CHAPTER 3—AFFECTED ENVIRONMENT

The affected environment is the baseline (see Table 3-1 at the end of Chapter 3) against which potential impacts caused by the planning alternatives are assessed. This chapter focuses on the natural and physical human environment that has the potential of being affected by implementing land management decisions.

The approach to defining the baseline was first to identify potential issues and concerns resulting from the proposed land management decisions. The region of influence potentially affected by these decisions is primarily the three-county area in which Jack Morrow Hills (JMH) lies (Map 1). From this information, relevant environmental and economic conditions were identified and described using geographic information systems data, existing databases and literature, previous reports and studies, field investigations, and personal and professional knowledge of the planning area.

BLM recognizes that a gap in information on public land resources exists within the JMH Coordinated Activity Plan (CAP) planning area. The environmental impact statement (EIS) interdisciplinary team examined the data and relationships used to estimate the effects of the alternatives. There is a substantial amount of credible information about the topics of this EIS; the central relationships and basic data are well established. The best available information was used to evaluate the effects of the alternatives, and studies such as the on-going elk study and vegetation inventories are included in the EIS. However, as noted in the affected environment and impact analyses of this final EIS, there is much that remains unknown about many of the plant and animal species and specific locations of cultural resources. Connectivity and habitat needs, range, migratory corridors, and other specific information for many species are unknown or uncertain. Likewise, because of the amount of public land within the JMH CAP planning area, the extent and specific locations of all cultural resources within the area are also unknown. Conducting surveys and studies to obtain all unavailable information for inclusion in this EIS would require additional time frames and incur exorbitant costs.

When encountering this gap in information, the question implicit in the Council on Environmental Quality (CEQ) regulations (40 CFR 1502.22(a)) on incomplete or unavailable information was posed: Is this information "essential to a reasoned choice among alternatives?" While additional information would often add precision to estimates, the basic data and central relationships in the JMH CAP planning area are sufficiently well established that any new information would not likely reverse or nullify relationships. Though new information would be welcome, no missing information is essential to a reasoned choice among the JMH CAP alternatives. Reasonably foreseeable actions have been analyzed, and are described in this EIS along with reasonably foreseeable effects.

3.1 LAND AND WATER RESOURCES

Land and water resources include the physical and biological features of the planning area and the land use programs that affect those features.

3.1.1 Fire

The Fire Management Implementation Plan for Bureau of Land Management (BLM) administered public lands in the State of Wyoming (USDI 1998b) guides the use and suppression of fire as a management tool in the JMH CAP planning area. The planning area lies in two geographic fire management areas: (1) the Big Sandy and Steamboat Mountain area, and (2) the Red Desert area.

Fire management planning objectives for the Big Sandy and Steamboat Mountain area are as follows: to reduce conifer and sagebrush encroachment into aspen and mountain shrub communities, improve habitat

for big game and the greater sage-grouse, improve forage for livestock and wild horses, and protect public and private property by reducing hazardous fuels near BLM-administered recreation sites and range improvements. Both wildland and prescribed fires could be used to meet resource management objectives throughout the entire fire management area. Steamboat Mountain contains unique vegetative communities and high-value wildlife habitat. Wildland fire is not desired in this area, and thus suppression techniques would be implemented here.

The Red Desert fire management area includes the portion of the Red Desert Watershed Management Area located within the planning area. Fire management planning objectives for this area are as follows: to improve wildlife habitat, improve forage for livestock and wild horses, and reduce conifer encroachment into aspen and mountain shrub communities. Prescribed fire would be used to achieve resource management objectives throughout the entire fire management area.

The use of heavy equipment for fire management purposes would be restricted, and other minimal impact suppression techniques would be followed in areas of critical environmental concern (ACEC), in wilderness study areas (WSA), and along historic trails. Chemical and dye retardants for fire suppression would be restricted in the vicinity of petroglyphs within the Big Sandy and Steamboat Mountain fire management areas.

Wildland fires in the fire management areas have been infrequent. Over the past decade, less than 900 acres have burned in 29 recorded fires, with the majority occurring in the Big Sandy and Steamboat Mountain area.

3.1.2 Water Resources

Water resources include surface and groundwater sources and water quality.

3.1.2.1 Watersheds and Surface Waters

The JMH CAP planning area lies within the Great Divide Basin, Colorado-Green River, and Platte-Sweetwater River watersheds. These watersheds have been further delineated into sub-basins by the State of Wyoming, as shown on Map 61. The upper reaches of the Colorado-Green River Basin drains the western portion of the planning area and occupies the majority of the area. It contains the Pacific Creek, Jack Morrow Creek, and Killpecker Creek subwatersheds. A small portion of the Platte-Sweetwater River Basin occupies the northeast corner of the planning area. The Great Divide Basin, which occupies the southwestern corner of the planning area, is a closed basin with no hydrological connection to any major river system.

Most surface water features in the planning area are ephemeral or intermittent streams, except for a few perennial streams and wetlands. Peak flows occur in the spring and summer during storm events. Flow in ephemeral streams is directly dependent on precipitation, because the channel is above the water table at all times, whereas intermittent streams carry seasonal flow generated by water from springs or from some other surface source. Perennial streams flow continuously and are generally associated with a water table in the localities through which they flow.

Riparian areas are those areas that show vegetative and morphologic influences as a result of their proximity to water features. They are important to fish and wildlife species as well as to livestock. Riparian and wetland areas can affect the health of entire watersheds by dissipating water energy; filtering sediments; reducing stream bank erosion; increasing groundwater supplies; maintaining habitat and forage for wildlife and livestock; and providing locations for recreationists to fish, camp, and picnic.

Ecologically important wetland resources include the melt-water-fed ephemeral ponds (flockets) located in the sand dunes region of the planning area. These standing waters and their aquatic communities create an important early season resource base for the production of food organisms (invertebrates) and for nesting sites for waterfowl and other birds common to the aquatic environment.

3.1.2.2 Proper Functioning Condition

Proper Functioning Condition (PFC) is the minimum acceptable level of the ecological condition for flowing (lotic) and still (lentic) surface waters. It is a qualitative method for assessing the physical functioning of riparian and wetland areas and is a term that defines on-the-ground condition. The PFC assessment considers hydrology, vegetation, soil, and landform attributes to reduce erosion and improve water quality during high flows. PFC is a state of resiliency that would allow a riparian-wetland system to remain stable during a 25- to 30-year flow event, sustaining that system's ability to produce values related to both physical and biological attributes such as fish and wildlife habitat, forage, and erosion control.

Riparian areas that are not in PFC are either classified as functioning at risk or nonfunctional. A riparian area functioning at risk may perform some degree of riparian function but still has a high probability of degradation associated with high-flow events. Apparent trend is also determined for riparian areas functioning at risk. An upward trend indicates that although the area has limited stability, it is showing signs of becoming more stable. A downward trend indicates that the resource is showing signs of becoming increasingly unstable. In some cases the trend is not apparent. Nonfunctional riparian areas clearly lack the attributes and processes necessary to maintain stability.

BLM conducted PFC assessments in the planning area on approximately 520 acres of wetlands and 80.5 miles of riparian areas. As shown in Table 3-2, approximately 21 percent of riparian areas and 13 percent of wetland areas surveyed are in PFC, with the remaining areas functioning at risk. Approximately half of the riparian areas functioning at risk exhibit an upward trend, while the other half of riparian areas and the remaining wetland areas exhibit a downward trend and show signs of becoming increasing unstable (Tables 3-3 and 3-4).

Table 3-2. PFC Assessment

Rating	Riparian Areas		Wetland Areas	
	Miles	Percent of Total Miles	Acres	Percent of Total Acres
Proper Functioning Condition	16.5	21	66	13
Functioning at Risk	64.0	79	454	87
Nonfunctional	0.0	0	0	0
Total	**80.5**	**100**	**520**	**100**

Table 3-3. JMH Stream PFC Summary for Lotic Systems

Year Surveyed	Stream	Reach	Rating					Reach Length (in miles)
			PFC	Functioning at Risk (FAR)			NF	
				Up	N/A	Down		
1995	Jack Morrow Creek	All		X (90%)		X (10%)		20.00
1995	Rock Cabin Creek	All		X (80%)		X (20%)		16.00
1995	Pacific Creek	Segment 1	X					1.50

Year Surveyed	Stream	Reach	Rating					Reach Length (in miles)
			PFC	Functioning at Risk (FAR)			NF	
				Up	N/A	Down		
1995	Pacific Creek	Segment 2		X				1.20
1995	Pacific Creek	Segment 3				X		2.00
1995	Parnell Creek	Segment 1– upper	X					2.00
1995	Parnell Creek	Segment 2– lower				X		8.00
1995	Pacific Creek	Segment 4				X		11.00
1997	Sand Creek	All			X			1.25
1997	Dickie Springs Creek	All	X					0.50
1997	Oregon Slough Creek	All	X					1.00
1999	Robin Creek (BLM name)	All	X					1.50
1999	Oregon Buttes Creek (BLM name)	All	X					2.50
1999	Pacific Creek	Project area			X			4.00
1999	Bear Creek	All	X					7.50
2000	Nitche Creek					X		0.50
Total								**80.45**

Table 3-4. JMH Stream PFC Summary for Lentic Systems

Date of Survey	Lentic Area	Legal Description	Rating					Size of Area (acres)
			PFC	Functioning at Risk (FAR)			NF	
				Up	N/A	Down		
1997	Oregon Slough		X					60
1977	Long Slough					X		35
6/17/99	Dunder Pond (BLM name)		X					6
7/26/99	15-mile Spring				X			10
7/26/99	Ox Yoke Spring				X			2
9/7/99	Flockets (dune pond area)	Part 1				X		362
9/7/99	Flockets (dune pond area)	Part 2			X			45
Total								**520**

The waterways in PFC are primarily located in the upper reaches, where much of the stability is attributed to rocky substrates. Waterways in PFC include Dickie Springs Creek, Oregon Slough Creek, Robin Creek, Oregon Buttes Creek, Bear Creek, and portions of Pacific Creek and Parnell Creek. The waterways located in areas of lower elevation are more susceptible to degradation because of their reliance on vegetation for channel stability. Waterways that are functioning at risk include Jack Morrow

Creek, Sand Creek, Rock Cabin Creek, and the lower reaches of Pacific Creek and Parnell Creek. Channel instability results in a greater than natural loss of soil and elevated levels of sediment and salinity in the water.

3.1.2.3 Groundwater

Locally elevated areas such as Steamboat Mountain and the highly permeable Killpecker Dunes provide the right conditions for locally fed seeps and springs to occur. Groundwater overlain by impermeable rock creates confined or artesian conditions. Such confined aquifers may be accessed in different locations throughout the planning area, but the quality and quantity of the water is highly variable.

Aquifers are not well defined in the planning area because of the nature of the geologic layers. Limited information is available from development of water wells for domestic, livestock, and agricultural use, and from oil and gas development. On the Green River Basin side of the Rock Springs Uplift, a number of water wells have been known to produce or are still producing from the Tertiary, Green River Formation. On the Great Divide Basin side, groundwater data indicate usable water in the Tertiary, Wasatch Formation, and the Green River Formation. Figure 1 shows the location of these formations.

Water from the Cretaceous, Almond, and Ericson formations, at shallow depths on the Rock Springs Uplift, is usable for livestock, irrigation, and/or domestic use. Other stratigraphic units that may have usable groundwater within the planning area include the Tertiary, Bridger Formation, and the Lewis Formation where it crops out. Quaternary sand dune deposits are likely to contain usable water but more important, they may act as a recharge zone for underlying aquifers and may produce seeps and springs used by wildlife.

3.1.2.4 Water Quality

Surface water and groundwater quality in the planning area are influenced primarily by the amount of total dissolved solids (TDS) in the water. There are no known point sources of water pollution within the planning area, thus surface water quality is influenced by nonpoint sources such as soil erosion and runoff.

Most of the planning area is subject to the Colorado River Salinity Compact. The seven basin states that make up the Colorado River Salinity Control Forum take a basinwide approach for controlling salinity in the waters that naturally drain into the Colorado River. BLM provides input to the Wyoming Department of Environmental Quality (DEQ) for the review of water quality standards for salinity in the Colorado River Basin.

Pacific, Jack Morrow, and Killpecker Creeks are all subject to the Colorado River Salinity Compact and have therefore been sampled to measure levels of TDS and other constituents. Based on historic TDS concentrations and DEQ groundwater suitability standards, these waterways tend to be suitable for livestock water (<5000 ppm) and depending on flow conditions, are often within the range for agricultural water (<2000 ppm). Waterways of less than 500 ppm TDS are considered potentially suitable for domestic water. TDS is not the sole criteria for determining use suitability of a water body; however, in open areas with salty soils and few if any point sources of pollution, TDS tends to be an acceptable first approximation (Table 3-5). There are no known perennial surface flows in the Great Divide Basin.

Table 3-5. Suggested Use For Streams Within the JMH CAP Planning Area Based on Limited Historic TDS Concentrations

Stream	Suggested Use
Pacific Creek	Agricultural
Jack Morrow Creek	Livestock
Killpecker Creek	Agricultural[1]
Sweetwater River	Domestic

[1]The TDS average for Killpecker Creek is toward the high end of the agricultural range. Several samples showed TDS levels greater than 2,000 ppm. Therefore Killpecker Creek may not be an ideal agricultural water source.

In general, groundwater quality decreases away from the basin margin and with increased depth. In both the Green River and Great Divide basins, the highest-quality groundwater would be expected in Quaternary deposits of alluvium along major drainages, Quaternary dune fields, Cretaceous and Tertiary sediments along the basin margins, and in the fine-to- medium grain sandstones of the Wasatch Formation away from the basin margin.

One method of measuring groundwater quality in the area is to compare TDS levels in well-producing aquifers against the Wyoming Department of Environmental Quality guidelines for acceptable uses. Groundwater containing TDS levels below 500 milligrams per liter (mg/l) is acceptable for domestic use; TDS levels between 500 and 2,000 mg/l are acceptable for agricultural use; and TDS levels between 2,000 and 5,000 mg/l are acceptable for livestock use. Acceptable concentrations of constituents for each use category are shown in Table 3-6 at the end of Chapter 3.

Quaternary aquifers generally contain the highest-quality water, with TDS ranging from 100 to 200 mg/l in the headwaters, to 700 mg/l along the Green River. Within the planning area, it is anticipated that TDS levels would be on the high end of the range because of local influences of the Green River Formation. On the Great Divide Basin side of the Rock Springs Uplift, the shallow Tertiary aquifers (depths from less than 500 to 1,500 feet) have TDS levels ranging from 400 to 1,800 mg/l. The Wasatch Formation varies from 100 to 6,600 mg/l TDS, depending on the distance from the basin margin.

3.1.3 Wild Horses

The first wild horses in the area were most likely with the Native Americans who traveled through or inhabited southwest Wyoming. As white settlers arrived in the mid-1800s, horses often escaped or were turned loose on the open range. Many local ranchers managed these herds for their own use, introducing studs to improve the stock. Thus several different breeds can be found in the planning area, including large draft horses, quarter horse mixtures, and some American saddle horses.

With the passage of the Wild Free-Roaming Horse and Burro Act in 1971, BLM was given the responsibility to protect, manage, and control wild horses and burros. The primary objectives of the act are as follows: to manage wild horses and burros as an integral part of the natural system of public lands under the principal of multiple use; to protect wild horses and burros from unauthorized capture, branding, harassment, or death; and to provide humane care and treatment of wild horses and burros.

3.1.3.1 Herd Management Area

BLM establishes herd management areas (HMA) for the maintenance of wild horse herds. HMAs are based on the appropriate management level for the herd, the habitat requirements of the animals, the relationships with other uses of the public and adjacent private lands, and constraints to management.

