified through land use planning as being essential for the management of BLM-administered lands and resources. Needs are ranked with other access needs throughout the state to determine how the limited resources for acquisition are utilized. Access easements fall into three categories:

- **Perpetual Exclusive.** A perpetual right acquired by the United States to use land of another for a particular purpose, such right being acquired exclusively by the United States and excluding others from enjoying the same privilege unless specifically authorized by the United States.
- **Perpetual Nonexclusive.** A perpetual right acquired by the United States to use land of another for a particular purpose, such right not being granted exclusively to the United States and not excluding others from enjoying the same privilege.
- **Temporary Nonexclusive.** A method similar to perpetual nonexclusive, except that the grant is for a period of time as specified in the conveyance document.

To establish joint agency cooperation when acquiring access to public lands, the BLM has a Memorandum of Understanding (MOU) with the Wyoming Board of Land Commissioners, Forest Service, and the Wyoming Game and Fish Department.

3.15 VEGETATION

The Pinedale RMPPA is a high-elevation, cold-desert ecosystem. Bailey's ecoregion classification identifies two provinces within the Pinedale RMPPA (Bailey 1995). Most of the area, roughly the eastern two-thirds, is within the intermountain semidesert province, which is composed of the Wyoming Basin and the Columbia–Snake River Plateaus. The portion of the Pinedale RMPPA that lies within this province is a portion of the Wyoming Basin. It consists of plains at elevations of 6,000 to 8,000 feet, with isolated hills and low mountains up to 2,000 feet higher. The high elevation of the Wyoming Basin results in cold winters and short summers. Most of the vegetation is described as sagebrush steppe (Bailey 1995).

The remainder of the Pinedale RMPPA is within the southern Rocky Mountain steppe–open woodland–coniferous forest–alpine meadow province of the middle and southern Rocky Mountains. This ecoregion province is characterized by high-elevation plateaus and mountain slopes. The climate is influenced by prevailing west winds, and east slopes are more arid than west slopes. A variety of vegetation communities are found within this province and are determined by elevation, slope aspect, and climate (Bailey 1995). Common vegetation communities are big sagebrush, aspen woodlands, and conifer communities.

Vegetation change over time in the Pinedale RMPPA is available from the University of Wyoming's Normalized Difference Vegetation Index (NDVI). These data are a result of comparisons between Landsat Multi Spectral Scanner images from the 1970s, 1980s, and 1990s and emphasizes differences between green vegetation and bare soil. Over the twenty year period of analysis, there has been minimal change over most of the Pinedale RMPPA. Few areas show noticeable increase in vegetation, whereas some areas along tributaries to the Green River show a decrease in vegetation and an associated increase in bare soil.

The source of vegetation community information within the area is the University of Wyoming's Gas Analysis Program (WY GAP) vegetation analysis data and land cover map. The GAP land cover is a result of interpretation of Landsat Thematic Mapper imagery (1994). Some other sources of land cover are available for portions of the Pinedale RMPPA, but the GAP data are used in this document because of its comprehensive coverage of the area.

(Note: Refer to Table 3.4-1 for scientific names of plant species.)

General Vegetation

Most of the Pinedale RMPPA is dominated by sagebrush and mountain shrub communities with some riparian-, saltbush-, and woodland-dominated areas. Vegetative composition and density is a function of climate, soils, and disturbance variations. Vegetation zones mapped using combinations of the GAP analysis plant communities include riparian/wetland, grasslands, big sagebrush, other shrub, aspen woodlands, lodgepole pine, other conifer, and barren (Map 3.15-1). In addition, open water and areas

of human impact, such as urban/settlement areas and cropland, are mapped. Table 3.15-1 displays the acreage of cover for each mapped vegetation zone. Note that these acreages differ from the acreages given in Section 3.4, which refer specifically to salable timber resources. These vegetation cover type acreages are for the area within the entire Pinedale RMPPA boundary, irrespective of land ownership.

Riparian and Wetland Communities

Riparian and wetland communities are the transition zones between terrestrial and aquatic ecosystems (Gregory et al. 1991). These communities are found in moist areas along perennial or intermittent drainages, seeps, and springs. Soils typically consist of deep, rich loams with high amounts of organic matter. Because of the high productivity of riparian areas, they are very important resources for wildlife and livestock. The lush vegetation in riparian communities provides valuable food and cover; if water is present, the importance of these areas increases even more.

Within the Pinedale RMPPA, riparian/wetland vegetation types include riparian forest, shrubland, and herbaceous meadow/wetland areas. Together, these three categories of vegetation types make up roughly 54,454 acres and approximately 3.4 percent of the area. These categories are mapped as a single zone on Map 3.15-1 and are individually described in more detail in the following subsections.

Riparian habitat throughout the Pinedale RMPPA was assessed for Proper Functioning Condition (PFC) following methodologies described in BLM technical references including 1737-9, 1737-11, 1737-15, and 1737-16. The assessment was conducted between 1994 and 2001. The results are summarized in table 3.15-2.

Forest- and Shrub-Dominated Riparian Communities

Riparian forest communities in the Pinedale RMPPA are dominated by narrow-leaf cottonwood with an understory of shrub, forb, and grass species. These communities cover approximately 19,547 acres, or 1.2 percent, of the Pinedale RMPPA.

Shrub-dominated riparian communities consist of high densities of various willow species with an understory of grasses, sedges, and forbs. These communities cover approximately 33,970 acres, or 2.1 percent, of the Pinedale RMPPA.

Herbaceous Riparian and Wetland Communities

Herbaceous riparian and wetland communities include moist meadows and irrigated hay fields along drainages. Moist meadow communities are dominated by herbaceous riparian and/or wetland species. Herbaceous riparian and wetland communities comprise about 937 acres, less than 1 percent, of the Pinedale RMPPA. They occur in areas of high moisture, such as near springs or seeps, supporting mesic or wetland herbaceous vegetation.

In addition, hay fields are located in privately owned riparian corridors of the Pinedale RMPPA. Native, nonnative, and improved seeded species (e.g., Garrison creeping

foxtail, timothy, smooth brome, and Kentucky bluegrass) are present in these communities.

Grassland Communities

Grasslands, which make up less than 1 percent of the Pinedale RMPPA, are primarily found in the western portion of the Pinedale RMPPA on shallow ridges of the Overthrust Belt (BLM 1985). Patches of grasslands are found scattered throughout low- and high-density sagebrush communities. These grassland communities provide important habitat and forage for wildlife. Grass species dominate these communities, but shrubs, subshrubs, and cushion plants are also common. Included within the grassland mapping zone is a small area (304 acres) of subalpine meadow in the western portion of the Pinedale RMPPA.

Sagebrush Communities

Sagebrush communities are the most extensive plant cover type not only in the Pinedale RMPPA, but also in the surrounding Wyoming Basin area and intermountain region. Sagebrush communities cover approximately 1,090,532 acres (68 percent) of the Pinedale RMPPA. Adaptations to different habitat characteristics (e.g., soil type, climate, and elevation) have resulted in a variety of sagebrush species in the western United States (Monsen and Shaw 2000). Sagebrush communities in the Pinedale RMPPA are dominated by either of two subspecies of big sagebrush: Wyoming big sagebrush and mountain big sagebrush, with a well-established grass and forb component.

Native sagebrush communities across the west have been altered by changes to the natural fire regime and disturbances, such as herbicides, cultivation, excessive grazing, and insect activity (BLM 1989). European settlement and impacts in sagebrush-dominated regions brought about changes in many of these areas, including an increase of sagebrush density, introduction of non-native species, and reduced numbers of certain native grasses and forbs (Tisdale and Hironaka 1981). Although the species composition of these communities may have changed somewhat since European settlement, these rangelands are still dominated by native plant communities, and a majority of the species that were present in historic plant communities are still present today.

Overgrazing by livestock tends to deplete sagebrush communities of their native grass and forb element, resulting in increases of density of sagebrush or, alternatively, invasion of exotic weedy species (BLM 1999b). Within the Pinedale RMPPA grazing has resulted in increases in the density of sagebrush, and some changes in the herbaceous plant communities. But no widespread invasions involving exotic weedy species that dominate the native plant communities have been observed. Wildfires in sagebrush communities have increased in numbers and intensity compared with historic levels in some parts of the West, but this has not been a particular issue in the Pinedale RMPPA.

Wyoming Big Sagebrush

Wyoming big sagebrush is the most xeric of the big sagebrush varieties. Within the Pinedale RMPPA, Wyoming big sagebrush communities are found at elevations of 7,000

to 7,500 feet. A canopy cover of sagebrush in high-density areas is typically greater than 35 percent. Wyoming big sagebrush covers approximately 823,495 acres (52 percent) of the Pinedale RMPPA. Species commonly associated with Wyoming big sagebrush include various other shrubs, grasses, and forbs such as rabbitbrush, Letterman's needlegrass, thickspike wheatgrass, various bluegrass species, phlox, and buckwheat.

Mountain Big Sagebrush

Mountain big sagebrush usually grows above 7,800 feet in portions of the Pinedale RMPPA that receive annual precipitation amounts of 15 inches or more. In the Pinedale RMPPA, this translates to approximately 267,037 acres, or 16.5 percent, of the total area. The same understory species occur in the Mountain big sagebrush as in the Wyoming big sagebrush, with the addition of fescues and other species of wheatgrasses. Also the understory is generally more productive in this type due to a greater amount of precipitation.

Low-Density Sagebrush Communities

Low-density sagebrush communities are found in basins and are characterized by shrub canopy cover of less than 35 percent. Various species of sagebrush may dominate, including basin big sagebrush, black sagebrush, alkali sagebrush, and three-tip sagebrush. In low-density areas dominated by Wyoming big sagebrush, associated species are similar to those for Wyoming big sagebrush communities. Additional common species associated with Wyoming big sagebrush in low-density areas include rabbitbrush, thickspike wheatgrass, Sandberg bluegrass, Letterman's needle grass, and Indian ricegrass, and horsebrushes.

Also included in the low-density sagebrush classification are low-growing sagebrush communities found on dry, windy ridges and/or areas with shallow soil.

Low-density sagebrush communities are mapped with other sagebrush communities in Map 3.15-1.

Mountain Shrub Communities

Mountain shrub communities include dominant shrub vegetation other than sagebrush, such as antelope bitterbrush, mountain mahogany, serviceberry, and snowberry. These communities are found within sagebrush communities in areas that receive additional moisture from snow banks, seeps, and springs (BLM 1986). The sagebrush communities within the glacial deposits on the east side of the field office area are characterized by a high percentage of bitterbush, and are significant vegetation zones for mule deer in spring and fall. Common associated species of mountain shrub communities are similar to those of mountain big sagebrush communities. In Map 3.15-1, mountain shrub communities are mapped with big sagebrush.

Salt Desert Shrub

Salt desert shrub communities are composed primarily of saltbush and greasewood communities (Map 3.15-1). Saltbush communities occur as typical saltbush communities and as half-shrub communities. Typical saltbush communities are usually found on soils with high salt or exchangeable sodium content, including badland clay soils, colluvial deposits, and alluvial outwashes. Salt-tolerant species inhabit these areas, and Gardner's saltbush is usually dominant (BLM 1986). Their grass and forb component is similar to that for the sagebrush community, with Indian ricegrass often the dominant grass (BLM 1986). Half shrub communities consist of shallow-rooted, salt-tolerant species (e.g., bud sagebrush, winterfat, and buckwheats), Gardner's saltbush, low rabbitbrush, spineless horsebrush, rhizomatous wheatgrass, and squirreltail. Soils tend to be heavy clay with slow permeability, sometimes shallow with shale bedrock in basins and flatlands (BLM 1986). Saltbush communities provide wildlife and livestock forage. However, their management and manipulation are strongly limited by climate and soils and are undertaken only after thorough analyses of community health, structure, and potential (BLM 1986). Greasewood communities are found in basins in heavy, dense alkaline soils or on the west side of the Green River in upland areas with neutral to alkaline sandy clay soils. Generally, these communities are not valuable for forage because of low productivity associated with the alkaline soil.

Forest and Woodland Communities

Forest and woodland communities are represented by broadleaf woodland communities.

Broadleaf woodland communities within the Pinedale RMPPA include aspen stands, cottonwood, and willow communities. Cottonwood and willow communities are described in the previous discussion of riparian communities. Aspen stands occur in areas with high moisture availability such as on northern and eastern exposures where snow packs accumulate. They also tend to occur on the edges of conifer stands, as a transition between sagebrush and conifer zones. Aspen stands cover 15,198 acres of the Pinedale RMPPA. The understory component of aspen stands includes a mix of shrubs, grasses and forbs, such as snowberry, creeping juniper, kingspike fescue, Idaho fescue, bluebunch wheatgrass, various bluegrass and needlegrass species, as well as Oregon grape and lupine.

Aspen communities are important forage areas for livestock and wildlife. These communities also have recreational value for scenery, camping, and hunting. Overgrazing of these communities can lead to depletion of the understory component, resulting in a decrease in forage value. Aspen stands have evolved with fire as a regular occurrence. Disturbance from, for example, logging or fire is necessary to promote root sprouting of aspens. Without some type of disturbance to encourage new trees, aspen stands will eventually die out and often will be replaced by conifer communities (DeByle 1985).

Conifer Communities

The western, northern, and eastern edges of the Pinedale RMPPA contain conifer communities. Lower elevation conifer communities are found on northern and eastern slopes, whereas those in higher elevations are more extensive and are found on all slopes (BLM 1986). Conifer communities contain several vegetation types, including lodgepole pine, subalpine fir, limber pine, Douglas fir, Engelmann spruce, blue spruce, and mixed conifer communities. Dominant conifer species are an indication of elevation, slope aspect, soil characteristics, and climate. For this document, discussion of conifer communities will be divided into two sections: lodgepole pine communities and "other conifer" communities.

Lodgepole Pine

Lodgepole pine often occurs in dense, pure stands with little understory. However, as the stand ages, shade-tolerant conifer species, such as spruce and fir, become established in the understory. Historically, before alteration of fire regimes by humans, fires would wipe out the stands before the other conifer species could become dominant. Lodgepole is dependent on fire for regeneration. Cones often retain seeds until fire or cutting causes opening and dispersal of seeds, and lodgepole are often the first trees to become established after fires (BLM 1989, ESA 2002). If fire does not occur, the stand may become dominated by other conifer species.

In addition to providing timber, an economic resource, lodgepole forests are valuable as cover for wildlife such as elk. In the Pinedale RMPPA, lodgepole forests cover 41,600 acres and make up approximately 2.6 percent of the area.

Other Conifer Communities

Other conifer communities in the Pinedale RMPPA may be dominated by subalpine fir, limber pine, Douglas fir, Engelmann spruce, blue spruce, or a mixture of any of the above species. Of these species, Douglas fir is the most likely to be found dominating on its own in stands with an understory of bunchgrasses in drier areas, or shrubs, grasses, and forbs in more mesic zones. More often, Douglas fir is mixed with Englemann or blue spruce (BLM 1989).