The Great Divide Basin Wild Horse HMA is located 40 miles east of Rock Springs and north of Interstate 80. It encompasses an area from the boundary of the Rawlins and Rock Springs Field Offices west to the Continental Divide. The area consists of 772,915 acres, of which 73 percent is public land, 2 percent is state land, and 25 percent is private land.

Approximately 222,000 acres of the Great Divide Basin Wild Horse HMA cover the eastern one-third of the JMH CAP planning area, which is predominantly public land (Map 62). The western branch of the Continental Divide forms the western boundary of the HMA. This boundary is unfenced, and the topographic feature does not provide an effective barrier to the movement of wild horses. Wild horses are often found outside the HMA yet within the JMH CAP planning area, primarily in the Steamboat Mountain ACEC and the Rock Cabin Creek/Oregon Buttes area. These horses are by definition "excess" and are subject to annual removal.

3.1.3.2 Appropriate Management Level

BLM develops herd management plans that identify management objectives and the tasks required to meet those objectives. Objectives may include maintaining certain herd characteristics, numbers, and genetic stock. Management tasks primarily focus on monitoring both the land and the herds, removing excess animals, preparing animals for adoption, adopting animals to the general public, ensuring compliance, and performing titling. By law BLM must limit its activities to those necessary to get the job done.

In 1979 an agreement with the Rock Springs Grazing Association, the International Society for the Protection of Mustangs and Burros, and Wild Horses Yes established a total population of 1,600 wild horses for the Rock Springs District. In 1982 BLM accepted this management level, and numbers for each wild horse HMA were designated. The appropriate management level (AML) established for wild horses in the Great Divide Basin Wild Horse HMA was set at 500 horses.

Because wild horse gatherings are expensive and the law requires the minimum level of management possible, BLM allows the horse populations to fluctuate so that the number of gatherings for any one herd is minimized. BLM allows the AML for the Great Divide Basin Wild Horse HMA to fluctuate between 415 to 600 wild horses at any given time. The 2001 projected population in the Great Divide Basin Wild Horse HMA was approximately 900 horses.

BLM analyzes inventory and monitoring information to determine whether the herds are healthy and if the animals are damaging rangelands within the HMA. When monitoring data and environmental analyses indicate that the population is in excess of the AML, BLM prepares gather plans detailing the methods and timing for gather and removal. After removing the animals, BLM's main goal is to place the animals through its adoption program.

3.1.4 Livestock Grazing

Congress enacted the Taylor Grazing Act in 1934 to provide for the orderly use, improvement, and development of public rangelands. The act allows the establishment of grazing districts and the issuance of permits to graze livestock. The Public Rangelands Improvement Act of 1978 further provides for the improvement of range conditions for watershed protection, livestock grazing, wildlife habitat, and other rangeland values.

3.1.4.1 Grazing Allotments

Livestock grazing is authorized within the JMH CAP planning area in 15 allotments of various sizes, as shown on Map 63. Nine of these allotments are entirely within the JMH CAP planning area, whereas the boundaries of the other six allotments extend outside the planning area. Approximately 92 percent of the land in the allotments within JMH is public, 5 percent is state, and the remaining 3 percent is under private ownership.

Most allotments contain some lands unsuitable for livestock grazing and areas suitable only for certain classes of livestock. The unsuitable areas contained within the JMH CAP planning area are small, isolated parcels (such as steep slopes, badlands, and sand dunes) that are insignificant in size as compared to the entire planning area. Livestock grazing is authorized and occurs within WSAs in the JMH CAP planning area. The interim management guidelines for WSAs outline minimum data requirements and maximum acceptable impacts for range developments and livestock grazing increases.

An animal unit is a unit of measure for rangeland livestock equivalent to one mature cow or five sheep, all over 6 months of age. An animal unit month (AUM) is the standard measure of forage utilization. An AUM is the amount of dry forage or feed required to feed a mature beef cow, or its equivalent, for 1 month. The equivalent of a cow for forage purposes is approximately one horse or five sheep.

The total AUMs for the JMH CAP planning area are estimated based on the active permitted use by each permittee and the percent of the allotment that falls within the planning area. For discussion purposes, if half the allotment is within the JMH CAP planning area, half the AUMs are included in the total for JMH. The active permitted use within the JMH CAP planning area is approximately 26,830 AUMs, of which approximately 12 percent is sheep (3,203 AUMs) and 88 percent is cattle (23,627 AUMs). Livestock grazing within these allotments has varied over time because of available forage, environmental conditions, business decisions made by permittees, and livestock prices. Thus the historic use over the past 5 years has averaged approximately half the active permitted use totals, as shown in Table 3-7 at the end of Chapter 3.

Congress enacted a grazing fee for public lands to be established each year. The fee is based on the value of livestock, the base economic value of grazing on public rangeland established by the 1966 Western Livestock Grazing Survey, livestock production costs, and the average costs of grazing on private lands. The grazing fee for the 2002 grazing season was set at $1.43 per AUM. Surcharge rates are charged for nonpermittee grazing on public lands. Permittees may lease to other livestock operators that do not have a permit with BLM for a particular allotment. The surcharge cost for these operators for the 2002 season was set at $4.01 per AUM plus the grazing fee of $1.43 for a total of $5.44 per AUM.

BLM develops individual allotment management plans (AMP) in cooperation with the permittees. The AMPs deal with specific units of rangeland and are based on multiple use resource management objectives. The plans include terms and conditions to achieve specific resource condition objectives. The AMPs consider livestock grazing in relation to other uses of rangelands in addition to watershed, vegetation, and wildlife. An AMP establishes the seasons of use, number and class of livestock, and rangeland improvements and provides for a monitoring program to evaluate the effectiveness of management actions in achieving resource condition objectives.

3.1.4.2 Rangeland Monitoring and Improvements

The rangeland program in the planning area is based on the Wyoming Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management developed for BLM-administered land (Appendix 10). The program emphasizes multiple use management of forage for livestock and wild horses and

incorporates needs for wildlife habitat and protection of riparian and watershed values. The specific goals and objectives of the program have been and continue to be accomplished through careful planning at the activity level, with attention given to proper placement of rangeland improvements, distribution of livestock, kind and class of livestock, season of use, suitable grazing systems, plant and animal requirements, and vegetative land treatments.

Rangeland monitoring information has been analyzed for the allotments in the planning area. Monitoring data include actual use, utilization, rangeland trend, and field observations. Such monitoring has shown that some allotments are not meeting all the standards. Furthermore, no information is available to date supporting the state water quality standard for any of the allotments. Measures have been implemented on allotments currently not meeting the standards, and progress is being made with these measures to achieve the standards. Table 3-8 shows which standards are not met or are unknown.

TABLE 3-8. RANGELAND STANDARDS NOT MET (N) OR UNKNOWN (U)

Allotment	Rangeland Standards Not Met or Unknown					
	1	2	3	4	5	6
Bar-X					U	
Bush Rim					U	
Continental Peak					U	
4th of July					U	
Pacific Creek	N	N			U	
Red Desert					U	
Sands					U	
Steamboat Mountain		N			U	
Houghton Place					U	
Crookston Ranch		N			U	
Chilton Place					U	
Johnson Place					U	
Hay Meadow		N			U	
Middle Hay Place					U	
Rock Springs		N			U	

A number of range improvement projects have been constructed both for the enhancement and protection of watershed and wildlife values and for the management of domestic livestock grazing. These projects include water developments, vegetation treatments, windmills, and fences (Map 63). Range improvement projects are authorized under cooperative agreements or permits, depending on overall benefits and objectives and private investment levels.

In some areas fences are constructed to form an “exclosure,” which serves to prevent livestock access and improve the ecological condition of such areas. Exclosures are generally constructed around fragile, degraded or historically important areas (e.g., springs, streams, historical sites). The name, purpose, and size of the 13 exclosures that currently exist within the planning area are provided in Table 3-9.

Table 3-9. Jack Morrow Hills Exclosures

Name	Purpose	Size (in acres)
Boar's Tusk	Range/Upland vegetation study	5
Crookston	Riparian enhancement, recovery, and study	6
Dunal Ponds	Riparian enhancement, recovery, and study	17
Chicken Springs	Spring source protection	8
Bush Rim	Spring source protection	8
Tri Territory	Historical site	0.1
Steamboat Spring	Spring source protection	0.2
South Pass	Historical site	12
Jack Morrow Creek	Riparian recovery, mitigation for livestock conversion (Sandy EIS)	22
Rock Cabin	Riparian recovery, mitigation for livestock conversion (Sandy EIS)	25
Pacific Creek	Riparian recovery, mitigation for livestock conversion (Sandy EIS)	275 (4 exclosures)
Lower Pacific Creek	Riparian recovery, mitigation for livestock conversion (Sandy EIS)	29
Oregon Slough	Riparian recovery, mitigation for livestock conversion (Sandy EIS)	17

3.1.5 Vegetation

The ecosystem of JMH has been assigned the highest biodiversity significance rating by the Wyoming Natural Diversity Database. This is because of the presence of the largest known occurrence of the basin big sagebrush/lemon scurfpea association in the State of Wyoming, the occurrences of several vascular plant species endemic to the intermountain Semi-Desert Province of Wyoming, and the importance of the vegetation communities as habitat for the pygmy rabbit and desert elk.

The high-elevation, cold-desert vegetation of the planning area is composed predominantly of Wyoming big sagebrush/grass and Gardner saltbush vegetation communities. Also found within the planning area are patches of mountain big sagebrush on slopes and escarpments; basin big sagebrush on sand dunes; cushion plant communities on rims above mountain shrub communities; Utah junipers on the steeper, mainly south-facing slopes; sparse patches of true mountain mahogany on sandstone outcrops; and aspen and limber pine mainly on north- and east-facing slopes of buttes and mesas. Table 3-10 provides information on the vegetation communities within the planning area.

Table 3-10. Vegetation Communities and Associated Species

Community	Association	Location	Prominent Features
Wyoming Big Sagebrush	Western Wheatgrass Bluebunch Wheatgrass	Lower parts of easterly slopes, benches, and valley bottoms. Exposed sites on southerly or westerly slopes, upper parts of easterly slopes.	Dominant vegetation community in planning area.
Gardner's Saltbush–Winterfat	None	Alkaline soils of benches, flats, and gentle slopes.	Second most abundant in planning area; large-fruited bladderpod (BLM sensitive species) occupies habitat within this community.
Mountain Shrub Communities			
Basin Big Sagebrush	Basin Wildrye Lemon Scurfpea Western Wheatgrass	Southeast-facing escarpments and valley bottoms on terraces above floodplains. Southwest of Steamboat Rim and south of Essex Mountain. Mesa east of Alkali Draw on northwest-facing slope and near Essex Mountain.	Basin big sagebrush/lemon scurfpea is a unique association rarely found anywhere else in the Western United States. Important for cover and crucial habitat for elk.
Mountain Big Sagebrush	Utah Snowberry/Basin Wildrye Bluebunch Wheatgrass	Slopes steeper than 10 percent on northerly and south-southeasterly aspects. Northeast face of Pacific Butte.	Aspen seedlings, which provide cover and crucial habitat for elk, grow around the edges of this shrub stand.
True Mountain Mahogany/ Bluebunch Wheatgrass	None	Steep slopes on or near sandstone outcrops.	Sparse, small stands throughout the planning area, which are browsed by elk and deer.
Utah Juniper/Bluebunch Wheatgrass	None	East- and south-facing slopes and outcrops.	Sparse, small stands throughout the planning area, which contain an understory with rich species diversity, but sparse vegetation.

3.1.5.1 Rare Plant Communities and Associations

There are two rare plant communities (cushion plant and woodlands) and one rare plant association (basin big sagebrush/lemon scurfpea) within the planning area (Map 15).

3.1.5.1.1 Cushion Plant Community

Cushion plant communities are areas with low-growing, matlike tufts of vegetation with bare soil and gravel between the individual plants. These areas occur on ridgetops that experience extreme weather conditions. Cold winters, little rainfall, and strong winds contribute to the development of these specialized communities. The communities are very vulnerable to surface disturbance and have a slow recovery time. Usually 50 years or more are needed to restore the communities to their original native

state after disturbance. The cushion plant community contains uncommon and regional endemic plant species. Typical associates found in these areas include different species of phlox, twinpods, bladderpods, and many legume species. The communities are prime habitat for the mountain plover, a BLM sensitive species, which uses the low-growing vegetation areas for nesting.

3.1.5.1.2 Woodlands Community

Tree species are a very minor component of the vegetation in the planning area. In addition to the Utah juniper community, small isolated stands of limber pine and aspen occur at the higher elevations of Oregon Buttes and Steamboat Mountain. The presence of these stands is attributable to snow accumulation and to the location of springs and seeps on the slopes of the buttes. In addition, sparse patches of Douglas fir and lodgepole pine occur on Oregon Buttes.

The woodlands community provides cover and calving habitat for big game species in the planning area.

3.1.5.1.3 Basin Big Sagebrush/Lemon Scurfpea Association

The basin big sagebrush/lemon scurfpea community is a unique assemblage found on stabilized sand dunes. This is the largest of the few known occurrences of this association. Most locations are within the JMH CAP planning area, and the association is not known elsewhere in Wyoming. The association is only rarely found in small patches elsewhere in the Western United States.

This vegetation type provides crucial calving habitat and cover for the desert elk herd, and important habitat for the pygmy rabbit, a BLM Wyoming sensitive species. The Wyoming Natural Diversity Database (WYNDD) considers this area to be a unique habitat deserving protection from unnecessary disturbances. WYNDD also recommends that the boundary of the Steamboat Mountain ACEC be adjusted to include the unprotected part of the occurrence.

3.1.5.2 Special Status Plant Species

Special status plants are those species that are federally listed as threatened or endangered (T&E), proposed for listing, or candidates for listing under the Endangered Species Act (ESA). They also include species designated by each BLM State Director as sensitive and those listed or proposed for listing by a state in a category implying potential endangerment or extinction. BLM is mandated to protect and manage threatened, endangered, candidate, proposed, and sensitive plant species and their habitat. BLM is also required to protect and manage sensitive species jointly identified with the appropriate state agency. The State of Wyoming does not have an official list of sensitive, threatened, or endangered plant species.

A significant amount of information on the vegetation and plant associations of the JMH CAP planning area has been accumulated by BLM to date. General floristic inventories were conducted in the Continental Divide region, and a specific survey of plant communities and species of special concern was performed in the planning area in 1994 and 1995.

3.1.5.2.1 Federal Threatened and Endangered Species

Two plant species federally listed under the ESA have the potential to occur within the planning area. The blowout penstemon (*Penstemon haydenii*) is listed as endangered, and the Ute ladies'-tresses (*Spiranthes diluvialis*) is listed as threatened. These species are described further in the Biological Assessment (Appendix 3). No proposed or candidate plant species have the potential to occur in the planning area.

The blowout penstemon occurs in the Sand Hills of central Nebraska and a recently discovered location in south-central Wyoming in the Ferris Mountains. Potential high-elevation sand dune habitat in the Killpecker Dunes in the planning area was surveyed in 2000, but no new population of the blowout penstemon was documented.

The Ute ladies'-tresses is known to occur near the base of the eastern slope of the Rocky Mountains in southeastern and central Wyoming. Although BLM-authorized searches for the species have been performed at several locations along the Green River and its tributaries (including Pacific Creek), the species has not been found in southwest Wyoming. Potential suitable habitat in the planning area may be found on Jack Morrow Creek and its tributaries, Pacific Creek, the meadows at Crookston Ranch (located on Nitchie Creek), Sweetwater River and its tributaries, sand dune ponds (flockets), and the perennial and intermittent streams in the Red Desert area.