Spruce-fir forests are dominated by subalpine fir and Englemann spruce. Limber pine, Douglas fir, lodgepole pine, and blue spruce are also associated with these communities (BLM 1989). Mixed conifer forests are often dense with a large amount of accumulated litter, and little understory growth (BLM 1989).

In the Pinedale RMPPA, based on information from the Wyoming Gap Analysis, approximately 10,049 acres, less than 1 percent, of the total area, is made up of the "other conifer" vegetation zone, as illustrated in Map 3.15-1.

The most important management issue in the other conifer communities is fire. Before human manipulation of fire regimes, these communities were exposed to frequent understory fires. These fires kept the understory growth and dead woody fuel to a

minimum. Accumulation of fuel and understory growth causes the fires that do burn in these areas to burn more intensely and spread to crowns of mature trees. In addition, continued prevention of fires in forest communities results in a change of forest composition, as fire-adapted species such as lodgepole and aspen will eventually be replaced by species not tolerant of fire.

Barren Communities

Areas with very little or no vegetative cover include steep slopes, rock outcrops, and badlands in addition to areas affected by roads and other types of nonurban development. Barren communities account for 5,664 acres of the PFO administrative area. As a result of low production of forage or cover, value to wildlife and livestock in these communities is low, though rock outcrop areas do provide nesting and perching habitat for raptors.

Agricultural/Urban Communities

Agricultural areas cover 284,132 acres (17.5 percent) of the Pinedale RMPPA, including irrigated and dry-land crops. Most of the agricultural area is irrigated hay meadows. Some dry-land crops are grown in upland areas away from drainages (5,283 acres). Crops grown on private land in the Pinedale RMPPA are dominated by grass hay, such as Garrison creeping foxtail, timothy, and smooth brome, with a few fields of alfalfa throughout the area.

Urban settlements in the Pinedale RMPPA account for 732 acres and include the towns of Pinedale, Boulder, and Daniel in the northern portion; Big Piney and Marbleton in the central area; and LaBarge in the southern portion. These locations are combined with croplands as the agricultural/urban zone on Map 3.15-1. This vegetation cover type can be expected to be entirely on private land that is not subject to BLM management.

Special Status Plant Species

Sensitive plants such as those listed as federally threatened, endangered, or candidate species, or those given other special designations, are known as “special status species.” These plants have been given this designation because they have an increased risk of extinction attributed to unique habitat attributes and restricted distribution areas. Consequently, the populations of special status species are of great conservation interest.

The BLM and Forest Service are among the federal agencies that have adopted policies to protect species designated by the USFWS as threatened, endangered, or candidate species under the Endangered Species Act (ESA) of 1973. The BLM and Forest Service also have their own “sensitive” designation for rare plants that exist within their management areas. In addition to USFWS-, Forest Service-, and BLM-listed species, those ranked under The Nature Conservancy’s (TNC) Natural Heritage ranking system are also discussed in this document.

Federally Listed Species

Of the 17 species on the federal threatened or endangered list for Wyoming, Ute ladies'-tresses is the only plant that is likely to occur in the Pinedale RMPPA. Meadow pussytoes, Trelease's racemose milkvetch, Cedar Rim thistle, large-fruited bladderpod, Beaver Rim phlox, and tufted twinpod are Wyoming BLM sensitive species. Meadow pussytoes and Payson's bladderpod are Forest Service Region 4 sensitive species, and Swallen Mountain ricegrass and Big Piney milkvetch are special status species of the BLM Rock Springs Field Office. These are described in detail below.

- **Ute Ladies'-Tresses.** Ute ladies'-tresses, a threatened species, has not yet been identified in western Wyoming, although potential habitat does exist. Habitat includes areas associated with springs, lakes, rivers, or perennial streams at elevations of 1,800 to 6,800 feet (Fertig 1999). The potential habitat within the Pinedale RMPPA includes riparian and wetland communities at elevations below 6,800 feet. Most of the Pinedale RMPPA is above 6,800 feet; therefore, the presence of Ute ladies'-tresses is unlikely, but should not be ruled out. Known populations include those along the base of the eastern side of the Rocky Mountains in portions of Wyoming, Montana, and Colorado. These areas have been heavily affected by development and stream channelization and other watershed alterations.

- **Meadow Pussytoes.** Meadow pussytoes is a regional endemic listed by both USFS Region 4 and Wyoming BLM as sensitive. It is ranked in the Natural Heritage Network as global and state imperiled. Meadow pussytoes grows in subirrigated meadows within broad stream channels at elevations of 4,950 to 7,900 feet. It is absent from riparian areas and other locations exhibiting saturated soils and dense graminoid or shrub cover (Fertig 1999). Wyoming locations of meadow pussytoes include one occurrence in the northern portion of the Pinedale RMPPA in the Green River Basin, as well as locations in the Sweetwater River Valley and the South Pass area of the southern Wind River Range in Fremont County. Riparian meadows in the Pinedale RMPPA at elevations of 7,200 to 7,900 feet have potential for occurrences of meadow pussytoes (Laster 2002b). Primary threats to the species in Wyoming generally include OHVs, mining, and water projects (Fertig 1999). Grazing is considered a threat, but to a lesser extent than originally thought.

- **Trelease's Racemose Milkvetch.** Trelease's racemose milkvetch is a Wyoming BLM sensitive species as well as a Natural Heritage Network State and trinomial imperiled species. It grows on barren hills and washes (Dorn 1992), although little else is known about this species. The Wyoming Rare Plant Technical Committee (WRPTC) is in the process of compiling information for Trelease's racemose milkvetch. Populations of Trelease's racemose milkvetch are known to occur in Sublette and Uinta Counties (Dorn 1992). Two occurrences are known from the southern portion of the Pinedale RMPPA. Threats to the species are unknown at present.

- **Cedar Rim Thistle.** Cedar Rim thistle is a Wyoming endemic perennial herb with Wyoming BLM sensitive status and Natural Heritage Network State and global imperiled status. The species grows on barren slopes, fans, and draws in open areas within Wyoming big sagebrush grasslands at 5,800 to 7,500 feet on specific geologic formations. Known populations of Cedar Rim thistle are limited to the Green River Basin in Sublette County, the Beaver Rim area of Fremont County, the Sweetwater River Valley in Carbon County, and highlands on the east side of Flaming Gorge in Sweetwater County (Fertig 1999). There are three occurrences in the southern portion of the Pinedale RMPPA. Pest control measures, including the spraying of herbicides and release of biocontrol insects to control other species of thistle that are invasive, are the main threats to the Cedar Rim thistle. The plant does not appear to be affected by livestock grazing or mineral exploration (Fertig 1999).

- **Large-Fruited Bladderpod.** Large-fruited bladderpod is a Wyoming BLM sensitive and Natural Heritage Network global and state imperiled perennial species. It grows in open Gardner's saltbush—squirreltail communities on barren clay hills and flats (Dorn 1992, Fertig 1999). Usually, populations are found on slopes of less than 15 percent on low hills, knolls, or colluvial fans at elevations of 6,800 to 7,700 feet. Soils are usually fine to textured barren clays and shales (Fertig 1999). The large-fruited bladderpod is endemic to an area less than 25 square miles in size on the western rim of the Great Divide Basin and in the Green River Basin near Opal and Ross Butte, Wyoming (Fertig 1999). Within the Pinedale RMPPA, large-fruited bladderpod is known from two occurrences on Ross Butte. Disturbance from oil and gas mining and exploration is a threat to the species. OHV and wild horse activity are also possible threats (Fertig 1999).

- **Payson's Bladderpod.** Payson's bladderpod is a Forest Service Region 4 sensitive species that is a regional endemic of west-central Wyoming, eastern Idaho, and southwestern Montana. It is found on rocky slopes, ridges, floodplains, and along disturbed roadsides at elevations of 5,500 to 10,600 feet. Within the Pinedale RMPPA, there is one known occurrence of Payson's bladderpod in the north-central portion of the area (Fertig 1999). The pothole region is an area with potential for occurrences of this species (Laster 2002b). Generally, threats to Payson's bladderpod are low, but may include hiking, OHV, ski development, grazing, and mining (Fertig 1999).

- **Beaver Rim Phlox.** Beaver Rim phlox was determined in 1988 to be endemic to Wyoming. It is classified as Wyoming BLM sensitive with a high conservation priority. It also is ranked by the Natural Heritage Network as a global and state imperiled species. It grows on dry desert hills on sparsely vegetated slopes with sandstone, siltstone, or limestone substrates at elevations of 6,000 to 7,400 feet (Dorn 1992, WRPTC 1994). Populations of Beaver Rim phlox are known to occur in the Green River Basin in Sublette and Lincoln Counties, and in southern Fremont County (Fertig 1999). Beaver Rim Phlox is known to occur in four locations within the Pinedale RMPPA, including one occurrence on Ross Butte. General threats to the Beaver Rim phlox include disturbance from oil and gas development, pipeline construction, and highway construction (Fertig 1999).

- **Tufted Twinpod.** Tufted twinpod is a Wyoming BLM sensitive perennial forb with Natural Heritage Network global and state imperiled status. It is found on dry, rocky, calcareous knolls and ridges, and shaley hills and clay banks. It occurs in openings within sagebrush grassland at elevations of 6,700 to 7,400 feet in sparsely vegetated cushion plant communities (Dorn 1992, Fertig 1999). Tufted twinpod is an endemic to the southern Overthrust Belt and lower Green River Basin in Lincoln, Sublette, and Uinta Counties in southwest Wyoming (Fertig 1999). Within the Pinedale RMPPA, it is known from one location in the southern portion of the area. Tufted twinpod may be adaptable to disturbed sites and, currently, threats appear minimal (Fertig 1999).

- **Swallen Mountain Ricegrass.** Swallen Mountain ricegrass is a perennial bunchgrass with BLM special status in the Rock Springs Field Office, occurring on sandy to gravely limey-clay soils covered with gravel. The Natural Heritage Network ranks the species as state imperiled and globally secure but possibly rare in parts of its range. It is found on rocky slopes, rims, and mesa summits, often associated with sagebrush grasslands at elevations of 6,500 to 7,900 feet (Dorn 1992, Fertig 1999). Swallen Mountain ricegrass is an endemic of east-central Idaho and western Wyoming. Wyoming populations are known only from the western Green River Basin in Lincoln and Sublette Counties (Fertig 1999). Populations may be threatened from oil and gas development (Fertig 1999). Populations are known from lands managed by the BLM Kemmerer, Pinedale, and Rock Springs Field Offices, including at least five occurrences throughout the Pinedale RMPPA (Fertig 1999).

- **Big Piney Milkvetch.** Big Piney Milkvetch is listed as a special status species in the Rock Springs and Pinedale field offices. The Natural Heritage Network ranks it as state and globally rare to imperiled. It grows in open areas within sagebrush and cushion plant communities on sandstone, stony clay, badlands, and barren clay slopes and ridges at 6,900 to 7,200 feet (Dorn 1992, Fertig 1999). Big Piney milkvetch is endemic to the Green River Basin in Sublette County. Reports also place it in Lincoln County, although these are not confirmed (Fertig 1999). More than 30 occurrences are known from a small geographic area within the BLM RMPPA and the Bridger–Teton National Forest (Fertig 1999). General threats to Big Piney milkvetch include habitat loss and disturbance from vehicles related to natural gas development and exploration activities.

Other Special Status Species

The remaining species, described below, are ranked by TNC's Natural Heritage Network and listed by the Wyoming Natural Diversity Database. These species lack formal federal status or protection, although they are considered locally or regionally rare or imperiled.

- **Sickle Saltbush.** Sickle saltbush is a shrub ranked by the Natural Heritage Network as critically imperiled in the State of Wyoming and globally secure. It grows in sagebrush-dominated communities on desert hills, mesas, draws, and gravel benches with sandy to clayey soil (Dorn 1992, Fertig 1999). The known

range of sickle saltbush includes southeastern Washington to northeastern California, east to Montana, Utah, and Nevada. In addition to southern portions of the Pinedale RMPPA in Sublette County, Uinta and Sweetwater Counties also contain known populations (Fertig 1999). Disturbance from mining exploration may affect some populations of sickle saltbush.

- **Divergent Wild Buckwheat.** Divergent wild buckwheat is ranked by the Natural Heritage Network as state critically imperiled and globally secure. It is a low-spreading annual that grows in cushion plant-bunchgrass communities or on the edges of sagebrush grasslands. It prefers barren or semibarren clay, shale, or sandstone hills and washes at elevations of 6,250 to 7,500 feet (Dorn 1992, Fertig 1999). The distribution of divergent wild buckwheat in Wyoming includes the Great Divide and Green River Basins in Sublette, Sweetwater, Lincoln, and Uinta Counties (Fertig 1999). Impacts and threats from oil and gas development that could potentially occur in or around populations are unknown (Fertig 1999).

- **California Hesperochiron.** California hesperochiron is a low-growing perennial herb that is found in moist to dry hills and flats, often in alkaline soils, at elevations of 6,700 to 7,000 feet (Dorn 1992; Fertig 1999). It is ranked critically imperiled in Wyoming and globally secure for most of its range by the Natural Heritage Network. California hesperochiron is distributed along the west coast states, western Montana and Wyoming, and northeastern Utah. The Wyoming distribution includes only the Evanston area in Uinta County and the upper Green River Basin in Sublette County (Fertig 1999). One occurrence is known from the northeast portion of the Pinedale RMPPA. Threats to the species have not been identified.

- **Mountain Peppergrass.** Mountain peppergrass is ranked by the Natural Heritage Network as critically imperiled in Wyoming, but secure throughout most of its range. It is a perennial herb that is found on meadows, slopes, and disturbed areas, such as roadsides, at elevations of 6,800 to 7,000 feet (Dorn 1992, Fertig 1999). The range of mountain peppergrass is from New Mexico to Utah and Wyoming. Wyoming populations are known from one occurrence the Green River Basin near the Big Piney and Marbleton areas in the Pinedale RMPPA (Fertig 1999). This species may be adapted to disturbance and therefore semiweedy. More research is needed to investigate this possibility. Roadside populations of mountain peppergrass may be susceptible to herbicides or other disturbances (Fertig 1999).

- **Juniper Prickly Pear.** Juniper prickly pear is a clump-forming perennial succulent cactus ranked as critically imperiled in Wyoming and rare to secure throughout its range by the Natural Heritage Network. Habitat includes sandy soils of flats, washes, and hillsides in desert shrub, grasslands, and open grassy flats in southern pinyon-juniper woodlands (Fertig 1999). The Wyoming populations are peripheral, and occur in sandy or gravelly substrates with desert shrub at elevations of 6,120 to 6,950 feet in the Green River Basin in Sublette and Sweetwater Counties, including one occurrence in the east-central portion of

the Pinedale RMPPA (Dorn 1992, Fertig 1999). Threats to juniper prickly pear are unknown.