3.1.5.2.2 Wyoming BLM Sensitive Plant Species

Instruction Memorandum (IM) No. WY-2001-040 lists the Wyoming BLM sensitive species and management policy. The policy emphasizes planning, management, and monitoring of sensitive species and directs management of these species to avoid or minimize adverse impacts. It is not the intent of the policy to create severe restrictions on activities such that other multiple use activities cannot occur. The policy goals of this instruction memorandum are to—

- Maintain vulnerable species and habitat components in functional BLM ecosystems
- Ensure sensitive species are considered in land management decisions
- Prevent the need for species listing under the ESA
- Prioritize needed conservation work with an emphasis on habitat.

Table 3-11 lists the Wyoming BLM sensitive species that grow in the planning area (Map 15). The Nature Conservancy ranks the meadow pussytoes (*Antennaria arcuata*), Nelson's milkvetch (*Astragalus nelsonianus*), and large-fruited bladderpod (*Lesquerella macrocarpa*) as very vulnerable to extirpation both globally and statewide.

Table 3-11. Wyoming BLM Sensitive Plant Species

Common Name	Scientific Name	Habitat
Meadow pussytoes	*Antennaria arcuata*	Moist, hummocky meadows, seeps, or springs surrounded by sage/grasslands
Nelson's milkvetch	*Astragalus nelsonianus*	Alkaline clay flats, shale bluffs and gullies, pebbly slopes, and volcanic cinders in sparsely vegetated sagebrush, juniper, and cushion plant communities
Large-fruited bladderpod	*Lesquerella macrocarpa*	Gypsum-clay hills and benches, clay flats, and barren hills

Source: BLM (Wyoming) Sensitive Species Policy and List, IM No. WY-2001-040, April 9, 2001.

Meadow pussytoes has been found in 20 sites in Fremont County, with two populations consisting of approximately 5 acres located within the planning area. One of the 20 populations is known to extend into the Rock Springs Field Office management area at Long Slough, near South Pass City. Trend data for the State of Wyoming show the population to be stable to slightly declining since 1982. However, a status survey of meadow pussytoes conducted for BLM in 1995 discovered a single new population in the Oregon Gulch drainage, approximately 4 miles west of Continental Peak (Fertig 1996a). Surveys in other areas of potential habitat along Dickie Springs, Alkali Creek, and West Pacific Creek did not locate any plant populations.

Nelson's milkvetch is regionally endemic to southwest and central Wyoming. Its distribution includes the Wind River, Green River, Washakie, southern Powder River, Great Divide Basins, Owl Creek Mountains, and the Rock Springs Uplift in Fremont, Natrona, and Sweetwater Counties. The population size of Nelson's milkvetch is not known and trend data are not available; however, it is presumed that populations are stable at present (Fertig and Beauvais 1999).

The large-fruited bladderpod was thought to be endemic to the northern Great Divide Basin in Sweetwater and Fremont Counties; however, it was located in Lincoln County during a vegetation survey in 1992 (Culwell 1992). Most of the known populations occur on public land northeast of Steamboat Mountain on Bush Rim, near Continental Peak, and in the Oregon Buttes area. Large-fruited bladderpod population sizes fluctuate from year to year, apparently in response to moisture availability. The species is much more vulnerable to impacts during dry years when populations are small.

3.1.5.3 Species of Concern

The Wyoming Natural Diversity Database lists other species of concern that occur within the planning area (Appendix 11). These species lack formal federal or state status or protection but are potentially threatened within the ecosystem. They include annuals and biennials that have fluctuating population sizes in response to favorably moist years. Several rare species of the JMH have small global ranges but are often locally abundant within areas of suitable habitat. Such species require little or no formal protection as long as areas of representative habitat are maintained in good condition.

3.1.5.4 Noxious and Invasive Weeds

Federal agencies are directed by Executive Order (E.O.) 13112, Invasive Species, to expand and coordinate efforts to prevent the introduction and spread of invasive plant species (noxious weeds) and to minimize the economic, ecological, and human health impacts that invasive species cause. Weed management is an integral part of maintaining ecosystem health.

Fremont, Sublette, and Sweetwater Counties have official lists of noxious and invasive weeds that occur within county limits. Those species that are known to occur within the planning area are listed in Table 3-12. Most of the weeds are found along County Road 21 (Tri-Territory Road) and County Road 74 (Oregon Buttes Road).

Table 3-12. Noxious and Invasive Weeds

Common Name	Scientific Name	Location	Other Characteristics
Halogeton	*Halogeton glomeratus*	Roadsides, borrow ditches, disturbed areas	Decreases if native grasses and shrubs are allowed to recolonize; moderately toxic to livestock.
Kochia	*Kochia scoparia*	Roadsides, borrow ditches, disturbed areas	Decreases if native grasses and shrubs are allowed to recolonize; moderately toxic to livestock.
Russian Thistle	*Salsola kali*	Roadsides, borrow ditches, disturbed areas	Decreases if native grasses and shrubs are allowed to recolonize; moderately toxic to livestock
Perennial Pepperweed	*Lepidium latifolium*	Stream banks on lower portions of Jack Morrow Creek/Pacific Creek	Causes loss of native grass communities in riparian areas.
Black Henbane	*Hyoscyamus niger*	Tri-territory road, north and south Table Mountain, sand dunes, Bar X Ranch road, disturbed locations of Pacific Creek and Rock Cabin Creek	Causes occasional livestock poisoning and is poisonous to humans
Whitetop	*Cardaria spp.*	Disturbed alkaline soils of sagebrush-grass or riparian communities	Highly competitive with native species once established
Musk Thistle	*Carduus nutans*	Rock Cabin Creek, Chicken Springs, Dickie Springs, seep areas on east side of Steamboat Mountain	Aggressive invader which forms dense stands to crowd out desirable species
Canada Thistle	*Cirsium arvense*	Rock Cabin Creek, Chicken Springs, Dickie Springs, seep areas on east side of Steamboat Mountain	Aggressive invader which forms dense stands to crowd out desirable species
Leafy Spurge	*Euphorbia esula*	West of Pinnacles	Aggressively out competes native rangeland species

Weed populations are generally found along main dirt roads and two-tracks (especially those that cross meadows and drainage bottoms), in areas of livestock concentration (stock reservoirs, riparian areas, and sheep camps), and in areas of intense recreational use (frequently used dispersed camping areas). Motorized vehicles transporting seeds in tire treads are a significant source of new infestations of weed species. Other ways weed species are spread include untimely road blading (spreading mature weed seeds along road banks), transportation of nonlocal livestock into the area, use of contaminated hay for stock animals, and overuse and damage of native plant communities.

3.1.6 Wildlife

There are a variety of wildlife habitats supporting more than 350 different species within the planning area, from sand dunes and dunal ponds in the western portion of the planning area to small woodlands in the higher elevations of Oregon Buttes and Steamboat Mountain. The term “wildlife” refers collectively to mammals, birds, fish, amphibians, and reptiles.

BLM manages wildlife habitat on public lands, while the Wyoming Game and Fish Department (WGFD) manages the wildlife populations. BLM and WGFD have officially coordinated their management activities since 1976. An “umbrella” Memorandum of Understanding (MOU) adopted in March 1990 (replacing a previous MOU from August 1976) is the basis for all cooperative efforts between BLM and WGFD. The MOU directs each agency to conduct a coordinated program of wildlife resource administration, participate in each other’s planning efforts, advocate a wildlife management strategy that

focuses on total ecosystem management, maintain a cooperative-based wildlife information gathering and exchange system, provide consideration for management or mitigation of wildlife resources in other BLM programs, and promote improved public understanding of wildlife management on public lands (BLM and WGFD 1990).

3.1.6.1 Mammals

The WGFD manages big game populations in herd units. Herd unit boundaries generally do not match BLM field office boundaries, making analysis and correlation of resource data and big game population data difficult. The WGFD revises its population objectives for each big game species based on new habitat information, population trends, recreation demand, and public input.

Table 3-13 details the big game species within the planning area, habitat use by big game, acreage of crucial habitat and birthing areas within the planning area, WGFD herd units and size, and population levels set by WGFD for each herd unit.

Table 3-13. Big Game Habitat Use and Size

Common and Scientific Name	Habitat Use in Planning Area (acres)	WGFD Herd Unit and Size (million acres)	WGFD Herd Unit in Planning Area (acres)	WGFD Population Objective[1]
Mule Deer (*Odocoileus hemionus*)	Crucial winter range = 132,900 Parturition = 36,300	Steamboat = 2.6 South Wind River Deer = 1.4	Steamboat = 563,256 South Wind River Deer = 59,074	Steamboat = 4,000 South Wind River Deer = 13,000
Rocky Mountain Elk (*Cervus elaphus*)	Crucial winter range = 194,900 Parturition= 91,500	Steamboat = 2.6	Steamboat = 622,330	Steamboat[2] = 1,200
Pronghorn Antelope (*Antilocapra Americana*)	Crucial winter range = 81,500	Red Desert = 2.2 Sublette = 6.7	Red Desert = 79,700 Sublette = 542,630	Sublette = 48,000 Red Desert = 15,000
Moose (*Alces alces*)	Migrant	Lander = 2.7	Lander = 55,100	Lander = 450

[1]Population objectives are for entire herd unit area.
[2]Herd objective was reevaluated and changed from 500 in 2002.

Crucial habitat (winter range) for mule deer, elk, and antelope covers approximately 40 percent of the JMH CAP planning area. Crucial habitat is generally the component of a species habitat that has been documented as the determining factor in a population's ability to maintain itself at a certain level over the long term. The elk and mule deer winter range overlaps primarily in the south-central part of the planning area, whereas the antelope winter range is in the western portion. Birthing areas for mule deer and elk are also located in the planning area, with most of the birthing areas overlapping with the winter range (Map 51).

An area of big game habitat, the connectivity area, was established for the original JMH CAP draft EIS effort in 2000 to maintain habitat connectivity between important habitats within the planning area. The connectivity area (Map 51) is a key wildlife habitat area that connects and includes important big game habitats. The area includes topographic relief for escape cover, important year-round forage, crucial winter range, and birthing areas for a majority of the deer and elk populations. The area also allows for free movement of animals among the various habitat components and provides an important migratory corridor throughout the year. Maintaining the integrity of the area is considered paramount to sustaining viable big game herds and other wildlife populations. Elk populations are currently above objective

because of the current lack of development within the planning area and the lack of vehicular access to sensitive habitats during essential times of the year.

Water is a large factor in influencing big game distribution. Most mule deer activity within the planning area is dependent on its availability. Studies have shown that in arid regions during the driest months, mule deer seldom move more than 1 to 1.5 miles from water. Lack of surface water in some areas also influences migration of pronghorn antelope and their season of use on particular ranges.

3.1.6.1.1 Mule Deer

Mule deer population levels are currently below objective for both herd units within the planning area. Herds declined dramatically in the early 1990s following a series of drought years and a harsher than normal winter in 1992. Since 1993 populations have been gradually increasing. The 2002 WGFD population estimate for the Steamboat mule deer herd was 3,100. Fawn production has been lower than normal and mortality normal to slightly higher than normal because of the drought over the past 3 years and the colder than normal winters of 2000–2001 and 2001–2002. The 2001 WGFD population estimate for the South Wind River herd was 9,600 (WGFD 2003).

Winter range is a limiting factor for deer populations over much of their habitat, because shrubs, which make up approximately 75 percent of the winter diet, are covered by snow in many areas. Drought conditions and competition with elk for preferred birthing areas may also be affecting the overall population and mule deer fawning success.

3.1.6.1.2 Pronghorn Antelope

Pronghorn antelope populations of the herd units in the planning area are currently below objective. During the early 1990s, harvests of does and fawns were increased to regulate the increasing population, but the severe winter of 1992–93 and associated mortalities led to a significant reduction of doe and fawn harvest from 1994 to the present (USDI 199b).

WGFD estimates the 2002 population for the Sublette herd is at about 44,700, which is 7 percent below the objective of 48,000. For the past 3 years, drought conditions have led to lower reproduction and somewhat higher winter mortality. Fawn production in the Red Desert herd has been low for at least 10 years. WGFD herd models indicate the herd was still below objective size in 2002, even with reduced sales of doe/fawn licenses, but should be near objective in 2003 with average fawn production (WGFD 2003b).

Weather and availability of crucial winter range can be an important factor affecting population levels. Severe winters with deep, crusted snow and below-zero temperatures cause high antelope mortalities, and fences affect antelope movement with direct and indirect effects to mortality. Antelope habitat is generally represented by water and low-growth (2 to 3 feet) sagebrush in combination with rabbitbrush and bitterbrush.

3.1.6.1.3 Rocky Mountain Elk

The Steamboat elk herd is a unique component of the wildlife resources in the southwestern part of Wyoming. This elk herd exists in the sagebrush desert ecosystem, which contains very little conifer or aspen cover.

Historically, elk migrated to the planning area from Jackson, Wyoming, and Yellowstone National Park, with the last major migration occurring in 1913. Records indicate that this movement was so large that portions of the area were proposed as a winter elk refuge. Historical information shows a remnant

population of elk lived within the planning area until around 1940. Transplants to reestablish elk began in 1944 and continued until around 1967. These transplant efforts failed to restore the migration but did establish a resident elk herd.

Elk population estimates for the Steamboat herd unit area have varied over time. A population objective of 500 was first established in the early 1970s, then increased to 700 in 1977, then lowered to 500 in 1984. Current estimated population counts show that the herd is approximately at 1,600 elk (WGFD 2003). The WGFD reevaluated the herd objective for the Steamboat herd unit area in 2002 and increased it from 500 to 1,200 to better fit the increased herd unit area.

Most research on elk habitat utilization has been conducted in forested habitat because of limited elk populations in sagebrush-steppe habitats. It is known that elk habitat selection patterns are strongly influenced by security and thermal needs (Irwin and Peek 1979; Thomas et al. 1979), and therefore that disturbance may be a larger issue in an open environment than in a forested environment. In forested habitats, cover is provided by timber stands with vegetation types such as aspen (*Populus tremuloides*) and conifer species. This type of vegetation is severely limited within the JMH CAP planning area; therefore, the elk use scattered stands of tall sagebrush (*Artemsia tridentata*), aspen, and limber pine (*Pinus flexilus*), in addition to topography, for cover. This limited amount of cover seems sufficient for the elk as long as the level of human disturbance is low.

Approximately 175,000 acres within the planning area are classified as crucial habitat (winter range), and 91,500 acres are classified as elk birthing (calving) areas. Most of the birthing areas overlap with the winter range. Approximately 67 percent of the winter range and 86 percent of the birthing areas for the Steamboat elk herd unit are in the JMH CAP planning area.

An elk study within the JMH CAP planning area (Powell 2003), initiated in 1999, was conducted through the Wyoming Cooperative Research Unit, with funding from BLM, the Rocky Mountain Elk Foundation, and the WGFD. The objectives of the study were to document habitat use patterns of elk within the JMH CAP planning area and determine how the elk responded to human activities (Powell 2003). The study was a 3-year effort whose results include the following:

- Elk selected habitats offering security cover (tall sage and mountain shrub) during calving and summer seasons, and generally avoided habitats offering little security cover (dune, badlands, sage/grass).
- During winter and spring, elk used dune habitats less than expected and all others in proportion to their availability.
- During the fall, elk selected against sage/grass habitats and used all others in proportion to their availability.
- Elk in proportion to their availability throughout the year used aspen, mountain mahogany, riparian, and short grass habitat types.
- During summer, elk avoided areas within 2 kilometers (km) of active gas/oil wells, showed no preference for areas within 2 to 3 km of active gas/oil wells, and selected areas between 3 and 5 km from active gas/oil wells
- Elk avoided areas within 2 km of major roads and used areas 4 to 5 km from major roads more than expected.
- During the summer, areas within 2 km of wells and major roads received 73 percent less use than was expected.

- Vegetation composition of habitats did not differ among 500-meter bands adjacent to roads or wells.
- Forty-three percent of all locations within roadless areas occurred during the 2-month fall hunting season.
- Annually, 26.5 percent of all elk locations were in nonvisible areas. During the summer and winter, 31.1 percent and 21.5 percent respectively of elk locations were located in nonvisible areas.
- Daily movements of treatment elk (1 day after disturbance) were significantly greater than those of control elk and treatment elk for all days before and after being disturbed.
- Significantly fewer pellet groups were counted in disturbed calving areas than areas not disturbed (i.e., control areas).

Overall, the study concluded that elk typically avoided habitats offering little security cover; topography and screening cover by vegetation are important during daylight hours for providing security cover; habitat use patterns within the planning area are strongly influenced by roads making the habitat loss more than that of the actual road "footprint"; human disturbance led to increased daily movements of disturbed elk and reduced elk use in traditional calving areas; and although disturbed elk moved greater distances, they apparently did not move to areas that were poorer in terms of security or habitat quality.

To further understand elk behavior, BLM has initiated a new elk study. Twenty-nine female elk have been equipped with global positioning system collars, enabling monitoring of a representative sample of the Steamboat elk herd. The goal of the study is to determine how the elk are affected by development and various types of human disturbance, and at what threshold they abandon an area. This study is contracted out through the University of Wyoming Fish and Wildlife Cooperative Studies Unit and is in partnership with WGFD. The information derived from the study will be used to facilitate the implementation, monitoring, and evaluation management strategy (Appendix 17) recommended in the JMH CAP.

3.1.6.1.4 Other Mammals

Mountain lions have been observed in the Steamboat Mountain and Oregon Buttes areas; however, indications show that their distribution and abundance in the planning area is very limited. Although black bear and gray wolves have been observed in the planning area, such sightings are rare and likely involve migrating or displaced animals. Other mammals that may be present in the planning area include moose (*Alces alces*), coyote (*Canis latrans*), white-tailed jackrabbit (*Lepus townsendi*), mountain cottontail rabbit (*Sylvilagus nuttalli*), pygmy rabbit (*Brachylagus idahoensi*), porcupine (*Erethizon dorsatum*), raccoon (*Procyon lotor*), red fox (*Vulpes fulva*), swift fox (*Vulpes velox*), beaver (*Castor canadensis*), striped skunk (*Mephitis mephitis*), white-tailed prairie dog (*Cynomys leucurus*), various rodents, bats, and weasel (*Mustela spp*.).

3.1.6.2 Birds

Avian species in the JMH CAP planning area include waterfowl, upland game birds, raptors, shorebirds, and neotropical migrants.

3.1.6.2.1 Waterfowl

Most of the planning area lies within the Pacific Flyway, with a very small portion occurring within the Central Flyway. Most waterfowl located in the planning area are migratory, short-term occupants because of the lack of available open water and riparian cover. Nesting in the Pacific Flyway occurs below 8,500 feet and is dependent on cover in riparian areas. Nesting occurs within the planning area on the dunal ponds and in Pacific Creek and Oregon Slough areas.

Waterfowl use every form of available open water in the planning area, from flowing wells and stock ponds to playa lakes and potholes. Northern shoveler (*Anas clypeata*), gadwalls (*Anas strepera*), mallards (*Anas platyrhynchos*), pintails (*Anas acuta*) and teal (*Anas spp*.) are the most common summer resident species. Some species only migrate through the area on their way to breeding or nesting grounds farther north or to winter areas farther south. Other species, such as the Barrow's goldeneye (*Bucephala islandica*), are resident for only part of the year, wintering in western Wyoming.

3.1.6.2.2 Greater Sage-Grouse

Greater sage-grouse (*Centrocercus urophasianus*) are found throughout the planning area wherever suitable habitat exists. Greater sage-grouse were historically found in all 23 Wyoming counties, and it was commonly agreed that Wyoming sagebrush habitats supported more greater sage-grouse than any other state, particularly within the upper Green River Basin (Patterson 1952). However, since the early 1950s when R. L. Patterson conducted the first comprehensive greater sage-grouse research project in Wyoming within the Eden Valley and Dry Sandy-Pacific Creek areas, greater sage-grouse populations have been declining. Data collected in 2003 by the WGFD compared to data collected by Patterson (1952) from sage-grouse leks surveys in the planning area have shown a 70 percent decline in the numbers of males attending leks since 1952. If information from the adjacent private lands is included, the decline reaches 90 percent. Although no single or combination of causes have been proven, the decline in greater sage-grouse populations is thought to be attributed to a multitude of factors which include, but are not limited to: drought; oil and gas wells and their associated infrastructure; powerlines; mammalian and avian predators; and a decline in the quantity and quality of sagebrush habitat resulting from livestock grazing, range management treatments, and development activities (Connelly et al. 2000).

With current levels of greater sage-grouse population declines, six petitions to list the greater sage-grouse under the ESA have been submitted to the U.S. Fish and Wildlife Service (USFWS). Across the West, various state and federal agencies have stepped up monitoring and research efforts in an attempt to prevent the listing of the species. The Director of the BLM has issued a draft national BLM Sage-Grouse Habitat Conservation Strategy to address concerns over population declines. The primary purpose of the BLM strategy is to focus attention, resources, and actions on reducing potential threats to greater sage-grouse on BLM-administered public land. The BLM strategy will identify key actions to be taken at a national level to minimize or eliminate threats to greater sage-grouse, set time frames and identify the appropriate BLM offices responsible for implementation of the strategy, and task BLM State Directors to development and implement state-level greater sage-grouse habitat conservation strategies tiered to the national-level strategy. The final national BLM Sage-Grouse Habitat Conservation Strategy is scheduled to be out in 2004.

In June 2003 the Wyoming Game and Fish Commission approved the Wyoming Greater Sage-Grouse Conservation Plan. This plan was drafted by an inter-disciplinary team of 18 Wyoming residents. The plan provides an overview of issues affecting the greater sage-grouse in Wyoming and provides management recommendations to address those issues.

The State of Wyoming has also taken steps to address potential effects of hunting on greater sage-grouse populations. In an effort to reduce hunting pressure on productive hens and reduce overall harvest, the WGFD has shifted the opening day of greater sage-grouse season multiple times over the past 9 years. In 2000, the WGFD closed the Snake River drainage in western Wyoming and portions of southeast Wyoming in Platte, Goshen, Laramie, and southern Albany County to protect remnant greater sage-grouse populations on the periphery of the natural range. In 2002 and 2003, the WGFD reduced the length of the season from 16 days to 9 days, reduced the daily bag limit from three to two, and reduced the possession limit from six to four birds (WGFD 2003a).

The southwestern portion of Wyoming is considered well suited for greater sage-grouse because of the nature of the physical environment. The physiography of the Green River Basin has influenced the development and the daily and seasonal activity patterns of greater sage-grouse. In general, greater sage-grouse move to the foothills, riparian areas, or irrigated hay fields during the spring and summer and to dryer upland sites during the fall and winter. These seasonal movements have developed primarily as a result of the wide variation in the nature, amount, and distribution of water, and the availability of sagebrush for nutritional and shelter requirements. The physical characteristics of sagebrush vary, providing the essential elements of greater sage-grouse habitat. Sagebrush ranges from a low, prostrate shrub a few inches in height found on dry, rocky sites to a bushy tree-like plant found on moist, sandy soils along watercourses.

The reproductive characteristics and habits of greater sage-grouse significantly limit their adaptability to human disturbance and habitat alteration. Birds can return to historic "strutting grounds" or breeding complexes as early as February. Strutting grounds, referred to as "leks," may be located at a point intermediate between the winter range and summer range or, in some cases, the summer and winter range may be the same area (Map 17). Leks are usually small open areas from 0.1 acre to 10 acres in size, but they may be as large as 100 acres or more. Snow conditions play a part in the suitability of an area for strutting, as does the amount of vegetation. The lek is generally in an area supported by low, sparse vegetation or in open areas surrounded by sagebrush, which provides escape, feeding, and cover (Connelly et al., 2000). The sparse vegetation around lek locations allows the opportunity for males to be seen by hens from further distances. Peak breeding season is early to mid-April. Birds are active in courtship displays during early morning darkness until sunrise. On overcast or foggy days, strutting grounds may remain active until midmorning. Strutting can take place all night during full moon periods.

Recent radiotelemetry data gathered by Rocky Mountain Energy biologists show that some grouse move up to 11 miles to nest, while most range 1 to 4 miles. Studies conducted by the University of Wyoming Cooperative Research Unit have consistently shown that the most successful nests are located beyond 2 miles (Anderson 1999). Nesting site selection is critical for successful reproduction. The availability of tall, dense grass cover combined with tall shrubs at nest sites decreases the likelihood of nest depredation (Heath et al. 1997). Results from Lyon 2000 demonstrated that hens have strong fidelity to nesting areas. Although none of the hens observed nested under the same sagebrush bush, the average distance between consecutive years' nests was 683 meters (2,240 feet). It is believed that fidelity to nesting areas may serve to increase fitness by reducing the risks associated with the uncertainty of unfamiliar nesting habitat (Heath et al. 1997).

Lek, nesting, and early brood-rearing habitat within the planning area for greater sage-grouse was delineated by BLM, in coordination with the WGFD, using the best available habitat data for the planning area including new locations, historical locations of leks, and vegetation characteristics derived from enhanced satellite images and professional knowledge of the area. This effort constituted an initial evaluation of potential habitat. Additional habitat evaluations will occur as part of the implementation, monitoring, and evaluation management strategy (Appendix 17) using suitable habitat characteristics as

defined in Table 3-14. Delineation of this habitat was also part of a greater effort by the WGFD to delineate sage-grouse habitats throughout the state. BLM is also evaluating new information received from WGFD and will incorporate it into the implementation, monitoring, and evaluation management strategy.

Table 3-14. Characteristics of Sagebrush Rangeland Needed for Productive High Quality Greater Sage-Grouse Habitat in Wyoming

Greater Sage-Grouse Habitat (Period of Use)	Sagebrush[a]		Perennial Grass/Forb		Residual Grass Cover		Area[f]
	Height (in.)	Canopy Cover (%)[b]	Height (in.)	Canopy Cover (%)	Height (in.)	Canopy Cover (%)	
Leks/Breeding (March–May)	Typically an open area surrounded by potential nesting habitat. A common feature is less shrub and herbaceous cover than surround habitats.						
Nesting/Early Brood-Rearing Habitat (March–July)	12–32	15–25	>7[c]	>13[d]	4–5	>3[e]	>80%
Late Brood-Rearing Habitat (July–October)	12–32	10–25	Variable (4" min.)	>13	N/A	N/A	>40%
Winter Habitat (November–March)	10–14	10–30	N/A	N/A	N/A	N/A	>80%

[a]Live plants
[b]Canopy coverage for sagebrush is defined as the percentage of ground covered by a vertical projection of the outermost perimeter of the natural spread of foliage of the plant. Small openings in the canopy are included.
[c]Measured as "droop height" of leaves; the highest naturally growing portion of the plant.
[d]Cover should be composed of approximately 60% perennial grasses and 40% for forbs; percentage of canopy cover should be substantially higher if most sagebrush has growth that provides little lateral cover (Schroeder 1995). Mesic sagebrush site herbaceous cover should exceed 15% for perennial grasses and 10% for forbs.
[e]Residual perennial grass canopy cover should equal or exceed 3% of the total vegetative cover.
[f]Percent of seasonal habitat for greater sage-grouse population needed with indicated conditions.
Sources: Connelly et al. 2000; Holloran 1999; Lyon 2000; Heath et al. 1997.

While greater sage-grouse generally return to traditional wintering areas before heavy snowfall, suitable winter habitats require sagebrush 10–14 inches above snow level with canopy covers that range from 10 to 30 percent. Winter foraging areas tend to be gentle southwest facing slopes and windswept ridges, and roosting takes place in open, low sagebrush sites on clear, calm nights, and in taller shrubs with greater canopy cover during windy periods or during snowstorms. Greater sage-grouse will fly considerable distances (>5 miles) and elevations (>1,000 feet) between winter feeding sites and suitable snow roosting sites and burrow in deep powdery snow to conserve energy. During severe winters, the amount of suitable available winter habitat is greatly reduced. Severe winter habitat may or may not be considered crucial habitat. Some severe winter habitat may be essential and used to a great extent during severe winters, while others may only be used occasionally (WGFD 2003). Wintering grounds are potentially the most limiting seasonal habitat for greater sage-grouse (Lyon 2000).

In February 2002, the Rock Springs BLM conducted aerial surveys (by helicopter) north of Rock Springs to obtain needed information on greater sage-grouse wintering areas. The survey area was chosen based on professional knowledge of BLM and WGFD biologists and information from previous studies such as Patterson (1952). Approximately 3,000 square miles were flown at low altitudes in a grid pattern to determine areas of winter use by greater sage-grouse. Approximately 2,758 birds were located.

As a result of these surveys BLM, in coordination with the WGFD, delineated winter range for greater sage-grouse (Map 17). Winter range designation was based on new aerial locations, historical locations

of wintering greater sage-grouse, and vegetation characteristics derived from enhanced satellite images and professional knowledge of the area. For winter habitat characteristics, see Table 3-14.

3.1.6.2.3 Raptors

There are 20 different species of hawks, eagles, and owls that are nesting, assumed to be nesting, or that have the potential of nesting in the planning area (Map 17). Other species are wintering populations, migrants, or possible migrants. Approximately 70 percent of the planning area has been surveyed for nesting raptors. In 1979, about 40 percent of the planning area was surveyed for "special habitat features," with most potential cliff-nesting habitat identified. A raptor inventory was conducted from 1980 to 1981 by BLM biologists and survey crews to satisfy coal leasing suitability criteria. Raptor surveys are currently driven by specific development projects, and data are collected to determine raptor management conflicts. Raptor species commonly seen in the planning area and their respective habitats are shown in Table 3-15.

Table 3-15. Raptor Species

Common Name	Scientific Name	Habitat
Prairie falcon	*Falco mexicanus*	Low rock outcroppings to tall vertical cliffs (Rock Springs Uplift, Steamboat Mountain)
American kestrel	*Falco sparverius*	Dead snags, clay streambanks, rimrock
Ferruginous hawk	*Buteo regalis*	Low cliffs, buttes, tresses, on the ground, artificial nesting platforms, sheepherder monuments
Red-tailed hawk	*Buteo jamaicensis*	Riparian zones and timbered areas
Swainson's hawk	*Buteo swainsoni*	Dry plains, open foothills, open forest, sparse trees, river bottoms
Northern harrier	*Circus cyaneus*	Wetlands and open fields
Burrowing owl	*Athene cunicularia*	Grasslands and mountain parks near prairie dog towns and steppes, deserts, and prairies
Raven	*Corvus corax*	Mountains and deserts
Golden eagle	*Aquila chrysaetos*	Cliffs, ledges, pinnacles
Great-horned owl	*Bubo virginianus*	Cliff holes, rock crevices, trees

3.1.6.3 Aquatic Species

Aquatic wildlife in the planning area is found primarily in the waterways that cross through the area. Coldwater game fish exist in some portions of the waterways except Jack Morrow Creek, which contains only nongame species. Amphibian species such as the Great Basin spadefoot toad (*Spea intermontana*), spotted frog (*Rana pretiosa*), and tiger salamander (*Ambystoma tigrinum*) are located within ponds, spring seeps, and permanent and temporary waters within the planning area. Ponds or lentic habitats, locally referred to as the dunal ponds or flockets, are found in the sand dunes region of the planning area. Table 3-16 lists the waterways with fish life within the planning area.