- **Desert Glandular Phacelia.** Desert glandular phacelia is ranked by the Natural Heritage Network as questionably critically imperiled in Wyoming and secure to rare across its range. It grows on semibarren south or west facing upper slopes in gray clay shale covered by fragmented slate (Fertig 1999). Less often, desert glandular phacelia may occur on chalky, limey-slate outcrops dominated by cushion plants, or in openings within shadscale, green rabbitbrush, and greasewood mixed shrubland (Fertig 1999). Desert glandular phacelia is endemic to the Great Divide Basin and the desert foothills of the Overthrust Belt in southwestern Wyoming in Lincoln, Sweetwater, and Sublette Counties (Fertig 1999). One occurrence is known from the Ross Butte vicinity of the Pinedale RMPPA. General threats to desert glandular phacelia include OHV activity and mineral exploration.
- **Hoary Willow.** Hoary willow is a ranked by the Natural Heritage Network as globally secure, but imperiled in Wyoming. This low-growing shrub is found on wet to saturated soils in floating mats, bogs, fens, and willow thickets around ponds from the foothills to montane zones at elevations of 6,600 to 9,200 feet (Dorn 1992, Fertig 1999). Wyoming populations of hoary willow are known from the Absaroka, Beartooth, Laramie, and Medicine Bow Ranges, the Yellowstone Plateau, and the upper Green River Basin, possibly within the Pinedale RMPPA (Fertig 1999). Grazing pressures may be a threat (Fertig 1999).
- **Low Spike-Moss.** Low spike-moss is a perennial moss-like herb that occurs in saturated moss-covered zones in wet meadows at elevations of 7,700 to 8,000 feet (Dorn 1992, Fertig 1999). It is ranked by the Natural Heritage Network as globally secure, but critically imperiled in Wyoming. Low spike-moss has a large range across North America. In Wyoming, populations are known from the upper Green River Basin in the Pinedale RMPPA, and from the foothills of the Wind River and Teton Ranges in Sublette and Teton Counties (Fertig 1999). General threats to low spike moss populations include development of subdivisions and dam construction (Fertig 1999).

Sensitive Areas

Ross Butte and Ross Ridge are located along Wyoming Highway 351 in the central portion of the Pinedale RMPPA. The Ross Butte ecosystem in this area provides habitat for many endemic plant species, including Big Piney milkvetch, Beaver Rim phlox, large-fruited bladderpod, and desert glandular phacelia (Fertig 1999). The report (Plant Species of Special Concern of the Ross Butte Ecosystem) contains the recommendation: "The Ross Butte ecosystem contains one of the highest known concentrations of regionally endemic basin plant species in southwestern Wyoming. Given the growing pressures to develop natural gas and oil resources in southwest Wyoming, the Ross Butte area stands out as a significant potential conservation site. Wetland areas within the Pinedale RMPPA provide potential habitat for such species as meadow pussytoes and Payson's bladderpod (Laster 2002b).

Noxious Weeds

Noxious weeds are defined in E.O. 13112 as those "species whose introduction does or is likely to cause economic or environmental harm or harm to human health." Noxious weed species, when introduced to an area, are aggressive and often dominate natural communities. They are often able to establish areas following disturbance. As listed in Table 3.15-3, the State of Wyoming has designated 22 weeds as noxious; 10 of these are known to be a problem within the Pinedale RMPPA.

Of the species listed in Table 3.15-3, perennial pepperweed, leafy spurge, knapweeds, and Dyer's woad are considered to have the highest management priority within the Pinedale RMPPA. The Sublette County Weed and Pest Agency is concerned with known significant infestations of perennial pepperweed along Muddy Creek north of Big Piney, and the Green River south of Big Piney to LaBarge (Laster 2002a).

Other weed species present within the Pinedale RMPPA, although not officially designated noxious, can be disruptive to native plant communities. These include cheatgrass, halogeton, and Russian thistle. Of these, halogeton is the most problematic in the Pinedale RMPPA. Weeds are primarily present in areas of disturbance, including along roads, areas of oil and gas development, and in heavily grazed areas. GIS data for weed populations have not been completed for most of the Pinedale RMPPA.

3.16 VISUAL RESOURCES

PFO's visual resources are influenced by the different characteristics of the two physiographic provinces in the region: the Wyoming Basin and the Central Rocky Mountains province.

The Wyoming Basin is located in the west-central portion of the state, bounded on the north by the Wind River Range and on the south by the Uinta Range. The province extends east to the Red Desert and west to the foothills of the Wyoming Range. The landform is typically composed of low mountains, low rolling or flat-topped hills, and isolated hills. The soils are highly erodible and, together with the multicolored sedimentary bedrock of the region, form the colorful badlands landscape common throughout most of the province. Most of this area is shrub steppe, dominated by sagebrush, greasewood and saltbush. The higher elevations are dominated by mountain shrub vegetation, with coniferous forest atop the highest areas.

The Central Rocky Mountains physiographic province extends from the western edge of Wyoming south into Colorado, north to the Montana/Wyoming border, and west into Idaho. The province is characterized by high, rugged, glaciated mountains rising to elevations of up to 13,000 feet above sea level. Glaciation has left broad flat valleys between mountain ranges. Deep, V-shaped drainages with steep, rocky slopes are common. Elevation determines the dominant vegetation: the areas of highest elevation support alpine tundra. The subalpine zone is dominated by Engelmann spruce and subalpine fir, with ponderosa pine and Douglas fir in the montane zone below that. Fire can change forests in either of those zones to lodgepole pine or aspen. Grass and

sagebrush occur under open pine forests that grade downslope into grasslands, woodlands, or shrub steppe.

Scenic Views

Within the Pinedale RMPPA, the diversity of topography and landforms exhibited by these two distinctly different topographic zones creates an extraordinary variety of visual contrasts and scenic beauty. The Pinedale RMPPA contains a major river system and watershed, the Upper Green River, and borders the slopes of several major mountain ranges: Gros Ventre Range to the north, Wind River Range to the east, and Wyoming Range to the west. The New Fork River is a major tributary of the Green River and flows south along the foothills of the Wind River Range.

Numerous areas within the Pinedale RMPPA exhibiting high degrees of scenic quality are easily accessible to tourists and other recreationists. Some examples of high quality scenic views and viewsheds within the area are as follows:

- The Green River and valley is highly scenic. River floaters can enjoy a variety of scenic landforms, vegetation and wildlife.
- In the vicinity of the town of Pinedale, adjacent to the Wind River Front, is an area that includes very scenic foothill country adjoining the Bridger National Forest. It includes the lands adjacent to Fremont, Soda, Willow, and New Fork Lakes.
- Scab Creek, an area of extraordinary scenic views, contains some of the best scenery of BLM-managed lands within the state. This area is typified by steep, rugged rock outcrops, aspen, lodgepole pine, and Douglas fir stands interspersed with grassy meadows, small lakes, and streams.
- The Mesa, an extensive, flat-topped highland south of Pinedale, provides excellent views of all the mountain ranges in the area.
- The stretch of road along Highway 352 in the vicinity of the town of Cora encompasses the majority of the land between the town of Pinedale and the Warren Bridge Campground. The upper New Fork flows adjacent to this highway and provides excellent views of the Wind River and Gros Ventre Ranges to the northeast.
- A section of the LaBarge Creek road passes between Lake Mountain and Miller Mountain, providing one of the most scenic drives through the Wyoming Range. The area consists of steep canyons, scenic rock outcrops along narrow canyon bottoms, and clear streams lined with aspens and willows. The landscape view leading to the mountain foothills is high rolling plains interspersed with colorful mesas and buttes.
- Blue Rim and Ross Butte provide a high desert landscape that is bounded on the north and west by the New Fork and Green Rivers. Dramatic views of a colorful

and massive badland escarpment are most evident to travelers along Highway 351 and Highway 189, and to river floaters.

Visibility

The Pinedale RMPPA is rural in character, and because it lacks a major source of air pollution, the Wyoming Air Quality Division has designated the Pinedale RMPPA as an air pollution attainment area, which meets all of EPA's national pollution and ambient air quality standards. Thus, the air quality is generally excellent, and pollutants generally do not obscure visibility.

Visual Resource Management System

The Pinedale RMPPA has been inventoried using the BLM Visual Resource Management (VRM) Classification System into four visual management classifications (I through IV), based on scenic quality, visual sensitivity levels, and viewer distance zones. Each VRM classification has a management objective, and these objectives are described below:

- **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 activities. The level of change to the characteristic landscape should be very low and should 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 landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes to the landscape 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 landscape should be moderate. Management activities may attract the attention of the casual observer, 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 landscape can be high. The management activities may dominate the view and may be the major focus of viewer attention. However, every attempt should be made to minimize the effect of these activities through careful location, minimal disturbance, and repetition of the basic visual elements of form, line, color, and texture (BLM 1986).

The established VRM classes for the Pinedale RMPPA are depicted in Map 3.16-1. The acreages for each VRM class within the Pinedale RMPPA are shown in Table 3.16-1, Visual Resource Management Classifications and Acreage (BLM 1988).

The VRM classification for the South LaBarge and Fontenelle Creek area is not consistent with the VRM classification of lands south of Fontenelle Creek in the Kemmerer Field Office Area. The north side of Fontenelle Creek, from Mammoth Hollow to the Highway 189 corridor, is classified as VRM Class IV. On the south side of Fontenelle Creek (Kemmerer side), the landscape has been classified as VRM Class II (Hudson 2002, Mierzejeweski 2002).

VRM classifications are generally not consistent across boundaries between the Pinedale and Rock Springs Field Office. The Highway 191 travel corridor designated as Class III in the Pinedale RMPPA becomes Class IV in the Rock Springs Field Office area; a Pinedale Class III area in the vicinity of Muddy Creek (west of Irish Canyon) is Class II in the Rock Springs Field Office.

Visual Resource Trends

OHV Use

The existing Pinedale RMP describes those areas that have been designated for OHV use. OHV use has increased in the Pinedale RMPPA. OHV use for recreational and nonrecreational purposes is creating noticeable visual impacts in some areas. Visual impacts produced by OHVs create trails and roads that are most visible on steep or erosive soils. Known areas of impact to scenic quality from OHV use are the Red Canyon area in the foothills of the Wyoming Range, localized small areas of the Blue Rim and the towns near Big Piney, Marbelton and Pinedale.

Section 3.9 (OHV) provides additional information on OHV use and resource conflicts.

Fluid Mineral and Other Surface Disturbing Activities

The trend toward continued expansion of oil and gas development within the Pinedale RMPPA may be creating cumulative visual impacts of potential conflict with the established VRM class objectives. The following areas are identified as areas of potential conflict: (1) Mesa area (south and west of Pinedale); (2) Upper Green River valley west and east of U.S. Highway 191; (3) historic Oregon Trail; (4) U.S. Highway 191 and 189 travel corridors; and (5) areas along the Wyoming and Wind River Fronts.

Other surface disturbing activities in the Pinedale RMPPA include housing development expansion along the foothills of the Wind River Range and associated activities, including an increased number of gravel pits, roads, and utility ROWs.

Visual Sensitivity

A trend is developing in which the public is becoming more sensitive to the areas scenic values. As the numbers of residents, travelers and recreastionists increase, this heightened sensitivity is likely to increase. Travel patterns and volume within the RMPPA have likely changed somewhat during the last 15 years.

3.17 WATER QUALITY AND WATERSHED

Water resources include surface and subsurface sources. Hydrological conditions affect riparian, wildlife, and fishery resources, and cause economic consequences to manmade structures and water supply.

This section focuses primarily on surface watersheds because these are the component of the hydrologic cycle most vulnerable to management choices. Ground water has remained largely undeveloped in the Pinedale RMPPA and is less likely to be affected by surface management decisions, although impacts may occur through oil and gas drilling activities. The quantity of water available in the Pinedale RMPPA, current uses of water (Table 3.17-1), water quality, and the regulatory framework surrounding water use are discussed.

Surface Water

Watersheds

The Pinedale RMPPA lies almost entirely within the Green River drainage. It contains portions of four separate watersheds located within the Upper Colorado hydrologic region (Region 14), as well as just touching the Pacific Northwest hydrologic region (Region 17). These boundaries are shown on Map 3.17-1. Within the Upper Colorado region, the bulk of the Pinedale RMPPA lies within the Upper Green River and New Fork River watersheds, both part of the Green River drainage. Very small portions of the Pinedale RMPPA lie within the Big Sandy and Slate watersheds, also part of the Green River drainage. These watersheds are defined by a Hydrologic Unit Code (HUC) that identifies the specific hydrologic unit and consists of a 2-digit sequence for each specific level within the delineation hierarchy. The original HUCs assigned by the U.S. Geologic Survey (USGS) in the 1970s were comprised of 8 digits and defined fourth-order watersheds. Since that time, diverse efforts to further subdivide these original areas have culminated in 2001 in a draft standard for delineating a nationally consistent hydrologic unit coverage. Subwatersheds are the sixth level (12-digit) in this hierarchy and generally range from 10,000 to 40,000 acres in size. All of the watersheds in Wyoming have been designated at the subwatershed level. The hydrologic unit selected for consideration depends on the scale of the project being considered.

Surface water in the RMP area is greatly influenced by topography and geology. The Pinedale RMPPA is characterized by a high plateau, dissected by the Green River and its tributaries, bounded to the north and east by the Wind River Range and to the west by the Wyoming Range and Absaroka Ridges. Glacial deposition features have created numerous lakes on the slopes of the Wind River Range; however, most of these lakes lie just outside the Pinedale RMPPA boundary (Woolley 1930).

The Green River, the major drainage in the Pinedale RMPPA, arises on the western slope of the north end of the Wind River Range before turning south and entering the planning area. The Green River runs through an alluvial valley the entire length of the Pinedale RMPPA to the southern boundary of the planning area at Fontenelle Reservoir. The

major tributary to the Green River is the New Fork River, whose tributaries arise from the glacial lakes on the western face of the Wind River Range. The New Fork River follows its own alluvial valley through a rolling plateau area, crossing south of the Mesa and joining the Green River in the vicinity of Big Piney. The land downstream of the New Fork River and east of the Green River consists of an arid, slightly rolling plateau known as the Little Colorado Desert (Woolley 1930).

Tributaries that drain the area west of the Green River include North Piney Creek, Middle Piney Creek, South Piney Creek, Cottonwood Creek, LaBarge Creek, and Fontenelle Creek, all of which arise from the east face of the Wyoming Range and flow through bluffs and buttes formed from a highly dissected plateau.

Surface Water Supply and Use

Water in the Pinedale RMPPA is used for agricultural, municipal, industrial (primarily oil and gas production), and recreation purposes. Surface water is stored in several large and small reservoirs. Fontenelle Reservoir is the largest (345,000 acre-feet of storage). Other reservoirs include McNinch Number 1 Reservoir (1,100 acre-feet), McNinch Number 2 Reservoir (200 acre-feet), and Sixtyseven Reservoir (5,000 acre-feet).