Table 3-16. Waterways and Fish Species

Fish Species	Sweetwater River[1]	Harris Slough[2]	Oregon Slough[2]	Pacific Creek[2]	Jack Morrow Creek[3]
Rainbow trout (*Oncorhynchus mykiss*)	X				
Brown trout (*Salmo trutta*)	X	X			
Brook trout (*Salvelinus fontinalis*)	X	X	X	X	

Fish Species	Sweetwater River[1]	Harris Slough[2]	Oregon Slough[2]	Pacific Creek[2]	Jack Morrow Creek[3]
Yellowstone cutthroat (*Oncorhynchus clarki bouvieri*)	X				
Snake River cutthroat (*Oncorhynchus clarki subspecies*)	X				
White sucker (*Catostomus commersoni*)	X		X	X	X
Longnose sucker (*Catostomus catostomus*)	X		X		
Mountain sucker (*Catostomus platyrhynchus*)	X			X	X
Flannelmouth sucker (*Catostomus latipinnis*)				X	
Creek chub (*Semotilus atromaculatus*)	X		X		
Lake chub (*Couesius plumbeus*)	X		X	X	X
Longnose dace (*Rhinichthys cataractae*)	X				
Fathead minnow (*Pimephales promelas*)	X			X	X
Redside shiner *(Richarsonius balteatus*)				X	X
Speckled dace (*Rhinichthys osculus*)				X	X
Utah chub (*Gila atraria*)					X

[1]WGFD Classification 3: Important trout water; fisheries of regional importance.
[2]WGFD Classification 4: Low production trout waters; fisheries frequently of local importance but generally incapable of sustaining substantial fishing pressure.
[3]WGFD Classification 5: Very low production waters.

The Sweetwater River represents the highest-value coldwater fishery in the planning area, with water quality generally suitable for most other aquatic organisms. Overall quality tends to decline as conductivity, temperature, and turbidity levels progressively increase across the desert plains. Lack of full bank development and an adequate riparian shade canopy also result in a progressive deterioration of fish habitat downstream.

The portion of Pacific Creek above state lands has brook trout and fair pool habitat. Spawning potential is limited, but bank protection and cover are better than in lower reaches of the creek, where bank instability, poor habitat, and high summer temperatures limit salmonid spawning. Sixty to 100 percent of the bottom is silted, making the lower reach most suited to cyprinids, which populate the lower half of the creek.

Spring sources on Steamboat Mountain feed Jack Morrow Creek, which flows northwest to its confluence with Pacific Creek. Jack Morrow Creek is not suitable for salmonids because of low flows that only maintain pool habitat in the lower 10 miles, but it provides suitable habitat for nongame fish, mostly minnow species.

Water flowing into the Green River Drainage is considered a direct contributor to the habitat for four endangered fish species in the upper Colorado River. Water flowing into the Platte River Drainage (including the Sweetwater River) is also considered a direct contributor to T&E species using the Platte River in Nebraska. Although no T&E aquatic species have been identified within drainages of the planning area, all water withdrawals from these tributaries are considered to adversely affect these species and require ESA Section 7 consultation with the USFWS. Water depletions and their effect on protected species are discussed in the Biological Assessment (Appendix 3).

3.1.6.4 Reptiles

Reptile species within the planning area are primarily located among rocky outcrops, cliffs, and boulders. Species include the short-horned lizard (*Phrynosoma douglassii*) and sagebrush lizard (*Sceloporus graciosus*).

3.1.6.5 Special Status Wildlife Species

Special status wildlife species include species federally listed as T&E, proposed for listing, or candidates for listing under the ESA. They also include species designated by each BLM State Director as sensitive and those listed or proposed for listing by a state in a category implying potential endangerment or extinction. BLM is mandated to protect and manage threatened, endangered, candidate, proposed, and sensitive wildlife species and their habitat. BLM is also required to protect and manage sensitive species jointly identified with the appropriate state agency. The State of Wyoming does not have an official list of sensitive, threatened, or endangered wildlife species.

3.1.6.5.1 Federal Threatened, Endangered, and Candidate Species

Two wildlife species protected by the ESA have the potential to occur within the planning area. These species are listed in Table 3-17 and described further in the Biological Assessment (Appendix 3).

Table 3-17. Threatened, Endangered, and Candidate Wildlife Species that May Occur in the Planning Area

Common Name	Scientific Name	Federal Status	Occurrence in Planning Area
Bald eagle	*Haliaeetus leucocephaulus*	Threatened	Casual migrant
Black-footed ferret	*Mustela nigripes*	Endangered	Historical sightings and potential habitat exists
Western population yellow-billed cuckoo	*Coccyzus americanus*	Candidate	Unknown
Gray wolf	*Canis lupus*	Nonessential Experimental Population	Historical occupancy and two recent confirmed sightings (Moody, WGFD 2003)
Grizzly bear	*Ursus arctos horribilis*	Threatened	Historical occurrence

Source: USFWS, Jack Morrow Hills Updated Species List, January 2, 2002

Bald eagles are found primarily along rivers and inland lakes, where their nests are usually located in large coniferous or deciduous trees. Streams and rivers with trees, especially conifers, are uncommon to nonexistent in the planning area. The bald eagle is classified as a casual migrant in the planning area and has been observed feeding on carrion near Pacific Butte and Jack Morrow Creek. Currently the only known active bald eagle nesting site near the planning area is on the Green River on Seedskadee National Wildlife Refuge. Bald eagles are known to occupy winter roosts in the cottonwood trees in the communities of Farson and Eden on private lands.

Historical documentation indicates the presence of black-footed ferrets in the Farson/Eden area adjacent to the planning area as late as 1984. Other areas where ferrets are presumed to have occurred are Sublette Flats, Seedskadee National Wildlife Refuge, and the Red Desert. Potential areas of ferret habitat can be delineated because of their association with prairie dogs and prairie dog colonies. Few formal surveys and inventories of prairie dogs have been conducted in the planning area.

Whooping cranes from the Gray's Lake flock were observed in the Rock Springs Field Office area in the late 1980s and early 1990s. In 1986, a lone whooping crane was observed on several occasions near Farson. The USFWS captured the bird to be used for mating with the Gray's Lake flock. During the summers of 1987 and 1988, a pair of whooping cranes were observed near Farson in crop fields and wetlands. Two observations of whooping cranes were made along Pacific Creek wetlands in 1991 and 1992. There have been no observations of whooping cranes in western Wyoming since 1992 and the last bird of the Gray's lake flock is believed to have died. The bird is now considered extirpated from western Wyoming (FWS 2003).

The western population of yellow-billed cuckoo inhabits open, streamside deciduous woodland with low scrubby vegetation and generally prefers cottonwood stands for foraging and willow thickets for nesting. This type of habitat does not exist within the planning area, which has no cottonwoods and only small thickets of coyote willow near the Sweetwater River. Formal surveys have not been conducted, and no reported sightings of cuckoos have occurred within the planning area.

The gray wolf historically occupied nearly all habitat types in North America including the planning area. Under current federal management by the USFWS, any wolves occurring in the planning area would be removed if they cause conflicts with other land management activities.

The grizzly bear historically inhabited the planning area around the Sweetwater River and Pacific Creek as reported in historical journals (Dorn). Under current federal (USFWS) and state (WGFD) management, any grizzly bears found in the planning area would be removed if they cause conflicts with other land management activities.

3.1.6.5.2 Wyoming BLM Sensitive Wildlife Species

Similar to the discussion of BLM sensitive plant species, the IM also lists Wyoming BLM sensitive wildlife species and management policy. The policy emphasizes preventing the need to list species under the ESA, avoiding or minimizing adverse impacts, and addressing these species through planning and management activities. Table 3-18 lists the Wyoming BLM sensitive wildlife species that may inhabit the planning area.

Table 3-18. Wyoming BLM Sensitive Wildlife Species

Common Name	Scientific Name	Habitat
Mammals		
Long-eared myotis	*Myotis evotis*	Coniferous forests; roosts in caves, buildings, or mines near a body of water
Fringed myotis	*Myotis thysanodes*	Elevations less than 7,500 feet in forests and shrublands
Spotted bat	*Euderma maculatum*	Desert and coniferous habitats
Townsend's big-eared bat	*Corynorhinus townsendii*	Coniferous forest; desert shrubland
Pygmy rabbit	*Brachylagus idahoensis*	Big, dense sagebrush
White-tailed prairie dog	*Cynomys leucurus*	Plains
Wyoming pocket gopher	*Thomomys clusius*	Dry ridgetops; gravelly, loose soil; greasewood
Idaho pocket gopher	*Thomomys idahoensis*	Stony, shallow soil
Swift fox	*Vulpes velox*	Shortgrass prairie
Avian		
Ferruginous hawk	*Buteo regalis*	Basin-prairie shrub, grassland, rock outcrops
Peregrine falcon	*Falco peregrinus*	Tall cliffs
Greater sage-grouse	*Centrocercus urophasianus*	Basin-prairie shrub, mountain-foothill shrub
Long-billed curlew	*Numenius americanus*	Grasslands, plains, foothills, wet meadows
Burrowing owl	*Athene cunicularia*	Grasslands, basin-prairie shrub
Sage thrasher	*Oreoscoptes montanus*	Basin-prairie shrub, mountain-foothill shrub
Loggerhead shrike	*Lanius ludovicianus*	Basin-prairie shrub, mountain-foothill shrub
Dwarf shrew	*Sorex nanus*	Mt foothills, shrub/grasslands, and greasewood flats
Mountain plover	*Chadrius montanus*	Areas of low vegetation
White-faced Ibis	*Plegadis chihi*	Marshes and wet meadows
Brewer's sparrow	*Spizella breweri*	Basin-prairie shrub
Sage sparrow	*Amphispiza billineata*	Basin-prairie shrub, mountain-foothill shrub
Fish		
Roundtail chub	*Gila robusta*	Colorado River drainage; mostly large rivers, streams, and lakes
Bluehead sucker	*Catostomus discobolus*	Colorado River drainage; large rivers, streams, and lakes
Flannelmouth sucker	*Catostomus latipinnis*	Colorado River drainage; large rivers, streams, and lakes
Amphibians		
Great Basin spadefoot toad	*Spea intermontana*	Springs; seeps; permanent and, temporary waters
Spotted frog	*Ranus pretiosa*	Ponds, sloughs, small streams

Source: Wyoming BLM Sensitive Species Policy and List, IM No. WY-2001-040, April 9, 2001.

3.1.6.6 Species of Concern

The Wyoming Natural Diversity Database lists other wildlife species of concern that occur within the planning area (Appendix 11). These species are lacking formal federal or state status or protection but are potentially threatened within the ecosystem.

3.2 HERITAGE RESOURCES

Heritage resources are archaeological, historical, paleontological, and Native American items, places, or events considered important to a culture, community, tradition, religion, or science. Archaeological and historic resources are locations where human activity measurably altered the earth or left deposits of physical or biological remains. Examples of prehistoric resources include arrowheads and other stone tools and debris from tool making, fire hearths, hunting and gathering camp locations, Native American trails and rock art sites, whereas examples of historic resources include livestock tending camps, pioneer roads and trails, and homesteads. Paleontological resources include vertebrate, invertebrate, and plant fossils. Places of concern to Native Americans societies include religious ceremonial areas, sacred places, including burial grounds and other places essential for the preservation of Native American traditional cultures.

The planning area is named after Jack Morrow, who had the reputation of being a common thief, swindler, and gunfighter. Although only limited formal cultural resources inventory has been conducted in the planning area, several significant resources and some important patterns of spatial distribution of archaeological resources have been identified (Map 64). Important historical resources and localities important to Native Americans have also been identified.

Legislative mandates require that cultural resources be considered during all undertakings on BLM land and that proposed land uses initiated or authorized by BLM avoid inadvertent damage to federal and nonfederal cultural resources. Authority to protect heritage resource sites is prescribed by numerous legislative mandates (Section 1.6.5), of which the National Historic Preservation Act (NHPA) of 1966, the Antiquities Act of 1906, the National Trails System Act of 1968, the American Indian Religious Freedom Act (AIRFA) of 1978, and the Archaeological Resources Protection Act (ARPA) of 1979 are a few of the key statutes.

Furthermore, Section 110 of the NHPA requires federal agencies to take a proactive role in identifying, evaluating, and nominating historic places for inclusion in the National Register of Historic Places (NRHP). Although funding for Section 110 work has been quite limited, the BLM has taken a number of steps to ensure proactive management such as identification, marking and interpretation of historic trails, designation of ACEC related to historic places including the South Pass National Historic Landscape ACEC and the White Mountain Petroglyphs ACEC, and identification of a number of places of concern to Native Americans and consultation with tribal representatives regarding those resources.

BLM has also strengthened its ongoing partnerships with the Wyoming State Historic Preservation Office (SHPO), and with several Native American tribes, to improve its appreciation of the contextual framework within which historic properties are evaluated. Historic properties are identified by several means including consultations, historical literature review, and on-the-ground inventory. As historic properties are identified, they are integrated into the SHPO data set for future reference and consideration in planning processes.

3.2.1 Historic Trails

The National Park Service administers congressionally designated National Historic Trails found in the planning area (Map 64). However, management of federal lands containing congressionally recognized trails is left to those agencies that have jurisdiction over the lands on which the trails occur (in this case BLM). BLM approved the Oregon/Mormon Pioneer National Historic Trails Management Plan in 1986, which governs management of these resources. BLM is preparing a statewide National Historic Trails context study to help identify and manage significant historic trail resources. BLM is also in the process

of consulting with the SHPO and National Park Service concerning additional guidance for management of these resources.

3.2.1.1 South Pass

Beginning in the winter of 1812–1813, the South Pass, located in the northeastern part of the planning area (Map 64), "became indelibly written in the annals of American history" (Devoto 1943). The gradual ascent of South Pass from the east along the Sweetwater River provided a relatively easy route across the towering Rocky Mountains. South Pass would allow hundreds of thousands of emigrants to move from the nation's eastern seaboard and central prairies to the fertile farmlands of western coastal valleys and rich hardrock mining bonanzas throughout the west. Historically, South Pass was used first by fur traders for easy entry into the river basins of the central Rocky Mountain region. Eventually over one-half million people and probably five times that many livestock traversed South Pass in their migration to the west coast. In 1959, Congress designated the South Pass National Historic Landmark in recognition of the importance of the pass to the pioneer migrations across the American west.

3.2.1.2 Oregon and California Trails

The drive to settle the Pacific Northwest and California would eventually give the United States an upper hand in control of territory claimed by the British Empire and the newly independent nation of Mexico. Beginning in 1838, people moved into Oregon to claim fertile farmlands in the Willamette Valley. Meddling in local political affairs by American citizens living in Mexico's territory of Alta California soon resulted in California's fall under the influence and eventual political domination of the United States. The discovery of gold near Sutter's Fort in northern California and the resulting swarm of settlers during the gold rush of 1849 for all intents and purposes cemented California's future as an American possession. The Oregon Trail and California Trail, which are located in the same corridor over South Pass and pass through about 20 miles of the planning area, were designated by Congress as National Historic Trails in 1978 and 1992, respectively.