Irrigation (primarily for hay fields) is the greatest water user in the basin, with roughly 186,000 irrigated acres accounting for 98 percent of all use, most from surface water diversions (States West 2001). Major industrial users of surface water elsewhere in the Green River Basin, though not in the Pinedale RMPPA, include soda ash production, power generation, and chemical manufacturing; however, no major surface water industrial users are located in the Pinedale RMPPA. Oil and gas leases account for some ground water use in the basin, although the amount is not known (States West 2001).

Municipal and domestic supply account for less than 2 percent of the total water use in the Pinedale RMPPA. Only four municipal supply systems are located in the Pinedale RMPPA. Pinedale and LaBarge rely on surface water, whereas Marbleton and Big Piney rely on ground water wells for their water supply. Domestic supply wells located in rural areas beyond the reach of the municipal supply systems likely account for as much water use, or more, than the major towns.

Surface Water Quality

Surface water quality problems are detailed in Wyoming's 303(d) list of impaired waters, required under the *Clean Water Act*. No streams or lakes within the Pinedale RMPPA are included on the 303(d) list (Wyoming Department of Environmental Quality [DEQ] 2002). This reflects the generally good quality of surface water in the Pinedale RMPPA. Total dissolved solids (TDS) for the waters of the Green River drainage above Fontenelle Reservoir are on average less than 500 milligrams per liter (mg/l), have an acceptable pH range of 6.5 to 9.0, and have temperatures ranging from 0 degrees Celsius (°C) in the winter to 25 °C in the summer. Total phosphorous concentrations can reach levels that cause nuisance algae and aquatic plant blooms in later summer or early fall (States West 2001).

Currently, an interbasin diversion of water exists from LaBarge Creek to Muddy Creek. The water is used for irrigation, but the disruption to the natural drainage tends to cause high sediment yield. This diversion is a major source of sediment for Muddy Creek, although it is probably not a large source of sediment for the drainage as a whole (Doncaster 2002a).

As part of the Upper Colorado River system, the Pinedale RMPPA is subject to the *Colorado River Salinity Control Act*. In the Pinedale RMPPA, there are no specific projects to reduce salinity at a given point. However, downstream salinity and sedimentation can be minimized by actions such as vegetation management and access route planning that are being done in the RMPPA, albeit primarily for other purposes (Doncaster 2002b).

Water Rights

Surface water is allocated through water rights as established by the Wyoming constitution under the doctrine of prior appropriation, or "first in time, first in right." However, water rights are considered property rights that are appurtenant to the land, and can be transferred in use or location only after review by the State Engineer's Office or the Board of Control.

No BLM water rights reserved to the federal government exist within the Pinedale RMPPA. All BLM water rights are established through the Wyoming State Engineers' Office (Doncaster 2002a).

Under Wyoming law, water rights may be established for instream flows. These rights are filed and granted on unappropriated water, either natural flow or as releases from reservoirs, to maintain and improve fisheries. Nine instream flow rights have been filed for by the State of Wyoming within or immediately adjacent to the Pinedale RMPPA.

In addition to instream flow rights, the Wyoming Game and Fish Department has established recommended minimum maintenance flows on many streams in the area, to support game fish populations in the late season, low-flow months.

Floodplains

The 100-year floodplain for major drainages is depicted on Map 3.17-2. Approximately 150,044 acres within the Pinedale RMPPA are within the 100-year floodplain. The status of the functioning condition of riparian vegetation along major waterways has been documented, and the condition of the floodplain and stability of stream banks still needs to be surveyed.

Overall Watershed Stream Health

The condition of streams within the Pinedale RMPPA watersheds is generally good throughout the higher elevations. These reaches have more streamside vegetation and coarser, more stable substrate. Furthermore, streams in this portion of the Pinedale RMPPA are mostly perennial with high frequency, low-magnitude flow events.

The condition of intermittent and ephemeral streams at lower elevations within RMPPA watersheds is generally poorer. This is a result of their lack of streambank vegetation, the flashiness of their runoff (lower frequency, high-magnitude floods), and the presence of finer-grained substrate more vulnerable to erosion.

Groundwater

Groundwater Supply and Use

Eight major aquifer systems are identified in the Pinedale RMPPA, but all have remained largely undeveloped as water supplies. Most of the bedrock surface exposures in the area are Cretaceous and Tertiary age rocks, which include several aquifer systems, including the Frontier aquifer (western part of the basin), Mesa Verde aquifer system, and Tertiary aquifer system. The Tertiary aquifer system is composed of a number of water-bearing formations, including the Green River, Wasatch, Battle Springs, and Fort Union Formations. The majority of the ground water use in the Pinedale RMPPA derives water from the Tertiary aquifer system or the Quaternary sands and gravels associated with the major river courses.

The main uses of ground water in the Pinedale RMPPA are for municipal and industrial purposes. Industrial use of ground water is primarily for oil and gas leases in the Pinedale RMPPA.

Ground Water Quality

Ground water quality varies throughout the Pinedale RMPPA based on location and geologic unit. Ground water at the periphery of the Pinedale RMPPA is nearer to high recharge areas in the bounding mountain ranges and generally has a TDS concentration less than 500 mg/L. However, ground water elsewhere in the Pinedale RMPPA can exceed TDS concentrations of 3,000 mg/L. Occasional ground water quality problems are caused by iron, manganese, fluoride, and nitrate (Lowham 1985).

Disposal of ground water directly into surface drainages is an issue that has recently developed in the Pinedale RMPPA. Large amounts of water can be generated from coalbed methane wells, gas wells, and oil wells, as is discussed more thoroughly in Section 3.5. This water can be saline and sodic. Discharge of this water directly into surface drainages can have a detrimental effect on native riparian vegetation and on stream channel stability. Salts from natural sources and industrial developments that originate in the Pinedale RMPPA eventually flow into the Colorado River. Salinity levels in the Colorado River are a regional, national, and international issue. Control of salts discharged from public lands is mandated by the Colorado River Basin Salinity Control Act of 1974.

3.18 WILD HORSES

Wild horses were removed from the Pinedale RMPPA in the early 1990s (Powell 2002), as specified in the 1988 RMP. The two herd management areas, Desert Herd and

LaBarge Herd, still exist but are not managed for wild horses at present. The removal of the wild horse herds has resulted in decreased conflicts for forage and water.

A small wild horse group eluded capture in the 1990s and remains in the Desert Herd management area, mainly in the South Desert Allotment. Currently, the herd number is low (around 12), and conflicts with the resource use in that area are minimal. However, in accordance with the 1988 RMP, the goal is to remove all the wild horses in the future.

3.19 WILDLIFE AND FISHERIES

The diverse natural communities throughout the Pinedale RMPPA support a wide variety of game and nongame wildlife and fish species, including several special status species. This section presents the current known status, distribution, and natural history as it pertains to management of game, nongame, and special status wildlife and fish species within the Pinedale RMPPA. The scientific names of the species discussed are provided in Table 3.4-1. Although many of these species occupy the Pinedale RMPPA all year, some species are present only seasonally. The scientific names of animal species are found in Table 3.4-1.

Terrestrial Wildlife

Game Species

Big Game

BLM administered public lands in the Pinedale RMPPA provide habitat for pronghorn, mule deer, whitetail deer, elk, moose, black bear, and mountain lion. Furthermore, these lands provide the majority of the crucial winter habitat for mule deer, and elk populations found in the Upper Green River Basin. Crucial winter habitat consists of those areas where most members of a population are forced to subsist during maximum snow depth each year. Population estimates, trends, and objectives for big game species in the Pinedale RMPPA are shown in Table 3.19-1. Herd unit and hunt area designations are different for each species and do not conform to the Pinedale RMPPA boundaries. Therefore, the population parameters shown in Table 3.19-1 represent a larger area than the Pinedale RMPPA.

The Wyoming Range Deer, Sublette Deer, and Sublette Antelope Herds are some of the most important in the state and could easily be considered of national importance. These are some of the largest migratory herds of mule deer and perhaps the largest antelope herd in the country, and all require migratory corridors.

Pronghorn

Pronghorn herds in the Pinedale RMPPA are known to migrate up to 150 miles between summer ranges in the Jackson Hole Valley and wintering areas along the Green River near Seedskadee National Wildlife Refuge, which is several miles south of the Pinedale RMPPA (WYDOT 2002).

Pronghorn can be found commonly throughout most of the Pinedale RMPPA. The Pinedale RMPPA includes the Sublette herd unit. Pronghorn seasonal use areas are shown on Map 3.19-1. Pronghorn are predominantly associated with low, rolling terrain supporting open grassland and sagebrush communities. Both summer and winter habitat is present throughout the Pinedale RMPPA.

Crucial winter range is extremely important for pronghorn survival in the Pinedale RMPPA. The availability of browse, especially sagebrush, appears to be the limiting factor for pronghorn winter range. Under severe winter conditions, pronghorns are further confined to limited crucial range generally occurring on lower south-southwest facing slopes that remain open during adverse conditions (BLM 1986). Salt desert shrubs are also an important forage species in some areas (BLM 1986).

Pronghorn require readily accessible water, which may be a limiting factor on the summer range (USDA 2002). Adequate water in the Pinedale RMPPA is normally available to pronghorns in reservoirs, pits, troughs and wells during May and June. During dry years, water availability may be limited in late summer and fall when reservoirs may be dry and some wells are deactivated.

Because pronghorn tend to crawl under fences rather than jump over them, BLM fence specifications require placing the bottom wire high enough to allow pronghorn to pass without affecting the containment of livestock. Although any new public land fences are constructed to these specifications, older fences are not, and new fences constructed on state or private lands within the RMPPA are not restricted to these specifications. Occasionally, snow may build up in the area between the bottom wire and the ground where it may impede herd movement. When problems with herd mobility are identified, the fences are modified or gates on these fences are opened, especially during severe snow years.

Livestock grazing occurs on the majority of the pronghorn summer range. Cattle and pronghorn have very little dietary overlap, therefore, some cattle grazing is compatible with pronghorn habitat. Heavy cattle stocking may convert shrub-grassland habitat into shrubland, making it less useful for pronghorn summer range. However, no known problems with livestock grazing and pronghorn habitat have been documented.

Mule Deer

Mule deer from the Sublette and Wyoming Range herd units are common residents of the Pinedale RMPPA.

Mule deer in the Pinedale RMPPA are migratory. Mule deer usually move on to winter range during November and remain there until early April or May with few animals wintering north of Pinedale. Extensive migrations of more than 100 miles are known, and seasonal areas used by adults may be traditional (Clark and Stromberg 1987). Studies by the Wyoming Cooperative Wildlife and Fisheries Research Unit have been under way since 1998 to monitor migratory pathways, winter range use, and survival rates of mule deer.

Mule deer seasonal use areas within the Pinedale RMPPA are shown on Map 3.19-2. Deer are primarily browsers, and big sagebrush is the key browse species year round in the Pinedale RMPPA (BLM 1986). On the winter ranges in the southwest portion of the Pinedale RMPPA, big sagebrush may be supplemented by limited quantities of mountain mahogany, rabbitbrush, bitterbrush, and serviceberry.

Mule deer seasonal and yearlong habitat is found throughout the Pinedale RMPPA except in the southeast and west-central regions. Public lands in the Pinedale RMPPA provide more than 100,000 acres of summer habitat for mule deer (BLM 1986). This area includes, but is not limited to the foothill aspen/conifer complex. Winter range and transitional ranges are considered the limiting factors for mule deer in the region (BLM 1986). These areas are usually sagebrush habitats in lower elevations with south-southwest facing slopes or on mesa tops where the snow is blown clear.

Elk

The elk in the Pinedale RMPPA are migratory, and most migrate to the Bridger-Teton National Forest in the summer. However, some elk remain on the higher elevation BLM-administered lands throughout the summer in areas where cover is adequate and disturbing activities are minimal (BLM 1985). Elk seasonal distributions within the Pinedale RMPPA are shown on Map 3.19-3. Elk diets consist mostly of grasses and forbs, with grasses being the dominant forage in spring and forbs being the dominant forage in summer months (Clark and Stromberg 1987). Shrubs are consumed year round but are especially important on the winter range when forbs and grasses are less accessible when forbs and grasses are covered by snow. BLM-administered lands provide less cover for elk and have a higher degree of road access than the adjacent Forest Service lands. Nonetheless, they are important because the long stringers (continuous strands) of cover along ridges allow elk access to forage and winter range (BLM 1986). High country areas along the forest boundary (aspen-conifer associations) support considerable spring/fall and some summer elk use, including parturition . In addition to managed feedgrounds, several natural elk winter ranges occur within the Pinedale RMPPA. Crucial winter habitat is found along the west and northeast borders along wind blown ridges and south-southwest facing slopes.

Winter feedgrounds were incorporated into the Pinedale RMPPA during the late 1940's and early 1950's to contain and provide supplemental food for elk that were damaging private haystacks during the winter. These feedgrounds reduced elk depredation of rancher's haystacks in traditionally used areas. Ten winter feedgrounds in the Pinedale RMPPA are administered by the Wyoming Game and Fish Department (WGFD) through a MOU with the BLM (Map 3.19-3).

Moose

Moose can be found in the Pinedale RMPPA along willow-covered riparian communities and on the aspen-conifer foothills throughout the year (BLM 1985). The Pinedale RMPPA supports the Sublette herd unit.

Moose are generalist browsers and are known to eat willow, bitterbrush, Douglas fir, serviceberry, subalpine fir, mountain ash, white-barked pine, cottonwoods, sedges, rushes, and blue spruce (BLM 1985, Clark and Stromberg 1987). Some intermediate areas between the stream bottoms and higher summer range are used during spring and fall. Winter populations are considerably larger in the Pinedale RMPPA than summer populations as moose summering at higher elevations on the Bridger-Teton National Forest migrate to the lower stream bottoms to escape extreme snow depths (BLM 1985). Moose seasonal distributions within the area are shown in Map 3.19-4. Crucial winter and yearlong habitat is found along most major drainages throughout the Pinedale RMPPA.

Black Bear

Black bear are found within the aspen-conifer areas on the east side of the Pinedale RMPPA during spring and early summer (BLM 1985). These bears appear to move to higher, more remote areas during midsummer and fall. On the west side of the Pinedale RMPPA, black bear are found in the timbered areas along the Bridger-Teton National Forest boundary and on the Hoback Rim. Some bears appear to remain in this area year round, whereas others use the area for "hibernation" and early spring range, moving into the higher Bridger-Teton National Forest during summer and fall.