3.2.1.3 Mormon Pioneer Trail

In 1847, pioneers of the Church of Jesus Christ of Latter-Day Saints, better known as Mormons, traveled over South Pass to settle in the valley of the Great Salt Lake in present-day Utah. This was the beginning of the migration of more than 70,000 Mormons and the colonization of the vast area that was to be known as Deseret. Eventually Mormons came to dominate the economy and politics of what would eventually become the states of Utah and Nevada, as well as significant portions of present-day Idaho, Wyoming, Arizona, and even California. The pioneer route of the Mormon Trail, used by Brigham Young's initial party in 1847, was designated a National Historic Trail by Congress in 1978. Within the planning area, the Mormon Pioneer Trail is located in the corridor over South Pass.

3.2.1.4 Pony Express Trail

The Pony Express route was designated a National Historic Trail in 1992 in recognition of its significance, but more so because of the romance of this short-lived operation that carried the United States mail from settlements in the East to the west coast during the Civil War. This helped to preserve political control over western regions by the United States Government. Within the planning area, the Pony Express Trail is located in the corridor over South Pass.

3.2.2 Native American Sites

University of Wyoming professor emeritus George Frison (1971) postulates that pottery recovered from the Eden-Farson site (Section 3.2.4.3) was made by Shoshone people. It is known that several Native American tribes, in addition to the Shoshone, were also present in the region in the late 18th and early 19th centuries, including the Ute, Bannock, Crow, Blackfoot, and to a degree the Arapaho. Tribes from the Northern Plains, Great Basin, and Columbia Plateau, as well as European Americans participated in fur trade rendezvous held along the Green River, located within 100 miles of the planning area. It is also likely that other groups, including Athapaskan-speaking ancestors of the modern-day Navajo and Apache people of the Southwest, passed through this region only a few hundred years before Europeans arrived in North America.

The White Mountain Petroglyphs site, located in the southwest corner of the planning area, contains historic and prehistoric images carved into rock. Images of human figures in several different styles may indicate some time depth to the site, although all the rock art is thought to have been drawn in the past 500 or so years (Tanner and Vlcek 1995) during what archaeologists call the Firehole Phase. Native American traditional elders have expressed interest in the White Mountain site and several other rock art locations in the greater Killpecker Creek area. At the request of tribal elders, the exact locations of sensitive Native American sites and the religious practices they may represent are kept confidential to protect them.

Several times during consultations, both tribal councils and elders pointed out the importance of wildlife, especially elk in the Jack Morrow Hills area. The time depth of Native American appreciation of the Steamboat elk herd seems evident at White Mountain Petroglyphs. A number of renditions of elk are depicted in an amplified scale compared to warriors on horseback, bison, tipis and other features. The fact that these drawings of elk are very detailed, and that they are roughly five times larger than people and other animals depicted at the site, reinforces the contention by modern Native Americans that the Steamboat elk herd has long been important to Native American people of the area.

The unique setting of mountain vistas, volcanic cones, and flat top mesas against a backdrop of white drifting sand dunes provides a spiritual experience for Native Americans. Several areas are identified as having landscape characteristics that typically are associated with respected sites. Although these areas have been roughly delineated, no attempt has been made to identify specific sites that may be of concern to traditional Native American peoples. Traditional elders have expressed interest in several landforms, including Killpecker Sand Dunes, Steamboat Mountain, Steamboat Rim, White Mountain Rim, Essex Mountain, Monument Ridge, and Boars Tusk within the planning area; the North and South Table Mountains and the Leucite Hills immediately to the south of the planning area; and Pilot Butte west of the planning area. Consultation visits with traditional elders indicate that these landmarks and the landscape vista of which they are a part are associated with the physical remains of a number of respected places associated with Native American religious practices.

The term “respected places” was first used by a Shoshone source to describe places that are of interest to individual tribal members and should be respected by them. These places are not high profile places but rather are often simply a few rocks in a pile on a ridge, or something similar. The term can also encompass a broad range of physical features including stone cairns, alignments such as medicine wheels, and rock art sites. For some Shoshone, the term “respected place” would apply to any place with any evidence of ancient habitation. A respected place may indicate where a single Native American, at some time in the distant past, may have made a prayer or an offering, or it may mark the place of a significant event in this individual’s life. Respected places, therefore, are not always significant to the entire tribe; however, upon seeing the feature, tribal members would respect the place because it was important to the individual who created it. Some relationship of these features to natural landscapes such as mesas is

recognized by Native American sources but the precise nature of this association is presently not well understood. Research is continuing into these connections between culture and landscape.

Many respected places known to the BLM are not identified in the JMH CAP because they are often very small, inconspicuous features and are extremely vulnerable to destruction. These places are therefore identified by BLM specialists only on a need-to-know basis when they are near a proposed BLM action. In these cases, BLM consults with tribal representatives and often takes steps to protect these locations even though they often would not qualify for the NRHP under any of the criteria in NRHP guidelines, as sacred sites under the AIRFA, or under the provisions of the much less defined terms in E.O. 13007.

Consultation with the Wyoming State Historic Preservation Officer indicates that there is not enough information to determine which of these respected places may be NRHP eligible Traditional Cultural Places (TCP) or sacred sites as defined under AIRFA and E.O. 13007. TCPs are properties associated 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 (USDI, 1998c). Even though some of these sites may not qualify as TCPs, BLM believes they do qualify for the National Register under Criteria A, because their apparent antiquity and complexity indicate a level of "association with events, activities, or patterns" important in American history. These sites also often contain huge amounts of information regarding Native American cultures, and therefore BLM believes they also qualify for the NRHP under Criteria D. The BLM has conducted considerable research into these issues over the past 15 years, and this historical information has been presented in several forums including academic publications and conference papers.

Sacred sites are specific, discrete, narrowly delineated locations on federal land that are identified by a Native American tribe, or Native American individual determined to be an appropriately authoritative representative of a Native American religion, as sacred by virtue of their established religious significance to, or ceremonial use by, a Native American religion. E.O. 13007 requires that the tribe, or the authoritative tribal representative, inform the federal agency of the importance of the site. This guidance generally requires a location to have some degree of ongoing use over time by more than a few Native peoples; therefore, the identification of a feature as having possibly been used by an individual or even a family at some time in the past probably does not qualify the place as a sacred site. Nearly all of the sites described in this section, and otherwise known in the planning area, were identified first by BLM archaeologists or consulting archaeologists who made Native Americans aware of them. The net effect has been that tribal authorities are now aware of specific places that associate with places known only vaguely from tribal traditions and oral history and most important tribes are now using these places in their attempts to revitalize their culture and religions and to increase the self-esteem of tribal young people.

3.2.2.1 Indian Gap

A site of concern to traditional Native American elders is the historic Native American Trail between the Ute Reservation in Utah and the Eastern Shoshone Reservation in the Wind River Basin. The name "Indian Gap Trail" was derived from the gap between Essex Mountain and Steamboat Mountain through which the trail passes. The precise antiquity of the trail is unknown, but historical records show the trail on the 1884 General Land Office plat for the area known as Indian Gap, and it is mentioned by a Native American historian as having been used until about 1906. Another source advised that Shoshone traveled the trail to haul coal from Rock Springs to their reservation at Fort Washakie in the early years of the 20th century. The Indian Gap Trail is a significant historic resource and may or may not also be a Traditional Cultural Property. To date, aerial reconnaissance has revealed a potential route of the trail; however, the route has not been verified on the ground, nor has it been mapped.

3.2.2.2 Native American Consultation

The AIRFA and the NHPA are procedural statutes requiring agency officials to take into account concerns of Native Americans regarding management of places of concern for religious, cultural, or historical reasons. These laws encourage a proactive consultation process between agency officials and Native American representatives. However, the legislation also recognizes that agency officials will not always be able to completely accommodate the wishes of Native American peoples.

The intent of consultation efforts is to foster respectful discussion aimed at resolving potential conflicts by avoiding areas of concern or by developing mitigation strategies that will lessen adverse effects to the extent possible. Both the AIRFA and the NHPA recognize that total avoidance of areas of concern will not always be possible; however, the laws and their implementing regulations encourage federal agencies to accommodate the needs of Native American peoples, especially where religious practices are concerned, to the extent possible without violating existing laws, regulations, and other preexisting mandates. While the BLM acknowledges the requirement to consult with tribes, it is also incumbent upon tribal representatives to bring places of concern to the attention of BLM officials.

Native American consultation with tribal elders is appropriate when identifying resources that may be important to tribal people represented by those elders. Consultation efforts have developed between the tribal governments of the Eastern Shoshone Nation, Uintah-Ouray bands of the Northern Ute Tribe, Shoshone-Bannock Tribes, and Northern Arapaho Tribe and the BLM Rock Springs Field Office. In some cases other tribal entities may also be involved in consultation with BLM.

BLM specialists have done extensive historical, ethnographic, and archaeological research into the Native peoples who occupied the Green River Basin in the past 10,000 plus years to identify the appropriate tribes to consult. Naturally, knowledge of more recent (e.g., the protohistoric period) human habitation of the area is far more developed than the understanding of prehistoric times.

This research indicates that three of the four tribes BLM consults with most extensively (e.g., the Ute-Aztecan-speaking Eastern Shoshone, Shoshone-Bannock, and Ute) have the greatest time depth in this region. The Northern Arapaho are known to have been in the area on a less continual basis for some time but not to have had the high degree of affinity with the area that the Shoshonean groups had.

Since at least the mid-nineteenth century, the Arapaho have been in the area and they are known to have contested to some degree with the Shoshone groups for control of the area. It is expected that Arapaho use of the area increased after they came to the Wind River Reservation in 1878. Before that time there was occasional Arapaho presence in the area often times for the purpose of raiding and warring with the Shoshone. The Arapaho presence in the JMH CAP planning area was likely never as strong or continuous as the Shoshone groups.

The Crow similarly contested for this area to some degree over many years in the past. The Crow also were integral partners in a cursorily documented trade relationship with the Shoshone groups. Indeed, many historians and anthropologists suggest a trading network covering the entire American West. Most believe a central foci of this network was centered in the Green River Basin where Ute (and later Comanche) traders brought horses acquired in the Southwest to trade with their Shoshone cousins who in turn traded them with Crow intermediaries who eventually traded with Mandan, Hidatsa, and other Lakota groups in the Missouri River Basin to the Northeast. At no time is it believed that the Crow had an extensive and permanent presence in the Green River Basin. The Crow, it could be argued, did have a considerably greater affinity with the Wind River-Big Horn Basin regions to the north where they contested for control of the area with the Shoshone and perhaps other groups, including at times the Blackfeet.

Likewise, the Blackfeet were present at times in the Green River Basin, sometimes trading, but more often warring with Shoshone occupants of the region. The Blackfeet presence in the area is probably somewhat earlier than extensive Crow presence. The Blackfeet are known to have been involved in the fur trade early in the eighteenth century, and at times they traded, especially for horses, with Shoshone. At that time and well into the nineteenth century there was much raiding among tribes across the West, mostly in quest for horses and all the power (real and ideological) that horses brought to the Plains Indian and Columbia Plateau cultures, which reached their zenith in the nineteenth century.

Between 1824 and 1840, EuroAmerican fur traders connected with the probably already long established trade network, and the famous fur trade rendezvous developed. Much of the fur trade during those years was centered in the Green River Basin attracting members of numerous tribes to the region for varying durations. Participants in the fur trade included individuals from almost every tribe in the American (and indeed Canadian) West. If anything, the tribes of the Columbia Plateau (Nez Perce, Flathead, Cayuse, et al.) were more strongly represented in this process than most of the Plains tribes (e.g., Cheyenne, Arapaho, and Lakota). The Blackfeet, while present, were probably represented somewhat less than the Plateau groups, the Crow, and the resident Shoshone societies.

These many other groups' presence in the Green River Basin was never permanent and each group always maintained stronger affinity with other regions of the West. Based on this knowledge, the BLM offices in the Green River Basin consult most extensively with the Eastern Shoshone, Shoshone-Bannock, Ute, and Arapaho tribes that BLM believes had substantial historic occupancy of the region. According to BLM guidance, tribes that had a "short-term or transitory use of the lands" (i.e., the Green River Basin) are not to be the primary focus of consultation efforts. Nonetheless, efforts have been made to reach out to other groups such as the Medicine Wheel Alliance.

The Comanche have long been recognized as closely related to the Eastern Shoshone, but only recently has the continuity of their presence in the Green River Basin been identified. This recognition resulted from BLM-initiated investigations of a rock art site in the Rock Springs Field Office area, though some 25 miles south of the JMH CAP planning area. When the level of Comanche presence in the area and the potential for Comanche sites in the area were recognized (in 2001), the BLM began to invite them to participate in consultation processes more often. Unfortunately, their present-day location in Oklahoma may somewhat limit their participation in these processes. This is partly because departmental policy does not allow the BLM to financially assist tribal representatives in participating in the consultation process. Efforts are being made, however, to have more ethnographic studies completed in the Green River Basin, and BLM anticipates involving the Comanche in these studies.

3.2.3 Paleontological and Archaeological Resources

The limited inventory of the planning area has identified approximately 1,000 cultural resources localities within the region, estimated to represent 2 percent of potential localities in the region. Despite this, some important patterns of resource distribution are apparent, particularly for archaeological sites.

The BLM manages paleontological resources for their scientific, educational, and recreational values and mitigates adverse impacts to them as necessary. In general, it is permissible to collect reasonable amounts of common invertebrate fossils from the public lands for non-commercial purposes, and to collect limited amounts of petrified wood as outlined in 43 CFR 3622. The Department of the Interior has administratively determined that the collection of vertebrate fossils requires a permit. Paleontological permits are issued under the authority of the Federal Land Policy and Management Act (FLPMA), and such permits are generally issued only to qualified paleontologists. The Tertiary volcanic and the pre-Cambrian igneous rocks have no potential for paleontological resources. The sand dunes and alluvial deposits in the planning area are unlikely to contain fossils because of their recent age. Common

invertebrate fossils (clams, etc.) are known to occur in the Cretaceous rocks of the Rock Springs Uplift, and scattered fragments of dinosaur fossils have been found in the Lance Formation on the Rock Springs Uplift (Breithaupt 1982). These rock formations are found at the southern edge of the JMH CAP planning area and have a similar fossil potential. Vertebrate fossils are known to occur in the Fort Union and the Wasatch formations around Bitter Creek, Wyoming. The American Museum of Natural History, the University of Colorado, and other institutions have collected numerous primate and other small mammal fossils from these formations. The Fort Union Formation has some potential for fossils but is largely buried under the sand dunes within the planning area. The Wasatch Formation composes much of the lower elevations within the planning area; it may have some potential for fossil occurrences. The Tipton Shale Member (Green River Formation) has a persistent layer of freshwater snails at its base (*Goniobasis* and *Viviparus*) and fossils may be present elsewhere in the planning area.

3.2.3.1 Paleosol Deposition Area

A region of soil deposition, known as the paleosol deposition area, dating back over ten thousand years to the end of the Pleistocene Ice Age occurs in the western portion of the planning area. Indications suggest that this depositional pattern may also extend across the southern edge of the planning area along the flanks of the Killpecker sand dune field, as well as along the Pacific Creek drainage basin in the northern part of the planning area. A number of extremely significant archaeological resources, including the Finley and Krmpotich sites, are located here. Because the soil unit occurs across broad regions of the planning area, similar sites of great antiquity and scientific significance should be expected where this stable soil regime is preserved.

The Finley and Krmpotich archaeological sites are not typical of archaeological sites in this region. They hold cultural evidence from some of the earliest inhabitants of the North American continent and are some of the most intact manifestations of such archaeological evidence known anywhere on the continent (Frison 1998). Many of these sites are deeply buried and have little if any surface manifestation. An array of archaeological methodologies will need to be implemented if resources like Finley and Krmpotich are to be located before they are impacted by development. Unless scientists (geomorphologists and archaeologists) understand the genesis of the Killpecker dune field and the broad ancient soil deposit associated with it, they will never be able to fully understand its significance, much less that of the archaeological material it contains. Predicting the location of archaeological remains within these deposits is beyond the grasp of science at the present time.

The protohistoric Eden-Farson site is another kind of archaeological manifestation observed in the planning area. The site sits on top of the stable soil deposit in the area where the Finley and Krmpotich sites are located, rather than being buried within those soils. The Eden-Farson site contains archaeological evidence of a large hunter-gatherer winter encampment, including remains of winter shelters, pottery, and a wide array of stone tools and bones from antelope that were apparently a major portion of the winter food supply.

Radiocarbon dates from the Eden-Farson site indicate that the site was probably occupied immediately before Euro-Americans first came into direct contact with Native Americans in this region (about 200 to 300 years ago). No Euro-American artifacts were recovered from the Eden-Farson site. It is assumed that direct contact between Native American and Euro-American cultures had not occurred in this region at the time the Eden-Farson site was occupied. However, journals (Morgan 1964) from early Euro-American traders, including William Ashley's men, especially Jedediah Smith, mention the presence of two large Native American encampments in this region. Smith identifies one camp as Crow and the other as Shoshone.

3.2.3.2 Archaic Sites

The planning area also has a number of archaeological sites that are younger than the PaleoIndian-aged Finley and Krmpotich sites. "Archaic" sites ranging from 2,000 to 7,000 years in age are known to occur in the region. The CK Adams site, as an example, contains a series of archaeological manifestations that were located both on the surface and buried in stratigraphic contexts. A limited excavation of the site was undertaken to salvage several hearth features that were rapidly eroding and to test the area for in-place buried materials. Because the effort was undertaken in an emergency situation, BLM has not fully studied and reported the results of the effort. The state archaeologist who conducted part of the salvage reported his results, which are due to be published in the near future (Miller 1998).

Perhaps the most important information gleaned from the CK Adams site is that stratified sites dating from the late prehistoric period through the archaic period should be expected in the Pacific Creek drainage basin. This portion of the planning area contains buried soils that are being crosscut by modern drainage channels, including Pacific Creek, resulting in the exposure of archaeological manifestations.

The stable soil deposit in the Pacific Creek basin seems somehow associated with the Killpecker dune field, but the nature of that association is not fully understood. However, although sites along Pacific Creek do hold archaeological deposits dating back 7,000 years, they do not appear from present evidence to have PaleoIndian deposits (i.e., from 7,000 to 12,000 years before present). Because stratified deposits are the best source of information about changes in human behavior over long periods of time, sites like the CK Adams site are quite significant.

3.2.4 Other Cultural and Historical Resources

3.2.4.1 South Pass National Historic Landmark and South Pass Historic Landscape

The significance of South Pass in the development of the United States as a nation was cause for designation as a National Historic Landmark in 1959. Upon its designation, no attempt was made to designate precise boundaries for the landmark.

In 1984, the National Park Service proposed a boundary encompassing approximately 5,500 acres, of which nearly 1,000 acres were privately owned. Local landowners, fearing the preservation mandate of the National Park Service, protested the proposal, which eventually was not pursued by that agency. It was then up to BLM to develop management prescriptions designed to protect the South Pass National Historic Landmark, which lies within its land management jurisdiction.

To ensure that the intent of the Congressional National Historic Landmark designation was not compromised, BLM developed the South Pass Historic Landscape within the Green River Resource Management Plan (GRRMP) (USDI 1997). The management objective for the South Pass Historic Landscape is to protect the visual and historical integrity of the historic trails and surrounding viewscape. Management prescriptions for the South Pass Historic Landscape ACEC prohibit development that would be visible within 3 miles of the historic trails corridor. A Geographic Information System (GIS) analysis of the vista indicates that within an arbitrary 3-mile distance from the main National Historic Trail corridor, about 23,000 acres are visible from the trails, while about 29,000 acres are shielded from view by topography.

It is anticipated that refinements in viewshed modeling technology, and additional knowledge regarding historic trail locations may change the configuration and acreage of the South Pass Historic Landscape somewhat. As these refinements are identified, the information would be included in the GRRMP through maintenance actions. Boundary adjustments other than refinements or minor adjustments would

require further analysis and if necessary an amendment of the ACEC boundary and management plan (for example, a net change of more than 10 percent [e.g., 5,000 acres]).

3.2.4.2 South Pass Historic Mining Region

Immediately following the Civil War, a rather significant discovery of gold was made in the South Pass region. By 1869, hundreds of prospectors had converged on the area and several small communities had been developed. The most important of the settlements was South Pass City, which today is a State Historical Park. Because the transcontinental railroad had just been completed between Omaha, Nebraska, and Sacramento, California, commerce with the new gold fields could be linked with the larger national economy much more easily than for the earlier historic trails network. This certainly did not mean, however, that wagon roads were obsolete. A network of roads soon developed to connect railheads on the Union Pacific Railroad in southern Wyoming within the South Pass region. South Pass City is located a few miles east of the planning area, but some historic resources associated with mining activity and community development, such as roads, are located in the JMH CAP planning area.

3.2.4.3 Expansion Era Roads

By 1870, roads to the gold fields had been started from three railheads on the Union Pacific: Point of Rocks, Green River, and Bryan. These became known as Expansion Era roads, linking communities along the railroad with newly developing mining, agricultural, and military settlements in the central Rocky Mountains (Map 64). Remnants of the three Expansion Era roads to the South Pass region cross the planning area, as do roads to ranching communities (such as New Fork in the upper Green River Basin). Expansion Era roads also run through the planning area from Rock Springs to military posts established to administer the Wind River Indian Reservation. Several stage stations and freighter's camp locations associated with these Expansion Era roads are known, including Freighter's Gap, Fourteen Mile, and The Wells within the planning area. Although the general routes of the Expansion Era roads are known, and some are marked on General Land Office plats, the physical integrity and historical significance of these resources have generally not been evaluated.

3.2.4.4 Ranching-Related Historic Sites

Soon after the Expansion Era road network began to develop, cattle and sheep ranching became important to the region's economy. Several early ranching-related historic sites are located within the planning area. The best-preserved ranching-related site on BLM-administered public lands is the Crookston Ranch, which includes several historic structures. The Green River RMP designates this site for special management for the interpretation of the region's ranching history. Numerous other less impressive sites related to the history of pastoral agriculture, including small, mostly unsuccessful homesteaders sites; sheepherder camps and shearing corrals; horse trapping facilities; and irrigation systems to support production of wild grass hay, are represented in the planning area. However, the most ubiquitous agricultural-related site is the common sheepherder or cowboy campsite, which today consists of only a small scattering of historic artifacts across the landscape.

3.2.4.5 The Tri-Territory Marker

The Tri-Territory Marker is located on the northeast side of Steamboat Mountain within the core area of the JMH CAP planning area. This monument marks the site where the Oregon Territory, Mexican Territory, and the Louisiana Purchase had a common boundary in the nineteenth century. A modern structure marks the site, commemorating its important national historical geographical location within Wyoming. The marker was placed and is maintained by the Rock Springs Kiwanis Club in cooperation with BLM. BLM has received a number of requests for information about this location, and it should be

more strongly integrated into the Rock Springs Field Office cultural and recreation management programs.

3.2.5 Unique Geological Features

Boars Tusk, located in the southwest portion of the planning area, is the remnant of a volcanic neck. Boars Tusk is a predominant landmark feature providing a striking visual contrast to the surrounding landscape. The Boars Tusk is located within the Greater Sand Dunes ACEC. Management actions identified for Boars Tusk in the Green River RMP are summarized in Appendix 2.

The Pinnacles are a well-known natural landmark of the Red Desert. Geologically, the Pinnacles are formations that are unique to this area because of their pyramid-like structure. The many small geologic microsites that are found in the area consist of small sandstone structures, volcanic intrusive dikes, badland, and windblown-type features. The Pinnacles themselves are nesting grounds for the ferruginous hawk. Antelope, elk, deer, and wild horses can also be found in the area. Recreational opportunities include big game hunting, rock hounding, camping, and hiking.

3.3 TRAVEL, ACCESS, AND REALTY

This resource management category includes the land use programs of transportation, off-highway vehicle (OHV) use, lands and realty management, rights-of-way (ROW), access routes and issues, and transport of hazardous materials.

3.3.1 Travel Management

Travel management includes the description of the existing roads and trails network to and through the JMH CAP planning area and the planning for manageable transportation routes.

3.3.1.1 Existing Network

The existing transportation network within the planning area is shown on Map 65. The network includes state, county, and BLM access roads. Historic and current uses of the roads have been primarily by livestock operators, recreationists, and mineral developers. Numerous trails and tracks cross the planning area and are referred to as census track trails. These trails are from remote sensing data files and have not been verified as to status. They are inaccessible to vehicular use, and they can include wildlife trails, access roads to wellheads, and pipeline or communication ROWs.

The primary paved access routes to the JMH CAP planning area are U.S. Highway 191 and Wyoming Highway 28. Unpaved county roads off the two main highways to the planning area include Superior Cutoff Road, Eden area roads, Chilton Road, Freighter Gap Road, Bar X Road, Oregon Buttes Road, and Nine Mile Road. Tri-Territory Road, a BLM road, also provides access to the planning area. Most of these roads have some degree of gravel or aggregate surface and are periodically maintained, but they can become impassable when wet or during winter months. County roads are maintained, but generally there is no snow removal during winter.

County roads provide public access across private land, whereas BLM roads or other roads that cross private lands may not provide such access. Although BLM roads are administered by a public agency and are open to use by the general public, they are not public roads, and permission is needed to cross private lands.

3.3.1.2 Transportation Planning

Transportation planning involves the reasoned and organized development of a plan that provides access to the planning area for multiple uses, including recreation, mineral development, and livestock operations. Transportation planning provides direction for future road development and a basis for future exploration, development, and production transportation activities. The transportation planning area includes U.S. Highway 191; Wyoming Highway 28; and county, BLM, and undeveloped roads and routes within and adjacent to the area.

Roads are classified according to ownership, use, size, and traffic volume. These classifications, listed in Table 3-19, are used in the development of a transportation plan, particularly for well field development.

Table 3-19. Road Classifications

Arterial	State highways or county roads Provides primary access High-traffic volume
Collector	BLM roads Connects with public road system Provides access to large blocks of land Accommodates mixed traffic and serves many uses High-traffic volume within BLM road system
Local	BLM roads or industry/operator roads on BLM-administered lands Connects with collector roads of public road system One- or two-lane roads Provides access to multiple well locations Accommodates fewer traffic types and serves fewer users Low-traffic volume
Resource	BLM roads or industry/operator roads on BLM-administered lands Connects with local roads or collector roads One-lane spur roads Provides access to the individual well location Accommodates and serves industry/operator users Low-traffic volume

A draft transportation plan for the JMH CAP planning area proposes specific access and travel routes in areas of particular concern as a result of anticipated development and use (Appendix 12). Road and ROW corridors and transportation standards would be described in a technical support document for specific projects occurring within these areas. The criteria to be considered in transportation planning include existing access rights, coordination with other jurisdictions (i.e., counties and state), seasonal limitations, and location of sensitive resources including Native American respected places and T&E species.

3.3.2 Off-Highway Use

E.O.s 11644 and 11989 and the regulations contained in 43 Code of Federal Regulations (CFR) 8340 provide the parameters for the management of OHV activities on public lands. The objectives of these regulations are to conserve soil, wildlife, water quality, native vegetation, air quality, and heritage resources while providing for appropriate recreational opportunities and promoting the safety of all users.

The use of OHVs on BLM lands has increased in popularity in recent years and accounts for approximately 17,000 annual recreation visitor days in the JMH CAP planning area. Recreationists,

hunters, livestock operators, and oil and gas surveyors and inspection crews account for the majority of OHV users in the planning area. The Greater Sand Dunes Recreation Area, located within the eastern portion of the Greater Sand Dunes Special Recreation Management Area (SRMA), provides more than 10,000 acres of open area for OHV users.

Off-highway access is designated to protect resources and the landscape from damage, to ensure public safety, and to minimize conflict among users. The three main designations are "open," "limited," or "closed" to OHV use and are described in Table 3-20. Designations are made through the land use planning process and are updated and revised as necessary to meet resource management objectives and to mitigate OHV-related impacts.

Table 3-20. OHV Use Designations

Designation	Use
Open	Area of intensive OHV use with no resource, user, or public safety conflicts Vehicle travel permitted both on and off roads Vehicle must be operated responsibly and must not cause significant damage to resources or to other authorized uses of public land
Limited	Restricted OHV use to meet specific resource management objectives Vehicle travel permitted only on existing roads and trails in existence prior to the designation Vehicle travel permitted only on designated roads and trails that are identified, signed, and mapped by BLM Vehicle travel limited by the number and type of vehicle Vehicle travel limited by time or season Vehicle travel limited to licensed or permitted use
Closed	Prohibited OHV use to protect resources, ensure visitor safety, or reduce conflicts Vehicle travel not allowed both on or off roads and trails Access by nonmotorized vehicle is generally allowed

The limited designation allows for parking within 300 feet from the edge of the road surface to accommodate recreationists, provided no damage occurs to the resources or hazard is imposed on public safety. Motorized vehicle use within 300 feet of roads and trails is also allowed to retrieve big game and trophy game animal kills.

The OHV use designations for the JMH CAP planning area were made in the Green River RMP (Map 9). The WSAs, Boars Tusk, and Crookston Ranch are closed to OHV use. Official designations for the areas identified as limited to designated roads and trails would be completed through site-specific activity planning with public input. Until that designation is completed, the areas are managed as limited to existing roads and trails.

3.3.3 Access and Realty Actions

The BLM road network in the JMH CAP planning area provides access to public and private lands for different management activities and recreation. It is BLM policy to provide reasonable access to public facilities and resources to meet the needs of private landowners, visitors, and users, including those with disabilities, while minimizing conflicts among users, promoting visitor safety, and preventing damage to resources.

Livestock operators use the many two-track roads and trails within the planning area to access water developments and other range improvements; recreationists use the routes for hiking, camping, hunting, sightseeing, rockhounding, and wildlife and wild horse viewing. Some existing roads are not passable

during inclement weather or during winter months. Consequently winter access is subject to seasonal road closures, and plowing of these roads is considered only on a case-by-case basis. Access is also subject to non-weather-related seasonal closures to protect resources during more sensitive times of the year, including birthing and wintering.

3.3.3.1 Rights-of-Way

A ROW grants the use of a specific piece of public land for specific facilities for a specific period of time. It is the policy of BLM to authorize all ROW applications at the discretion of the authorized officer in the most efficient and economic manner possible. The majority of ROWs are authorized under Title V of the FLPMA and the Mineral Leasing Act. The ROWs under FLPMA are for structures, pipelines, and facilities to store and transport water, electrical power, communication systems, and solid materials, and for highways, roads, railroads, and other means of transportation. Under the Mineral Leasing Act, ROWs are granted for oil and natural gas gathering, distribution, and transmission pipelines and related facilities.

Management objectives address the designation of ROW corridors for public lands that currently accommodate existing authorized ROWs consistent with natural resource planning decisions. The realty program in the JMH CAP planning area is driven by the local mineral industry, and the majority of the ROWs issued are in support of oil and gas development and for county roads. No utility corridors have been designated in the planning area; however, an east-west window for underground utility lines is located along the southern border. New ROW corridors would be considered and designated for interstate and intrastate ROW facilities to meet demand forecasts for utility commodities. A communication line, power line, and abandoned railroad line cross the width of the planning area, and two communication sites are also located on public lands.