Mountain Lion

Mountain lions are fairly uncommon within the Pinedale RMPPA, but sightings are reported occasionally. This species has one of the widest distributions of any native mammal in the western hemisphere and therefore occupies a wide variety of plant communities. They are found in montane coniferous forests, lowland tropical forests, swamps, grasslands, dry brushlands, and any other area with adequate cover and prey. Typical mountain lion habitat in western North America, including Wyoming, is open woodland such as oak scrub, pinyon, juniper, ponderosa pine, spruce, fir, and aspen, as well as shrublands such as sagebrush, desert shrub, mountain-mahogany, and snowberry, especially where these communities are interspersed with grasslands or meadows. Mountain lions also inhabit deep, rocky, vertical-walled river canyons containing riparian vegetation such as cottonwood and willows. As a large carnivore, the lion prefers large prey. Research indicates that 80 to 90 percent of a lion's diet is deer. On average an adult with an established territory will kill one deer per week. Other prey species include elk and smaller mammals.

Game Birds

Small game within the Pinedale RMPPA include upland game birds such as greater sage grouse, blue grouse, ruffed grouse, and mourning dove, several species of waterfowl, and several small mammal species.

Greater Sage Grouse

Greater Sage Grouse are discussed under BLM Sensitive Species.

Forest Grouse

Within the Pinedale RMPPA, blue and ruffed grouse are restricted to foothill and mountain areas and are found in association with aspen, conifers, and riparian vegetation. Blue grouse typically occur above 8,500 feet in mountains vegetated with aspen, fir and spruce. While they do not typically range too far from dense stands of cover, they often forage along abandoned logging roads and in meadow clearings, especially along the base and tops of knolls and ridges for plant foods such as currants, elderberries, raspberries, vetch, strawberries, aspen leaves, dandelions, clover blooms and buds. Insects, especially grasshoppers and also ants and beetles are an important dietary component for grouse broods. As these food sources diminish toward winter, blue grouse increasingly subsist on the needles and buds of Douglas fir and other conifers.

Of the two forest grouse species, ruffed grouse are more common in the RMPPA. Ruffed grouse tend to occur in deciduous and mixed forests, especially those with scattered clearings and dense undergrowth. Successional to subclimax hardwood forests larger than 10 acres that have aspen present and an understory of small hardwoods, shrubs, and fruit-producing bushes are ideal. Such habitats are often provided by overgrown pastures or the early successional stages of plant growth on logged-over areas. As seasons change, this species frequents hedgerows and brushy patches in early fall and moves into more heavily wooded areas, especially coniferous cover in winter. It may roost in snow when snow is deep and soft, in trees or on the ground. In the Rocky Mountain West, including Wyoming, favored habitats tend to be in broadleaf aspen and riverine woods. The summer diet is varied and consists of insects, seeds, fruits, and even an occasional small snake or frog. The winter diet is primarily buds and catkins. In addition to undergrowth with some openings, drumming sites, such as logs, rocks, or other elevated sites, for males are required in breeding habitat. Nests are typically in a shallow depression on dry ground, lined with leaves, and in the shelter of a fallen log, bush, rock, root, or low-hanging conifer limb, usually near the base of a tree.

Mourning Dove

Mourning Doves are a common inhabitant throughout many areas of the Pinedale RMPPA (Dorn and Dorn 1990). No assessment of dove habitat conditions has been conducted for the Pinedale RMPPA. The mourning dove occupies a broad range of plant communities including desert areas, open mixed woodlands and wood edges, farm and ranchlands, shelterbelts, and grasslands. The mourning dove primarily inhabits woodland-grassland edge, prairies, and open forests but avoids densely forested regions. They are often attracted to disturbed areas supporting annual weedy plant species or to agricultural areas. They are also common in towns and cities. Mourning doves generally nest 10 to 25 feet above the ground on horizontal branches of shrubs and trees having forks and large branches and in stands with low canopy cover. Although tree nests are most common, in their absence, mourning doves will readily nest on the ground.

Mourning doves forage primarily on the ground and feed almost entirely on seeds of grasses, weeds, and cultivated grains. They also eat insects, snails, fruits, nuts, acorns, and pine seeds.

Waterfowl

The scattered aquatic resources in the Upper Green River Basin provide habitat for at least 24 species of waterfowl (BLM 1985). Within the Pinedale RMPPA, the amount and quality of aquatic habitats potentially suitable for waterfowl fluctuate yearly based on hydrologic conditions. Main waterfowl use areas in the Pinedale RMPPA include the Upper Green River, its tributaries and adjacent wetlands; the New Fork River and its tributaries, the New Fork Pothole area in the northern portion of the Pinedale RMPPA; South Soda Lake; and Fontenelle Reservoir and associated waterbodies in the southern end of the Pinedale RMPPA (the lower Pinedale RMPPA portion of the Upper Green River). The most abundant species found in the Pinedale RMPPA include canvasbacks, mallard, green-winged teal, northern pintail, ring-necked duck, common goldeneye, and common merganser. Waterfowl populations in the Pinedale RMPPA are composed mostly of migrants, although some populations of nesting birds exist. Winter populations are very minimal as a result of climatic conditions that freeze waterways, making them unavailable to waterfowl during winter months.

Portions of the Green River and its tributaries, and the New Fork Potholes area, provide habitat for populations of nesting waterfowl. The New Fork Potholes may be a significant nesting area for the canvasback duck. However, waterfowl nesting habitat in the Pinedale RMPPA is typically not abundant because of the low availability of water and lack of dense vegetative nesting cover adjacent to shorelines. Most available water bodies in the Pinedale RMPPA provide staging and migration stopover habitat for waterfowl.

Small Game Mammals

Four species of small mammals are harvested as game animals within the Pinedale RMPPA. These include cottontail rabbit, snowshoe hare, white-tailed jackrabbit, and red squirrel. No assessments of habitat condition, estimates of population size, mortality or natality rates, or hunter effort are known for any of these species.

Furbearers

The following furbearer species occur within the Pinedale RMPPA, but population figures are available only on a statewide basis.

Badgers can be found throughout the Pinedale RMPPA and habitat is abundant. Beavers are common in waters throughout the Pinedale RMPPA. Bobcats occur in most habitats except high mountain areas. Good quality habitats are abundant in the Pinedale RMPPA, and bobcat populations are thought to be stable. Coyotes occur throughout the Pinedale RMPPA. Mink are common in riparian habitats throughout the Pinedale RMPPA. Muskrats occur along riparian corridors throughout the Pinedale RMPPA. Marten

occupy the forested regions in mountains along the perimeter of the Pinedale RMPPA and may also be found along some portions of the Green and New Fork Rivers between Highways 191 and 189 north of Highway 351 (WBN 1996). Red fox can be found throughout the area.

Nongame Species

The diverse habitats present on the Pinedale RMPPA provide for a multitude of nongame species.

Birds

A myriad of nongame bird species are found within the Pinedale RMPPA. Most songbird populations in the area are adapted for open areas. The vast sagebrush component of the Pinedale RMPPA provides crucial habitat for major indicators of that type—namely, sage thrasher, Brewer's sparrow, and sage sparrow. Forests, riparian, and water resources within the Pinedale RMPPA also provide a requisite habitat for multitudes of other species.

Raptors

Sensitive to environmental perturbations, raptors are high-trophic level predators, which are good indicators of habitat quality. Nine species are federally listed, BLM/Forest Service sensitive, or as species or Special Concern by WGFD: bald eagle, northern goshawk, ferruginous hawk, Richardson's merlin, peregrine falcon, northern pygmy-owl, great gray owl, boreal owl, and burrowing owl.

Within the vast, open sagebrush areas, common breeding inhabitants of the Pinedale RMPPA include Swainson's hawk, red-tailed hawk, northern harrier, golden eagle, prairie falcon, American kestrel, and great horned owl. Nest sites in open, sagebrush areas of the Pinedale RMPPA include scattered trees, cliffs, platforms, snags and ground nests. This variation depends on prey availability, habitat quality, level of raptor populations, levels of competition, the success or failure of young bird recruitment and other factors. Nesting raptors typically exhibit fidelity to a nesting territory and may be present for years if no perturbations to the nesting site, habitat, or mate occur. Other raptor species adapted for open areas that can be found at various portions of the year include rough-legged hawk, a winter resident; snowy owl, a rare winter visitant; long-eared owl, a denizen of open and forested areas; and short-eared owl. Ospreys are a common summer resident in the Pinedale RMPPA along the river systems.

Nonlisted forest raptors within the Pinedale RMPPA are sharp-shinned hawk, Cooper's hawk, and northern saw-whet owl. Sharp-shinned hawks frequent the edges of woods, hedgerows, and brushy pastures where they prey especially on smaller bird species; they nest in both coniferous and deciduous trees. Cooper's hawks use similar habitats, but prey especially on larger birds because they are themselves larger than the sharp-shinned hawk. The saw-whet owl occupies more dense woods when they are available, nesting especially in abandoned woodpecker holes and preying primarily on small mammals.

Mammals

According to Clark and Stromberg (1987), the Pinedale RMPPA is inhabited by at least 42 species of nongame mammals, including 5 species of shrews, 12 species of bats, 9 species of the squirrel family, 2 species of gophers, 14 species of mice/rats, and porcupines.

Reptiles and Amphibians

The climate and habitat types found in the Pinedale RMPPA restrict the diversity and abundance of reptiles and amphibians. However, 10 species of reptiles and amphibians inhabit the Pinedale RMPPA: tiger salamander, boreal western toad, Great Basin spadefoot toad, boreal chorus frog, northern leopard frog, Columbia spotted frog, eastern short-horned lizard, northern sagebrush lizard, rubber boa, and wandering garter snake. All of the salamander, toad, and frog species require quiet water for springtime breeding, and are therefore seldom found far from ponds and transient pools. Larvae that hatch from the eggs laid in water remain in these aquatic habitats until they metamorphose into adults, which may take up to two years. Apart from their nocturnal breeding, adult salamanders and toads typically forage at night and during the day may be found hiding in crevices, beneath bark and other surface objects, or in rodent burrows, decaying logs and stumps. The spadefood toad digs itself into soft earth. The frogs remain in marshy aquatic habitats year around, but in the winter they hibernate in the mud. Of these three frog species, the Columbia spotted frog is the most aquatic and the boreal chorus frog is the least aquatic and may occupy seasonally flooded areas with little year around water. The two snake species, and especially the two lizard species occupy drier habitats since they are not dependent on water for breeding. Nonetheless, both the rubber boa and wandering garter snake are typically found in moist locations, with the boa frequenting coniferous forests and the garter snake frequenting grassy meadows. The short-horned and northern sagebrush lizards occur in dry areas that may have clumps of brush, stumps, and surface litter or be rocky, and may have scattered or no trees. The short-horned lizard may also occur where there are areas of hardpan or otherwise consolidated crust, as well as in sandy soils. No estimates of population size are known for any of these species. The boreal western toad and Columbia spotted frog are listed species and are discussed further in this document.

Special Status Species

U.S. Fish and Wildlife Listed Species

The following discussion contains information on the Endangered, Threatened, Proposed, and Candidate species that are known to occur or have the potential to occur in the Pinedale RMPPA, based upon information from the USFWS.

- **Black-Footed Ferret.** The black-footed ferret was designated as a USFWS-Endangered species in March 1967 under a precursor to the Endangered Species Act of 1973 (Fed. Reg. 1967). This species is also a WGFD Species of Special Concern. Black-footed ferrets are closely associated with prairie dog towns and

rely almost entirely on these rodents as prey. Ferrets also use prairie dog burrows for denning and shelter. Potential breeding habitat for this species is present south of Daniel and near Boulder (WNDD 2002). No live ferret occurrences have been confirmed; however, a ferret skull was found south of the RMPPA in 2000.

- **Gray Wolf.** The gray wolf was designated as a USFWS-Endangered species in 1967 (Fed. Reg. 1967). All wolves currently in Wyoming are classified as a nonessential experimental population, allowing for more flexible management guidelines. The availability of prey, especially large ungulates, is critical to habitat selection. In 2001, two new packs, the Big Piney and Pinedale packs, were formed within the Pinedale RMPPA. According to the USFWS et al. (Rocky Mountain Wolf Recovery 2001 Annual Report 2002), the Pinedale pack consists of only one pair of wolves and the number of wolves in the Big Piney pack is unknown. Members of these two packs are thought to be young dispersers and neither pack has yet produced pups.

- **Grizzly Bear.** The grizzly bear was listed as an Endangered species in 1967 and subsequently reclassified as Threatened in 1975 (Fed. Reg. 1975). In Wyoming, grizzly bears currently occupy Yellowstone and Grand Teton National Parks and portions of adjacent national forest and private lands extending south in the Wind River Range to the Green River Lakes area (Moody et al. 2002). The Green River Lakes area is just outside the northern boundary of the Pinedale RMPPA. At this time, no occurrences of grizzly bears in the Pinedale RMPPA have been confirmed. Potential habitat for grizzly bears exists in forested regions of the Wyoming and Wind River ranges along the perimeter of the Pinedale RMPPA. Grizzly bears may occur within the Pinedale RMPPA in the future if the southward expansion of northern populations continues.

- **Canada Lynx.** The Canada lynx was designated as a USFWS-Threatened species in April 2000 (Fed. Reg. 2000). This large, snow-adapted cat is typically associated with high-elevation forested areas that support ample populations of snowshoe hares and other preferred prey species. The Pinedale RMPPA is within the historic range of the lynx. Extensive potential habitat for this species occurs immediately adjacent to the RMPPA in the Wind River Mountains and the Wyoming Range. Canada lynx inhabiting these areas would be expected to range into the RMPPA.

- **Bald Eagle.** The bald eagle is a USFWS-Threatened species and a WGFD Species of Special Concern. This species was declassified from USFWS-Endangered to Threatened status in 1995 (Fed. Reg. 1995). In the Pinedale RMPPA, wintering bald eagles have been observed at the Fontenelle Reservoir, near Pinedale, west of Daniel, southwest of Boulder, and in the southeast area (WNDD 2002). Seven bald eagle nests are known to occur scattered throughout the Pinedale RMPPA.

- **Whooping Crane.** Whooping cranes nest in marshes, bogs, and other wetland areas having still water and sufficient prey base. The nests are usually built on mats of vegetation. In Wyoming, the whooping crane is considered a spring and

fall migrant. Within the Pinedale RMPPA, this species has been seen in the northern region and near Big Piney (WNDD 2002). In 1997, the Rocky Mountain population was designated as Experimental Nonessential (Fed. Reg. 1997).

- **Mountain Plover.** The mountain plover was designated as a Proposed Threatened species in 1999 (Fed. Reg. 1999). Short vegetation, bare ground, and flat terrain, typically found in prairie dog towns, appear to be key habitat characteristics for this species. Within the Pinedale RMPPA, mountain plovers are known to nest southeast of Big Piney and southwest of Boulder (WNDD 2002).

- **Yellow-Billed Cuckoo.** In July 2001, responding to a petition to list the western yellow-billed cuckoo under the Endangered Species Act, the USFWS determined that such a listing was warranted but precluded by higher priority listing actions (Fed. Reg. 2001). As a result, the western yellow-billed cuckoo has been designated as a Federal Candidate species. The western yellow-billed cuckoo is also a BLM and Forest Service Sensitive species and a WGFD Species of Special Concern. The yellow-billed cuckoo prefers large tracts of deciduous riparian woodlands with dense, scrubby undergrowth. It frequently uses willow thickets for nesting and forages among large cottonwoods (Bennett and Keinath 2001). In Wyoming, the western subspecies of the yellow-billed cuckoo is considered uncommon and is primarily found along waterways in the lower Green River Basin. The species has been documented within the Pinedale RMPPA, but currently there are no known nest sites (WNDD 2002).

- **Columbia Spotted Frog.** In 1999, the USFWS listed the Columbia spotted frog as a Candidate species (Fed. Reg. 1999a). The Columbia spotted frog is also a BLM and Forest Service Sensitive species, and a WGFD Species of Special Concern. Columbia spotted frogs live in or near permanent bodies of water. They prefer areas with thick algae and vegetation for cover. They are most often found in nonwoody wetland plant communities (Leonard et al. 1993).

BLM Sensitive Species

BLM defines sensitive species as species that could easily become endangered or extinct in a state unless protection is granted. Designated sensitive species are provided the same level of protection by the BLM as Federal Candidate species. The Forest Service and WGFD have also designated various species as Sensitive or Special-Concern. WGFD Species of Special-Concern include species that are vulnerable to extinction at the global or state level due to inherent rarity, loss of habitat, or sensitivity to human-caused mortality or habitat disturbances. Following are discussions on the known status of each such species within the Pinedale RMPPA, unless it has been previously discussed above as a special status species or, in one specific instance (greater sage grouse), as a small game species:

- **Greater Sage Grouse.** Greater sage grouse are the most numerous and widespread game bird within the Pinedale RMPPA with year round habitats found almost entirely within sagebrush dominated areas. As with the Sublette

Pronghorn Herd, the sage grouse populations in the area are of national importance. This is due to the extent of the area's sagebrush communities (sage-steppe). They require open areas within this sagebrush community for leks where they perform courtship rituals. Lekking sites (strutting grounds) are traditional. Identified lek locations within the Pinedale RMPPA are depicted on Map 3.19-5. Greater sage grouse broods prefer to feed on succulent forbs. Grouse with broods will move to riparian areas and irrigated fields that support succulent vegetation and high populations of insects in late spring and late summer. Their diet consists almost entirely of sagebrush during late fall and winter. All sagebrush types with available water and some vegetation diversity are considered greater sage grouse habitat.

- **Dwarf Shrew.** The dwarf shrew is a BLM and Forest Service Sensitive species, and a WGFD Species of Special Concern. Very little is known about the natural history of this diminutive insectivore. Its known distribution generally follows the Rocky Mountains. Dwarf shrews have been found in a variety of habitats but seem to prefer high-elevation rocky areas in woodlands, grasslands, and alpine tundra, typically near water (Brown 1967). In Wyoming, the dwarf shrew is distributed along either side of the Rocky Mountains. Potential habitat occurs along the perimeter of the Pinedale RMPPA.

- **Long-Eared Myotis.** The long-eared myotis is a BLM Sensitive species and a WGFD Species of Special-Concern. The long-eared myotis is frequently found roosting under the bark or within cavities of ponderosa pine trees during the daytime, though it can also be found at much higher and lower elevations. The long-eared myotis is likely scattered throughout the Pinedale RMPPA where there are suitable roost sites. This species was also confirmed in 2001 in the Jonah Field along Sand Draw in 29N R108 section 28. Luce et al. (1997) reported this species as occurring in the Pinedale RMPPA.

- **Pygmy Rabbit.** The pygmy rabbit is a BLM Sensitive species and a WGFD Species of Special Concern. The pygmy rabbit is the only rabbit native to North America that digs its own burrows. It is also uniquely dependent upon sagebrush, which comprises a majority of its winter diet. Dense sagebrush and relatively deep, loose soils are important characteristics of pygmy rabbit habitat (Green and Flinders 1980). Within the Pinedale RMPPA, this species was reported during the 1970s and 1980s south of Pinedale and west of Fontenelle Reservoir (WNDD 2002).

- **White-Tailed Prairie Dog.** The white-tailed prairie dog is listed as a BLM Sensitive species. It is found in a variety of grassy habitats, including mountain valleys, mesas, and shrubby and semidesert grasslands (Clark et al. 1971). In the Pinedale RMPPA, this species occurs across a broad area.

- **Idaho Pocket Gopher.** The Idaho pocket gopher is a BLM Sensitive species. It has been found in subalpine mountain meadows, shrub steppes, and various grasslands, but appears to favor rocky, shallow soils. Within the Pinedale

RMPPA, Idaho pocket gophers have been documented in the northwest, near Big Piney, and in the extreme eastern region (WNDD 2002).

- **White-Faced Ibis.** The white-faced ibis is a BLM and Forest Service Sensitive species, and a WGFD Species of Special Concern. The white-faced ibis has been confirmed as nesting in the Pinedale RMPPA (Luce et al. 1997). White-faced ibis have also been documented north of Fontenelle Reservoir (WNDD 2002) and have been observed near Big Piney during the spring migration.

- **Trumpeter Swan.** The trumpeter swan is a BLM and Forest Service Sensitive species and a WGFD Species of Special Concern. Fond of lakes, ponds, marshes, and other wetlands areas, trumpeter swans are found in Wyoming in the extreme eastern and western regions. Within the Pinedale RMPPA, this species summers southwest of Boulder and winters in the southeast region if open water persists (WNDD 2002). According to Luce et al. 1997, trumpeter swans have been observed in the RMPPA. Trumpeter swans have been periodically released on public land in the New Fork Potholes area.

- **Northern Goshawk.** The northern goshawk is a BLM and Forest Service Sensitive species and a WGFD Species of Special Concern. The limited amount of forested areas in the Pinedale RMPPA indicates that few nesting goshawks are present. However, goshawks have been confirmed as nesting (Luce et al. 1997) and are known to winter east of Pinedale, north of Fontenelle Reservoir, and in the southeast region (WNDD 2002).

- **Ferruginous Hawk.** Ferruginous hawks are a BLM and Forest Service Sensitive species and a WGFD Species of Special Concern. They construct their big, bulky nests in lone trees, on rock ledges, and occasionally on the ground. Ferruginous hawks will only nest in areas with abundant prey, typically small rodents (Woffinden and Murphy 1983). Within the Pinedale RMPPA, the species is uncommon and is known to breed in scattered locations, especially areas southwest of Boulder and north of Fontenelle Reservoir. Small numbers are known to winter near Pinedale and in the southeast portion of the Pinedale RMPPA (WNDD 2002).

- **American Peregrine Falcon.** The American peregrine falcon is a BLM Sensitive species and a WGFD Species of Special Concern. In 1999, this species was removed from the USFWS Endangered Species List (Fed. Reg. 1999b). Peregrine falcons nest on high cliffs, trees, high riverbanks, towers, and tall buildings (Savage 1992). This species is considered uncommon within the Pinedale RMPPA, but some nesting has occurred (Luce et al. 1997). Peregrine falcons have been released on public lands near the upper Green River.

- **Long-Billed Curlew.** The long-billed curlew is a BLM and Forest Service Sensitive species, and a WGFD Species of Special Concern. Long-billed curlews usually nest in prairie and grassy meadows near water, but occasionally choose dry upland sites. In the Pinedale RMPPA, this species nests in scattered areas throughout the northern half of the area and near Fontenelle Reservoir (WNDD 2002). Luce et al. (1997) confirmed breeding of this species.

- **Burrowing Owl.** The burrowing owl is a BLM and Forest Service Sensitive species and a WGFD Species of Special Concern. Burrowing owls nest in grassland, scrub, and steppe areas, usually using burrows excavated by other animals (Martin 1973). Within the Pinedale RMPPA, the burrowing owl is known to nest throughout the central and eastern regions (WNDD 2002).
- **Sage Thrasher.** The sage thrasher is a BLM Sensitive species that nests in large, open tracts of dry shrub and grassland with dense stands of sagebrush, bitterbrush, or rabbitbrush. Within the Pinedale RMPPA, this species is known to nest west of Daniel, south of LaBarge, and southwest of Boulder (WNDD 2002).
- **Loggerhead Shrike.** The loggerhead shrike is a BLM and Forest Service Sensitive species. Loggerhead shrikes generally prefer open country with shrubs and low trees for nesting, and spiny shrubs for impaling prey items (Porter et al. 1975). In the Pinedale RMPPA, this species has been documented north of Fontenelle Reservoir (WNDD 2002). Luce et al. (1997) reported confirmed nesting of this species.
- **Brewer's Sparrow.** The Brewer's sparrow is listed as a BLM Sensitive species that breeds in high-elevation shrubs and thickets, and in sagebrush deserts. Within the Pinedale RMPPA, Brewer's sparrows are known to nest in the north region, west of Daniel, southwest of Boulder, north of Fontenelle Reservoir, and in the extreme east (WNDD 2002).
- **Sage Sparrow.** The sage sparrow is a BLM Sensitive species that nests in large tracts of arid shrub and sagebrush communities. Within the Pinedale RMPPA, this species is known to nest west of Danial, south of LaBarge, and southwest of Boulder (WNDD 2002).
- **Boreal Western Toad.** Boreal western toad is considered Sensitive by both the BLM and the Forest Service. Boreal western toads can be found breeding in wet meadows, ponds, marshes, and other shallow waters in spring. In summer, this species uses upland montane sites, usually within 300 to 1,500 feet of the breeding ponds. During hibernation, boreal western toads seek shelter under rocks, logs, or within rodent burrows (Keinath and Bennett 2000). In 2000, several adults, tadpoles, and metamorphs were discovered downstream of the confluence of the Middle and South Sawmill creeks on BLM-managed land, about 10 miles northwest of La Barge, Sublette County. Within the Pinedale RMPPA, this species has also been found in the central and east-central regions (WNDD 2002).
- **Northern Leopard Frog.** The northern leopard frog is a BLM and Forest Service Sensitive species. Within the Pinedale RMPPA, suspected breeding sites for this species exist in the central and east-central regions (WNDD 2002). Luce et al. (1997) report observations of the species but did not report confirmation of breeding.

Other Special Status Species

Some species listed as sensitive by Forest Service or as of Special Concern by the State of Wyoming are not listed by BLM due to significant habitat or range differences. The known status and distribution of those species are discussed below.

- **Water Vole.** The water vole is a Forest Service Sensitive species and a WGFD Species of Special Concern. The water vole lives in semiaquatic habitats of subalpine meadows and alpine areas. This species lives near water, generally along stream and creek banks or around flooded marshes. The water vole is found more often in old-growth stands than in mature forest stands. Populations of this species are found in areas with a high percentage of exposed soil and a low percentage of canopy cover (Doyle 1987). There is confirmed breeding of water voles where potential habitat for this species occurs along the periphery of the Pinedale RMPPA (Luce et al. 1997).

- **Wolverine.** The wolverine is a Forest Service Sensitive species and a WGFD Species of Special Concern. Wolverines have been found in a variety of habitats but are most commonly associated with boreal forest and tundra areas. Within the Pinedale RMPPA, this species has been reported near Boulder Lake and Cora (WNDD 2002).

- **River Otter.** The river otter is a WGFD Species of Special Concern. River otters are found in largely undisturbed riparian areas and may range up to 40 miles from in search of food such as fish, crayfish, frogs, clams, salamanders, snails, turtles, snakes, insects, muskrats, and birds. They nest in burrows and caves and are largely nocturnal. Natural populations of this species occur in the Green River basin.

- **Harlequin Duck.** The harlequin duck is a Forest Service Sensitive species and a WGFD Species of Special Concern. Harlequin ducks breed along small, clear turbulent streams and rivers with a high abundance of aquatic invertebrates. Nests are constructed under cover on cliffs along the shore, and occasionally in tree cavities. The species has been confirmed breeding in the western half of the Pinedale RMPPA and has also been observed in the eastern portion of the Pinedale RMPPA.

- **Merlin.** The merlin is a Forest Service Sensitive species and a WGFD Species of Special Concern. In Wyoming, the species typically found is Richardson's merlin, the prairie species. Merlins nest in the canopy of large trees, often in association with old nests of other birds. They seem to prefer coniferous forests for nesting, but will also use a variety of mature forested habitats. Preferred habitats are usually intermixed with suitable foraging areas, such as shorelines, meadows, and recently cleared areas (DeGraaf et al. 1991). The Richardson's merlin is a year-round resident in Lincoln and Sublette Counties, although many birds migrate south for the winter. Luce et al. (1997) report confirmation of breeding merlins in the RMPPA. This species has also been known to winter in the southeast region of the Pinedale RMPPA (WNDD 2002).

- **Arctic Peregrine Falcon.** The arctic peregrine is a WGFD Species of Special Concern. In 1999, this species was removed from the USFWS Endangered Species List along with the peregrine falcon (Fed. Reg. 1999b). The arctic peregrine is considered a migrant in all counties in Wyoming. Peak migration periods in the state are April/May and September/October.

- **Forster's Tern.** The Forster's tern is a WGFD Species of Special Concern. Forster's terns nest along large marshes, estuaries, inland lakes, and reservoirs (Bergman et al. 1970). Within the Pinedale RMPPA, Forster's terns are known to breed on the north end of Fontenelle Reservoir (WNDD 2002). The species has also been observed in the eastern portion of the Pinedale RMPPA (Luce et al. 1997).

- **Black Tern.** The black tern is a Forest Service Sensitive species and a WGFD Species of Special Concern. Black terns nest along inland marshes and sloughs with fairly dense cattail (*Typha* spp.) or other marsh vegetation and pockets of open water. These wetlands are often shallow in nature (Dunn and Agro 1995). Within the Pinedale RMPPA, there is circumstantial evidence that black terns nest in Lincoln County within the Pinedale RMPPA, and they also have been observed in the eastern portion of the Pinedale RMPPA (Luce et al. 1997).

- **Northern Pygmy Owl.** The northern pygmy owl is a WGFD Species of Special Concern. Northern pygmy owls nest in coniferous and mixed forests containing open spaces and clearings. These owls frequently use old woodpecker cavities for their nests (Holt and Peterson 2000). According to Luce et al. (1997), northern pygmy owls have been confirmed as nesting in the Pinedale RMPPA.

- **Great Gray Owl.** The great gray owl is a Forest Service Sensitive species and a WGFD Species of Special Concern. The great gray owl inhabits dense montane coniferous forests. Great gray owls have been observed and are thought to possibly breed in the Pinedale RMPPA (Luce et al. 1997).

- **Boreal Owl.** The boreal owl is a Forest Service Sensitive species and a WGFD Species of Special Concern. Boreal owls inhabit dense stands of mature coniferous trees in areas typically adjacent to small meadows. Because they cannot excavate their own nest sites, they frequently rely on cavities created by other species such as woodpeckers (Marco 1995). The boreal owl has been observed nesting near Big Piney (WNDD 2002). Based on confirmed breeding near Big Piney, the boreal owl may be a year-round resident of higher elevation coniferous forests within the Pinedale RMPPA.

- **Lewis' Woodpecker.** Lewis' woodpecker is a Forest Service Sensitive species and a WGFD Species of Special Concern. Lewis' woodpeckers use ponderosa pine forests; open riparian woodlands dominated by cottonwood; and mixed-conifer, logged, or burned pine forest. Luce et al. (1997) documented breeding in the Pinedale RMPPA. It is possible that occasional over-wintering by this species occurs within the Pinedale RMPPA.

- **Three-Toed Woodpecker.** The three-toed woodpecker is a Forest Service Sensitive species and a WGFD Species of Special Concern. The three-toed woodpecker nests in older, dense coniferous forests and in areas with natural clearings from disease, fire, or windfall (Yunick 1985). Luce et al. (1997) confirmed nesting of three-toed woodpeckers in the Pinedale RMPPA.
- **Golden-Crowned Kinglet.** The golden-crowned kinglet is a Forest Service Sensitive species. Golden-crowned kinglets nest in coniferous forests and are very active birds that frequently hover above the ends of tree branches in search of prey (DeGraaf et al. 1991). Golden-crowned kinglets are considered year-round residents of Lincoln and Sublette Counties. Luce et al. (1997) confirmed nesting of this species in the Pinedale RMPPA. Golden-crowned kinglets are also known to winter northeast of Pinedale and in the southeast region (WNDD 2002).

Fisheries

Fisheries in the Pinedale RMPPA are restricted within the upper Green River Basin above Fontenelle Reservoir. The reaches of the Green River and its tributaries in this area are moderately productive cold-water fisheries, with some reaches having limited fisheries potential. The area is currently managed as a trout fishery and serves as a key management area for the Colorado River cutthroat trout (the only native trout species in the Pinedale RMPPA).

Currently, many of the native species that were historically common throughout the area are either uncommon or have been extirpated. Several of the large Colorado River fishes, including the Colorado River pikeminnow and razorback sucker, may have periodically been found in stream reaches in the Pinedale area. However, the area was likely the extreme northern extent of their range, and no documented collections have been located for this area. The loss of the native species can be partially attributed to widespread poisoning of the area in September 1962 and introduction of nonnative game species. Additionally, hydromodification of the Green River and its tributaries for agricultural, mining, drilling, and recreational interests has played a role in the reduction of fluvial habitat.

Distribution

The majority of the Pinedale RMPPA lies within the Upper Green River and New Fork River watersheds in the Green River Basin of the Upper Colorado hydrologic region. Additional portions of the area lie within the Big Sandy and Slate watersheds, also part of the Green River Basin and the Upper Colorado hydrologic region. Watershed boundaries are illustrated and tabulated in Section 3.17 (Watershed and Water Quality).

Approximately 300 miles of stream and riverine habitat and 2,500 acres of lake and reservoir habitat occur in the Pinedale RMPPA, however some of these do not support fish. Fisheries within the area consist of both native and nonnative game and nongame species. Several listed species or species of concern also are found within the area. Native fishes within the Pinedale RMPPA have been greatly impacted by previous management actions. In September 1962, approximately 445 miles of the Green River

and tributaries above Flaming Gorge Dam were poisoned with rotenone. This effort to control "rough fish" for game fish enhancement effectively killed all native fishes above the dam.

Productivity and Use of Fisheries

The WGFD classifies streams within the Green River Basin and Pinedale RMPPA according to the relative productivity of each reach's trout fishery (States West 2000). The following five classifications are used to describe the quality of each river reach that has been assessed:

- **Class 1.** "Blue Waters": Premium trout waters and fisheries of national importance
- **Class 2.** "Red Waters": Very good trout waters and fisheries of statewide importance
- **Class 3.** "Yellow Waters": Important trout waters and fisheries of regional importance
- **Class 4.** "Brown Waters": Low-production waters; trout fisheries are locally important but cannot support heavy fishing pressure
- **Class 5.** No Color Designation: Waters with very low productivity, generally incapable of sustaining trout fisheries.

Within the Pinedale RMPPA, no reaches are classified as Class 1. However, four reaches, three on the Green River above Fontenelle Reservoir and one on the New Fork River near Boulder, have been identified as Class 2. The remainder of the area stream and river reaches have been classified as Class 3 or Class 4 waters, with some waters having no classification.

The WGFD has developed habitat quality indices for streams in the Pinedale area. These indices indicate that habitat quality in the Pinedale area is sufficient for maintaining game and nongame fisheries. However, the data provided appear to indicate that instream cover and water temperature values could be improved in some areas in the Pinedale region to enhance existing habitats. In 1988, supply and demand for fisheries resources in the Green River Basin above Flaming Gorge Reservoir indicated that total fishing demand was approximately 51 percent of the total supply for lakes and reservoirs in the basin (States West 2000). However, streams and rivers in the basin had approximately 91 percent utilization while standing water had only 36 percent utilization.

Annual angler effort for standing water types (ponds, lakes, and reservoirs) within the Pinedale portion of the Green River Basin was estimated as 85,097 angler days by the WGFD (States West 2000). Of this angler effort, 90 percent was in natural alpine (70 percent of total) and lowland lakes (20 percent of total). The remaining 10 percent of the angler effort was for alpine reservoirs (9 percent of total), lowland reservoirs (<1 percent), and trout farm ponds (<1 percent).

Annual angler effort for streams and rivers was not separated for the Pinedale portion. However, for the Green River Basin above Flaming Gorge Reservoir, angler effort has decreased over the past 20 years (States West 2000).

Water Quality

The majority of the waters in the Pinedale RMPPA are listed as Class 2AB waters by the Wyoming Department of Environmental Quality (DEQ), Water Quality Division (DEQ 2001a). Class 2AB waters are defined as—

> Those known to support game fish populations or spawning and nursery areas at least seasonally and all their perennial tributaries and adjacent wetlands and where a game fishery and drinking water use is otherwise attainable (DEQ 2001a).

Additional protections of Class 2AB waters include "non-game fisheries, fish consumption, aquatic life other than fish, primary contact recreation, wildlife, industry, agriculture and scenic values" (DEQ 2001a).

Other water quality designations within the Pinedale RMPPA include Class 1 and Class 3B waters. Class 1 waters are defined as "Outstanding Waters" (DEQ 2001b). This designation is made for all waters for which water quality degradation, other than that originating from dam discharges, is not allowed. Class 3B waters include tributaries that are not known to support fisheries or drinking water supplies. They are typically intermittent or ephemeral in nature but have the hydrologic conditions necessary to support invertebrate populations, amphibians, and obligate or facultative wetland plant species.

Game Species

Game fish found within the Pinedale RMPPA primarily consist of nonnative species. However, several native salmonid species do exist within the Green River and Snake River drainages. The Colorado River cutthroat trout and the mountain whitefish are both native to the Green River Basin, although they are widely distributed elsewhere throughout much of their historic range. The Snake River fine-spotted cutthroat trout is native to the headwaters of the Snake River drainage and has been introduced to areas of the Pinedale RMPPA. A similar species to the Snake River fine-spotted cutthroat trout, the Yellowstone cutthroat trout, has also been introduced to the area. Additional game fish in the area include other introduced salmonids such as the rainbow, brook, and brown trouts.

According to WGFD data, native and nonnative game fish populations are generally stable in the Pinedale area. Brown trout populations average between 125 and 300 fish per mile in the Green and New Fork Rivers, respectively. Brook trout populations average between 6 and 8 fish per mile for the New Fork and Green Rivers. Rainbow trout populations varied and ranged from 16 fish per mile in the New Fork drainage to 245 fish per mile in the Green River. Much of the variation in these estimates could be attributed to the habitat availability in the Green River versus that in the New Fork River.

Colorado River cutthroat populations were stable and averaged approximately 200 fish per mile throughout their current range in the Pinedale area. The stability of these populations is due in part to the implementation of management objectives described in WGFD Basin Management plans. These plans identify specific strategies to ensure the survival of wild native fish stocks while providing consistent yields from recreational fisheries.

Non-Game Species

The majority of fish species in the Pinedale RMPPA are native or nonnative, nongame species, including mottled sculpin, five species of suckers, redside shiners, three species of dace, carp, and several species of chub. Distribution and abundance of these species varies throughout the area. Generally, these species occupy the same water bodies as the game species.

Special Status Species

Federally Listed Species

The USFWS listed the Kendall Warm Springs dace as endangered on October 13, 1990 (Fed. Reg. 1990). The species is also listed as a species of special concern by the State of Wyoming. The species is not known to exist on BLM-administered lands in the Pinedale RMPPA but, because it exists in public lands adjacent to lands of the area, it was listed in this section. The species is endemic to approximately 300 meters of Kendall Warm Springs, a small tributary to the Green River in the Bridger-Teton National Forest near the town of Pinedale. It is the only known species in Kendall Warm Springs.

Other Special Status Species

- **Roundtail Chub.** The roundtail chub is listed as a BLM Sensitive species in Wyoming (BLM 2001). The species ranges throughout the upper Colorado River Basin, historically from the mainstem Colorado River upstream of the Grand Canyon and into its tributaries in the Gila and Green River Basins (Lee et al. 1980). Roundtail chub with adjunct distributions outside of the Colorado River Basin are classified as three distinct subspecies (Lee et al. 1980). Declines in abundance throughout the roundtail chub's range have been attributed mainly to the many forms of habitat degradation that followed the construction of dams throughout the Colorado River Basin, such as disruption of the natural flow regime, changes in the temperature and turbidity regimes, and channelization. In particular, the loss of natural flooding seems to limit roundtail chub recruitment (Brouder 2001), and low temperatures below reservoirs exclude roundtail chub from tailwater reaches (Vanicek et al. 1970). Declines in roundtail chub populations within the Pinedale RMPPA can be partially attributed to September 1962, when 444 miles of the Green River and tributaries above Flaming Gorge Dam were poisoned with rotenone. Recovery of roundtail chub in this region has probably been hampered by the invasion of nonnative fish species following the poisoning (Holden 1991). Within the Pinedale RMPPA, roundtail chub

distribution is not well documented. Suitable habitat likely exists from above Fontenelle Reservoir to Pinedale. Once the Green River enters mountainous regions where temperatures drop, habitat likely becomes unsuitable for roundtail chub. Surveys are needed to determine the present distribution of roundtail chub in the study area.

- **Leatherside Chub.** The leatherside chub is a BLM Sensitive species in Wyoming (BLM 2001). According to Johnson et al. (1995), the leatherside chub was once a candidate for federal protection under the Endangered Species Act; however, at present, the species has no federal status. The leatherside chub is native to the southern and eastern Bonneville Basin (including Salt Lake and Provo Lake drainages) and upper Snake River above Shoshone Falls (Utah, Idaho, and Wyoming) and the Wood River drainage in Idaho. It has also been introduced into the Green River in Utah (Lee et al. 1980). This species has experienced declines and local extirpations in various parts of its range. Reasons for decline include impoundments, dewatering, siltation, and predation by introduced brown trout (Walser et al. 1999). The leatherside chub is not native to the Green River, so any leatherside chub found within the Pinedale RMPPA would constitute an introduced population. Although documented occurrences of leatherside chub in the Green River are restricted to Utah (Lee et al. 1980), the prevalence of use of this species as a bait fish indicates that leatherside chub certainly could be in the upper Green River in Wyoming. Surveys are needed to determine whether this species occurs within the area.

- **Flannelmouth Sucker.** The flannelmouth sucker is listed as a BLM Sensitive species in Wyoming (BLM 2001). Its native range spans the entire Colorado River Basin, including the Green, Yampa, Gunnison, San Juan, and Little Colorado Rivers, the Gila River Basin, and the mainstream Colorado River (Lee et al. 1980). The flannelmouth sucker remains fairly abundant throughout the Colorado River Basin, in contrast to many native fishes in the region. However, dispersal is an important component of this species' life history, and aggregations of adults below dams during spawning season suggest that impoundments may be disrupting spawning migrations (Chart and Bergersen 1992; McKinney et al. 1999). Furthermore, evidence of hybridization between the flannelmouth sucker and the introduced white sucker in the upper Colorado River Basin (Holden and Stalnaker 1975, Valdez 2002) indicates another potential threat to the integrity and persistence of this species. Within the Pinedale RMPPA, flannelmouth sucker populations were eliminated in 1962 when the entire Green River and its tributaries upstream of Flaming Gorge Dam were poisoned with rotenone (Holden 1991). Although the species has since recolonized the region above the dam, the potentially harmful effects to this population have not been assessed. Following its extermination upstream of the Flaming Gorge Dam in 1962, the flannelmouth sucker became reestablished in the upper Green River and is likely found in the large to moderate stretches of river within the Pinedale RMPPA. However, the exact limits of its distribution upstream of Fontenelle Reservoir are not currently known.

- **Bluehead Sucker.** The bluehead sucker is listed as a BLM Sensitive species in Wyoming. This species has an interesting distribution, occurring in the Colorado River from the Grand Canyon on up into its tributaries including the Green, Yampa, Gunnison, and San Juan Rivers, but absent from the Colorado River below Grand Canyon, including the Gila River Basin. The bluehead sucker is also native to the Bear and Weber River drainages and the Snake River upstream of Shoshone Falls (Lee et al. 1980). Declines in abundance of this species have not been well documented, but potential threats include habitat degradation resulting from impoundment and dewatering. The presence of dams throughout the bluehead sucker's range may interfere with migrations. Holden and Stalnaker (1975) collected both white sucker and longnose sucker in the upper Colorado River Basin; competitive interactions with these two introduced species could also harm the bluehead sucker. Hybridization with flannelmouth and white suckers may also be threatening the integrity of this species in the upper Colorado River Basin (Holden and Stalnaker 1975). Populations of bluehead sucker within the Pinedale RMPPA were exterminated in 1962, when the upper Green River and its tributaries above the Flaming Gorge Dam were poisoned with rotenone (Holden 1991). After the poisoning, the bluehead sucker was found to be one of the dominant species below the Flaming Gorge Dam (Holden and Stalnaker 1975), and the species has recolonized the region upstream of the dam. Given its wide tolerance of habitat types, it is likely that this species occurs throughout the area. However, surveys are needed to determine whether interactions with nonnative suckers have restricted the bluehead sucker's distribution within the upper Green River.

- **Yellowstone Cutthroat Trout.** The Yellowstone cutthroat trout is distinguished from other trout species by its two prominent red slashes on the lower jaw, and from other cutthroat trout subspecies by medium-to-large, pronounced, outlined spots. Spots are concentrated on the caudal peduncle, except in Yellowstone Lake fish, which have spots that are evenly distributed over both sides of the body. Coloration is a dull yellowish brown, silvery, or brassy. Bright golden-yellow, orange, or red colors are typically absent. Rose tints may appear on the body of mature fish (Behnke 1992, Baxter and Stone 1995). The Yellowstone cutthroat trout is endemic to part of the Snake River Basin, but moved naturally into the Yellowstone River drainage (Missouri River system) via Two Ocean Pass. In this area, Pacific Creek drains into the Snake River system and Atlantic Creek drains into the Yellowstone system. Fish movement can still occur between these two streams (Behnke 1992). The distribution of Yellowstone cutthroat trout is now limited to the Snake River above Shoshone Falls and to the Yellowstone River drainage downstream of the Tongue River. Above Shoshone Falls, the Yellowstone cutthroat trout is native to all the Snake River system except for waters between Jackson Lake and Palisades Reservoir, where the fine spotted Snake River cutthroat exists. Yellowstone cutthroat trout exist today in Pacific Creek, which joins the Snake River just below Jackson Lake. Approximately 65 percent of the historical range of the Yellowstone cutthroat was in northwestern Wyoming. Any current populations in the Pinedale RMPPA are likely introduced.

Yellowstone and other cutthroat species hold one advantage over competitors in their apparent physiological tolerance for higher elevations and colder temperatures, which has given them a slight advantage in headwater tributaries (Kruse et al. 2000). However, these headwater populations are susceptible to stochastic events, limiting population size, stability, and sustainability (Bozek and Hubert 1992). Although the competitive mechanisms are poorly understood, it is generally suspected that in many circumstances nonnative salmonids will replace cutthroat trout over time (Fausch 1988, DeStaso and Rahel 1994). Additionally, cutthroat are susceptible to water quality perturbations that may be caused by irrigation, logging, mining, or overgrazing such as turbidity, contaminants, or changes in water temperature (Gresswell 1995). Whirling disease, transferred through *Myxobolus cerebralis*, is also a threat to Yellowstone cutthroat trout populations. Positive results have confirmed whirling disease infections in Yellowstone Lake (Mahoney nd). At this time the impact the disease may have on the Yellowstone cutthroat trout populations in Wyoming is unclear. It is also unclear how this disease will impact trout in the area. Yellowstone cutthroats are listed as sensitive species by the Forest Service Region 2 and the Wyoming BLM. The species has been given special consideration by the state agencies of Wyoming and Montana.

- **Fine Spotted Snake River Cutthroat Trout**. The fine spotted Snake River cutthroat is distinguished by its fine, pepper-like spots. It is predominantly yellowish brown, sometimes with purple and silvery tones. Faint rose tints may appear on mature fish, and the lower fins typically are orange or red. The greatest concentration of the spots on the body is towards the caudal peduncle and above the lateral line anterior to the dorsal fin (Behnke 1992). Behnke found the marked difference in spotting between the Yellowstone and the Snake River cutthroats to be the only consistent difference between the two fish. The relationship between Yellowstone cutthroat trout and the fine spotted Snake River cutthroat trout is uncertain. They both occur in the Snake River drainage; however, very little hybridization has been recorded. Genetic analysis could not distinguish these subspecies until recently (Kruse 1995). Bonneville cutthroat trout are also closely related and can be very similar in appearance.

  Snake River cutthroat prefer spring streams and the cool, clear, upper reaches of the Snake River. The present known distribution of the fine spotted Snake River cutthroat trout in its native range includes the Snake River drainage from below Jackson Lake downstream to Palisades Reservoir, encompassing all tributaries from the Gros Ventre River to the Salt River. The subspecies has proven to be a highly adaptable fish and has become important to many state fishery stocking programs. It was likely introduced in the Pinedale RMPPA. The Snake River cutthroat has been listed as a sensitive species in its native range by the Forest Service Region 4 and the Wyoming BLM. It has been given special consideration by the state agencies of Wyoming and Idaho.

- **Colorado River Cutthroat Trout.** Colorado River cutthroat is the only native Colorado River trout and one of only two native salmonids (the other being the

mountain whitefish). Colorado River cutthroat develop brilliant red, orange, and golden-yellow coloration, especially during spawning. The Colorado River cutthroat was once common in the upper Green River and Colorado River watersheds, but it currently occupies less than 1 percent of its former range. It exists in isolated subdrainages in Colorado, Utah, and Wyoming (Behnke 1992, Young 1995).

Pure populations of Colorado River cutthroat have been extirpated from most of the historical range. They have been listed as a subspecies of "special concern" by the American Fisheries Society, a Category 2 species by the U.S. Fish and Wildlife Service, and a sensitive species by Forest Service Regions 2 and 4. Wyoming BLM lists it as a sensitive species, and it has been given special consideration by the state agencies of Colorado, Utah, and Wyoming. A petition to list the Colorado River cutthroat as endangered or threatened was filed with the Secretary of Interior. To date, the USFWS has not listed the subspecies. Threats to the Colorado River cutthroat include continued hydromodifications and habitat fragmentation throughout its historic range; competition and hybridization with nonnative salmonids; whirling disease; continued development of oil, gas, and mineral leases; grazing impacts; and a number of other natural and manmade threats.

In the Green River drainage, Colorado River cutthroat trout are restricted to areas above upstream migration barriers, populations are disjunct, and displacement by nonnative salmonids has occurred (Bozek and Rahel 1991). According to Wyoming Game and Fish data and basin management plans, Colorado River cutthroat were located in more than 10 basins in the Pinedale RMPPA. This includes 5 populations in the North Piney Creek basin, 3 in the Dry Piney Creek basin, 9 in the South Piney Creek basin, 18 in the LaBarge Creek basin, 4 in the Beaver Creek basin, 12 in the Cottonwood Creek basin, 3 in the Muddy creek basin, 12 in the Horse Creek basin, and 3 in the East Fork River basin. Within the East Fork drainage, the population in Irish Canyon Creek is the only known wild and pure population in the Pinedale RMPPA and is of significant importance. Other important populations occur in the Rock Creek drainage and the Beaver Creek ACEC.

Populations of Colorado River cutthroat trout in these drainages appear to be stable. Population estimates provided by Wyoming Game and Fish range in abundance from approximately 50 fish per mile in Pine Grove Creek in the Dry Piney basin to nearly 2,000 fish per mile in Irish Canyon Creek. Ongoing protection of the Colorado River cutthroat includes implementation of management objectives outlined in the 1999 Conservation Agreement and Strategy for Colorado River Cutthroat in the States of Colorado, Utah, and Wyoming. These important management tools have identified measures necessary for the conservation of the genetic and demographic viability of the cutthroat.

3.20 SPECIAL MANAGEMENT AREAS

ACECs

ACECs are areas that contain one or more resources that require special management and protection to maintain the value of the resource and the area. Areas designated as ACECs may contain such resources as rare or sensitive archaeological resources; habitat for endangered, sensitive, or threatened species; or rare geologic features. This section discusses the ACEC designations managed by BLM's Pinedale RMPPA.

ACEC designations indicate areas for which special management attention is necessary to protect and prevent irreparable damage to important historic, cultural, and scenic values; to fish or wildlife resources or other natural systems or processes; or to protect human life and safety from natural hazards. Management is considered special if it is unique to the area and includes terms and conditions specifically designed to protect the values within the ACEC.

BLM recognizes that an ACEC has significant values and establishes special management measures to protect those values. The designation is a reminder that significant values exist that must be accommodated when future management actions and land use proposals are considered within the ACEC. Designation may also support a funding priority. The designation of ACECs is achieved only through the resources management planning process, either in the RMP itself or in a plan amendment.

Two ACECs are included in the existing Pinedale Field Office RMP:

- **Rock Creek.** The objective for managing the 5,264-acre Rock Creek ACEC is the protection of the Rock Creek drainage, thereby assuring quality aquatic habitat for the sensitive Colorado River cutthroat trout (*Oncorhyncus clarki pleuriticus*) and providing crucial winter range for a portion of the Piney elk herd. Rock Creek was designated as an ACEC during the 1988 RMP planning process
- **Beaver Creek.** The objectives for managing the approximately 3,548-acre Beaver Creek ACEC are to assure quality aquatic habitat for the sensitive Colorado River cutthroat trout and to protect elk calving habitat. Beaver Creek was designated as an ACEC during the 1988 RMP planning process.

Both ACECs are located along the western portion of the Pinedale RMPPA, as shown in Map 3.20-1.

Special Recreation Management Areas

The basic units of recreational management are either the Special Recreation Management Area (SRMA) or the Extensive Recreation Management Area (ERMA). The SRMA is an area with a commitment to provide specific recreational activities and opportunities. These areas usually require a high level of recreational management. The ERMA is an area where recreation management is one of several management objectives and consists of the remainder of land not included in SRMAs. These areas may include

developed and primitive recreation sites with minimal facilities. The SRMAs in Pinedale RMPPA include 1) Scab Creek; 2) Boulder Lake; and 3) Upper Green River. The SRMAs are summarized below:

- **Scab Creek SRMA.** The Scab Creek SRMA is located on the eastern boundary of the RMPPA, along the lower slopes of the Wind River Range and adjacent to the Bridger Wilderness Area. This area provides a wide range of recreational uses including camping, horseback riding, rock climbing, hunting, and fishing. The area is being managed as a proposed wilderness area, but facilities such as horse corrals, horse loading docks, camping areas, road access and trailhead parking areas, toilets, and fire rings are provided. The Scab Creek SRMA is heavily used by the public throughout the year. There are 2 miles of developed trail (Scab Creek Trail) and 4 miles of undeveloped trail in the area. The area is consistently used by the National Outdoor Leadership School (NOLS) to teach rock climbing, wilderness camping, and cross-country skiing.
- **Boulder Lake SRMA.** Boulder Lake SRMA is composed of approximately 1,840 acres, and encompasses approximately 3 miles of the shoreline of Boulder Lake and the surrounding area. The SRMA is located approximately 8 miles north of the town of Boulder and provides two campgrounds located on the north and south sides of the lake. The north campground consists of picnic tables, grills, a toilet, and an undeveloped boat launch site. The south campground consists of several undesignated campsites, picnic tables, a toilet, and a primitive boat launch site. The area is heavily used during the summer and fall and is a popular destination for boaters, fishermen, and campers.
- **Upper Green and New Fork Rivers SRMA.** These two areas comprise the most heavily used SRMA in the Pinedale RMPPA but receive the least management. The most heavily developed area is the 12-mile stretch of river referred to as the Upper Green, which is mainly used for river fishing access. This SRMA provides 12 semideveloped river and picnicking facilities located along a maintained dead end road. The remainder of the river access points is undeveloped and receives little management. The area is provided with picnic tables and toilets, and trash service is provided at the base of the road that connects all of the sites. Located at the northern end of the Pinedale RMPPA, the Upper Green SRMA provides river fishing, river floating, and float fishing access. Much of the BLM-administered land is not accessible except from the river because it is surrounded by privately owned land with no legal access.

Wild and Scenic Rivers

The Wild and Scenic Rivers Act of 1968 (WSRA) was passed to protect free flowing rivers or river segments and their related outstandingly remarkable values (e.g. scenic, recreational, geologic, fish and wildlife, historic, cultural). The WSRA establishes three wild and scenic river classifications: Wild, Scenic, and Recreational. The BLM is required to evaluate all rivers located on land under its administration to determine if the rivers are eligible and suitable for inclusion in the National Wild and Scenic Rivers System (NWSRS).

The BLM is conducting a review of all BLM administered public lands along waterways in the Pinedale RMPPA for their eligibility and suitability to be included in the NWSRS. The findings of this review and recommendations will be incorporated into the Pinedale RMP planning effort.

Wilderness Study Areas

In 1964, Congress passed the Wilderness Act, thereby establishing a national system of lands for the purpose of preserving a representative sample of ecosystems in a natural condition for the benefit of future generations. Until 1976, most land considered for and designated as wilderness was managed by the Forest Service and National Park Service. With the passage of the Federal Land Policy and Management Act (FLPMA) in 1976, Congress directed BLM to inventory, study, and recommend which public lands under its administration should be designated wilderness. In the Pinedale RMPPA the Scab Creek WSA was recommended for wilderness designation, and the Lake Mountain WSA was not recommended for wilderness designation.

In the interim between the inventory that identifies suitable and eligible areas appropriate for wilderness designation and the actual congressional designation of a wilderness, BLM must manage the potential wilderness. BLM manages these potential wilderness areas as Wilderness Study Areas (WSA) (BLM 1990). During the time that Congress considers an area for wilderness, which can be many years, designated WSAs require special management practices to preserve the wilderness characteristics that make an area appropriate for designation.

WSAs, established under the authority of Section 603(c) of FLPMA, are managed to preserve their wilderness values according to the Interim Management Policy (IMP), and will continue to be managed in that manner until Congress either designates them wilderness or releases them for other uses. Only Congress can designate or release Section 603 WSAs, and their status will not change as a result of the Pinedale Field Office planning process. The RMPPA currently has two WSAs (Lake Mountain and Scab Creek) as shown on Map 3.20-1.

Potential wilderness can be identified through BLM or through external nominations by the public. Both methods require the same type of review to determine whether the area has wilderness values, and if the area is manageable as wilderness.

Currently, two WSAs are identified in the Pinedale RMPPA: Scab Creek WSA, which is comprised of 7,636 acres, and Lake Mountain WSA, which is comprised of 13,970 acres. These areas are illustrated on Map 3.20-1. The final document for each area (Final Scab Creek Wilderness Study Report [BLM 1981; Final Rock Springs Wilderness Environmental Impact Statement [BLM 1990]) have been used in the Pinedale Field Office to aid the determination of areas that are suitable for WSA designation. A summary of each WSA follows:

- **Scab Creek WSA.** This area was originally established and managed as a primitive area in 1975. In April 1985, the Scab Creek Instant Study Area was

proposed by former president Ronald Reagan for addition to the National Wilderness Preservation System. The Scab Creek WSA adjoins the Bridger Wilderness in Bridger National Forest, which lies to the east. Scab Creek WSA offers extraordinary natural wilderness features, as well as ample opportunity for solitary wilderness experiences.

- **Lake Mountain WSA.** Lake Mountain WSA contains important elk winter range, as well as Colorado River cutthroat trout (*Oncorhyncus clarki pleuriticus*) habitat. Lake Mountain WSA was determined to be difficult to manage as wilderness and, therefore, was not recommended for designation as wilderness in the Final Rock Springs Wilderness EIS (BLM 1990). Nonetheless, the BLM must manage the area as a WSA until such time Congress does or does not designate it as wilderness.

In accordance with the BLM policy outlined in Manual Handbook H-6310-1, an interdisciplinary team of BLM specialists evaluates each public proposal for wilderness to determine 1) if it was new and significantly different from information considered in prior wilderness inventories conducted by the BLM, and 2) whether there was a reasonable probability that the areas (or significant portions thereof) may have wilderness character. From that evaluation, the BLM determines which areas have wilderness character. These areas are then analyzed through an RMP or supplemental plan to determine if they are eligible for wilderness designation; during this time, the areas are managed as WSAs. Currently, there are no externally generated wilderness proposal areas within the Pinedale RMPPA.

There is no congressionally designated wilderness within the Pinedale RMP plan area.

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