Portions of JMH are designated as avoidance or exclusion areas for ROWs. Avoidance areas are public lands where future ROWs may be granted only when no feasible alternative route or designated ROW corridor is available; exclusion areas would permit future ROWs only when mandated by law. The ROW avoidance and exclusion areas for the JMH CAP planning area were established in the Green River RMP (Map 8).

3.3.3.2 Exchanges, Withdrawals, and Ownership Adjustments

The majority of the planning area (surface and mineral) is composed of solid blocks of public lands administered by BLM. Nonfederal landowners include the State of Wyoming and private individuals. No communities are located within the area. Rock Springs and Superior are the nearest incorporated cities, and Eden-Farson is the nearest unincorporated populated area.

BLM provides for acquisition, use, disposal, and adjustment of land resources when it is in the public interest and consistent with approved land use plans. Acquisition can be by exchange, purchase, easement, or donation. The land acquisition program is designed to improve management of natural resources through consolidation of federal, state, and private lands and to secure land necessary to protect endangered species, promote biological diversity, increase recreational opportunities, and preserve heritage resources. Exchanges are only pursued with willing landowners and are the preferred method of obtaining lands, because federal purchase dollars are limited. Lands to be exchanged must be of equal monetary value and located within the same state. BLM is proposing the exchange of state inholdings in the Sand Dunes WSA, in the Greater Sand Dunes ACEC, and on Steamboat Mountain.

Withdrawals are used to protect sensitive environmental values, protect major federal investments in facilities, support national security, and provide for public health and safety. A withdrawal removes an

area from settlement, sale, location, or entry under the general land laws for the purpose of limiting activities and to maintain other public values. Public land orders provide for the initiation, modification, extension, or revocation of land withdrawals.

Existing withdrawals in the planning area include lands classified as prospectively valuable for oil shale and coal. This classification indicates that oil shale and coal have priority for mineral resource development over location of mining claims. Oil shale and coal are leasable minerals, and therefore withdrawals to protect these minerals from speculation through mining claim activity are no longer applicable. Prior to revocation, withdrawn lands will be reviewed to determine whether any other resource values require withdrawal protection. Upon revocation, the area would be open to filing mineral claims, exploration, and development of locatable minerals. The White Mountain Petroglyphs located in the oil shale classification lands and Greater Sand Dunes ACEC, special status plant sites, Crookston Ranch, public water reserves, Tri-Territory Marker, and South Pass Summit located in the coal classification lands would be withdrawn from mineral location prior to the revocation.

3.3.4 Hazardous Materials

Hazardous materials are transported through the JMH CAP planning area and used primarily by mineral developers. There are no known hazardous materials sites within the planning area other than the materials kept and used by the minerals industry at individual well locations. A few old abandoned reserve pits remain scattered throughout the area but have not been tested for the presence of hazardous materials or hazardous waste. Small oil and gas fields within the planning area could contribute hazardous materials to the environment. Any spills or leakages of hazardous materials are reported by the operator and are controlled and removed as necessary in accordance with BLM regulations. The materials spilled or leaked are exempt from federal hazardous materials rules under the Resource Conservation and Recovery Act of 1976.

3.4 RECREATION RESOURCES

Recreation activities available on BLM-administered lands in the planning area are many and varied. A brief listing includes hunting for elk, deer, antelope, and greater sage-grouse; camping, backpacking, and hiking; horsepacking and riding; OHV use; mountain biking; rock and petrified wood collecting; sightseeing of historic trails and places; wild horse viewing; wildlife viewing; and photography. Recreation use in the planning area predominantly occurs between May and October, because lack of maintained roads in the winter restricts year-round recreational access.

Major recreation locations include the Greater Sand Dunes area; Steamboat Mountain; Oregon Buttes; White Mountain Petroglyphs; Honeycomb Buttes; Tri-Territory Marker; and the Oregon, Mormon Pioneer, California, and Pony Express National Historic Trails (Map 2).

Estimated dispersed recreational use within the planning area is summarized in Table 3-21. Recreational use was estimated by using recreational visitor days (RVD) (each RVD defined as a 12-hour period) as a unit of measure. Dispersed recreational uses in the planning area were estimated using data from the BLM Recreational Management Information System (RMIS).

Table 3-21. Estimated Annual Nonconsumptive Recreational Visitor Days

Activity	Total RVDs	Resident RVDs	Nonresident RVDs
OHV	16,691	6,676	10,015
Other Dispersed Uses			
Archery	71	57	14
Backpacking	214	107	107
Bicycling—Mountain	143	71	71
Camping	1,661	830	830
Driving for Pleasure	1,720	1,548	172
Environmental Education	50	5	45
Gather Noncommercial Products	143	114	29
Hiking/Walking/Running	500	250	250
Nature Study	76	46	30
Picnicking	100	50	50
Re-enactment Events/Tours	60	6	54
Rockhounding/Mineral Collection	285	228	57
Target Practice	71	57	14
Viewing Cultural Sites	106	11	95
Viewing Wild Horses	285	171	114
Viewing Wildlife	304	182	122
Viewing—Interpretive Exhibit	528	53	475
Subtotal—Other Dispersed Uses	**6,315**	**3,786**	**2,529**
Total Recreational Visitor Days	**23,006**	**10,462**	**12,544**

BLM tracks recreational use for several areas within Wyoming; however, visitor day estimates are not available specifically for the JMH CAP planning area. Therefore, estimated RVDs were extrapolated from the RMIS database for the Rock Springs Field Office. The RMIS database was queried for the number of RVDs per activity for the Rock Springs Field Office for the time period October 1, 1998, to September 30, 2001. The JMH CAP planning area accounts for 19 percent of the land area under the jurisdiction of the Rock Springs Field Office; as a first estimate, it was assumed that RVDs associated with JMH would account for 19 percent of those recorded within the field office. The estimated RVDs per activity were then modified using information specific to JMH. For example, it was assumed that very little fishing, cross-country skiing, or snowmobile activity occurs in the planning area. In addition, camping RVDs were revised downward given the lack of developed campsites within the JMH CAP planning area. Because this system does not track visitor origin, resident and nonresident visits were based on observations and professional judgment of BLM staff.

The results summarized in Table 3-21 show that OHV use is the most popular recreational activity, accounting for more than 16,000 RVDs per year. In addition, it was estimated that visitors enjoyed approximately 5,400 RVDs associated with other dispersed recreational activities.

3.4.1 Off-Highway Vehicle Use

OHV use is the most popular recreational activity within the planning area. Most of this activity takes place within the Greater Sand Dunes Recreation Area, which carries an "open" OHV designation on 10,020 acres. BLM estimates that an average of 14,000 RVDs occur in this area annually. In addition, OHV recreation occurs in other areas that fall within the "limited" use category. The limited category includes areas limited to existing roads and trails, areas limited to designated roads and trails, areas

limited by number and type of vehicle, areas limited to licensed or permitted use, and areas with seasonal limitations. Using the RMIS database for the Rock Springs Field Office, it was estimated that OHV use in other areas of the planning area account for approximately 2,400 RVDs per year.

3.4.2 Hunting

Hunting is the second most popular activity within the planning area and includes elk, antelope, mule deer, greater sage-grouse, morning dove, and rabbits. The seasons of use and limitations are summarized in Table 3-22. Hunting days reported under this section are not comparable with BLM recreation days given the differences in estimation procedures and the definition of a recreation day. Because of the migratory nature of game herds, it is difficult to estimate the total RVDs associated with hunting in the planning area; therefore, total hunting activity estimated by WGFD within hunting units that partially include the planning area were considered.

The *Wyoming Game and Fish Annual Report of Big Game Harvest* and the *Upland Game & Furbearer Harvest Annual Report* published for the last 10 years were used to estimate the average hunting days per species within the planning area. Residents and nonresidents of Wyoming spend approximately 3,100 days hunting in the planning area annually, as summarized in Table 3-23. Wyoming residents dominate hunting use in the planning area, accounting for more than 80 percent of the hunting days on average. Hunting antelope is the most popular hunting activity, with more than 1,300 hunting days, followed by greater sage-grouse, mule deer, and elk.

Table 3-22. Hunting Seasons [2000]*

Species	Hunt Area	Seasons		Limitations
		Opens	Closes	
Antelope	92	9/10	10/14	Limited Quota: 750 licenses to hunt any antelope
		9/10	10/14	Limited Quota: 705 licenses to hunt doe or fawn, valid only in that portion of Area 92 within the Pacific Creek Drainage
		9/10	10/14	Limited Quota: 150 licenses to hunt doe or fawn, valid only in that portion of Area 92 in the Farson-Eden Irrigation Project
	107	9/10	9/30	Limited Quota: 200 licenses to hunt any antelope
		9/10	9/30	Limited Quota: 500 licenses to hunt doe or fawn
		8/20	9/9	Limited Quota: 125 licenses to hunt any antelope; muzzleloading, firearms, and handguns using legal cartridges
	60	9/16	10/14	Limited Quota: 100 licenses to hunt any antelope
		9/16	10/14	Limited Quota: 50 licenses to hunt doe or fawn
	64	9/16	10/14	Limited Quota: 150 licenses to hunt any antelope
		9/16	10/14	Limited Quota: 300 licenses to hunt doe or fawn

*WGFD 2000 Annual Report of Big and Trophy Game Harvest.

Table 3-22. Hunting Seasons [2000]* Continued

Species	Hunt Area	Seasons		Limitations
Mule Deer	95	10/15	10/22	General License; antlered mule deer or any while-tailed deer
	131	10/1	10/8	General License; antlered deer
		11/4	11/12	Limited Quota: 25 licenses to hunt antlerless deer valid only in that portion of Area 131 north of Wyoming Highway 28 and west of the Lower Farson Cut Off Road (Sweetwater County Road 8)
Elk	100	10/15	10/31	Limited Quota: 100 licenses to hunt antlered elk
		10/15	10/31	Limited Quota: 110 licenses to hunt antlerless elk
		10/21	10/31	Limited Quota: 90 licenses to hunt antlerless elk
		10/15	10/31	Limited Quota: 50 licenses to hunt cow or calf valid only in that portion of Area 100 east and north of the Three Forks/Atlantic City Road (BLM Road 2317) and west of the Bison Basin Road (Fremont County and BLM Road 3221)
Greater sage-grouse	1	9/16	10/1	Daily Bag Limit: 3; Possession: 6

*WGFD 2000 Annual Report of Big and Trophy Game Harvest.

Table 3-23. Estimated Annual Average Hunting Days

Hunter Type	Elk[1]	Antelope[2]	Mule Deer[3]	Greater Sage-Grouse[4]
Resident	364	1,486	823	695
Nonresident	97	78	785	185
Total	**461**	**1,565**	**1,609**	**880**

[1]Estimated with data from WGFD Hunt Area 100 (Steamboat); assumed that 70 percent of the hunting within Hunt Area 100 occurred in the JMH CAP planning area.
[2]Estimated with data from WGFD for Hunt Area 92 (Steamboat), 107 (Upper Sweetwater), 60 (Table Rock), and 64 (Bison Basin); assumed that 70 percent of the hunting within Hunt Area 92, 23 percent within Hunt Area 107, 4 percent within Hunt Area 64, and 6 percent within Hunt Area 60 occurred in the JMH CAP planning area.
[3]Estimated with data from WGFD for Hunt Area 131 (Steamboat) and 95 (South Pass); assumed that 60 percent of the hunting within Hunt Area 131 and 13.5 percent within Hunt Area 95 occurred in the JMH CAP planning area.
[4]Estimated with data from WGFD for Hunt Area 7 (Eden) and 8 (Beaver Rim); assumed that 25 percent of the hunting within Hunt Area 7 and 5 percent within Hunt Area 8 occurred in the JMH CAP planning area.

3.4.3 Special Recreational Management Areas

There are two SRMAs within the planning area: (1)Greater Sand Dunes and (2) Oregon, Mormon Pioneer, California, and Pony Express National Historic Trails. These areas are discussed in further detail in Section 3.7, Special Management Areas and Other Management Areas.

3.4.4 Continental Divide National Scenic Trail

The National Trails System Act of 1968 provides for designation and conservation of trails that provide maximum outdoor recreation potential in areas of nationally significant scenic, historic, natural, or cultural qualities. In 1978, as an amendment to the National Scenic Trail System Act, Congress designated the Continental Divide National Scenic Trail (CDNST). This trail route traverses approximately 3,100 miles of the length of the Rocky Mountains, in proximity to the Continental Divide, through the states of Montana, Idaho, Wyoming, Colorado, and New Mexico. The Forest Service published a comprehensive management plan for the trail in 1985 that set broad goals and policy for local trail management.

In 1998, BLM issued an Environmental Assessment for the designation of the proposed on-the-ground route for the trail. The Continental Peak/South Pass Connecting Side Trail (35 miles) was proposed and analyzed. However, designation of the route was deferred pending completion of the JMH Environmental Impact Statement (EIS) to analyze the side trail along with other related resource issues. About 25 miles of existing roads and routes have been identified as a side trail for the CDNST. The remainder of the route would require cross-country travel. This route would partially occur in the South Pass Historic Landscape area (Map 64).

Allowable uses of the Continental Peak/South Pass Connecting Side Trail include hiking, mountain biking, horseback riding, and limited motor vehicle use. Approximately 95 percent of the trail is primitive two-track roads, 4 percent is improved roads, and 1 percent requires cross-country travel. Cross-country segments are closed to motorized vehicles.

3.4.5 Recreation Opportunity Spectrum

The goal of the recreationist is to have satisfying recreational experiences by participating in preferred activities in favorable environmental settings, the goal of the recreation resource manager then becomes to provide opportunities to obtain such experiences. This can be achieved by managing the natural setting and activities through the use of the Recreational Opportunity Spectrum (ROS).

Developed in the late 1970s by the Forest Service, the ROS has proven to be an effective recreation management and inventory tool for both the public and private sectors. In essence, the ROS is a spatial-based inventory system that recognizes the need to maintain a range of recreational opportunities while also providing multiple recreational experiences. Whereas traditional methods of recreational inventories have focused attention on the classification of facilities or types of activities, the ROS instead is a spatially orientated, experience-based inventory system. The key term is “experiences” in that the fundamental assumption is that different kinds of land, or landscapes, can support different kinds of recreational experiences and opportunities.

Operationally, the ROS is a form of zoning in which inventories of lands are arranged along a continuum that is divided into six classes or zones, ranging from natural, low-use areas (resource-dependent recreational opportunities) to highly developed, intensive use areas (facility/vehicle-dependent recreational opportunities). The six classes included within the ROS are primitive, semiprimitive nonmotorized, semiprimitive motorized, roaded natural, rural, and urban. The principal factor in determining an ROS class is the setting. The setting describes the overall outdoor environment of a given area, which ultimately influences the types of opportunities and the experiences that take place within that area. Therefore, to enable the recreational manager to achieve the goal of providing opportunities for satisfying recreational experiences, he or she must provide settings that promote varying types of recreational opportunities. Although some classifications may appear to designate areas with wilderness qualities, they should never be confused with the classification of wilderness areas. Wilderness areas are special, legally designated areas that can cross classes.

The following describes the six classifications of ROS settings and is then followed by a description of the types of experiences that each setting encourages.

3.4.5.1 ROS Setting Characterization

3.4.5.1.1 Primitive

The primitive area is characterized by essentially an unmodified natural environment of fairly large size. Interaction between users is very low and evidence of other users is minimal. The area is managed to be

essentially free from evidence of human-induced restrictions and controls. Motorized use within the area is not permitted.

3.4.5.1.2 Semiprimitive Nonmotorized

This area is characterized by a predominantly natural or natural-appearing environment of moderate to large size. Interaction between users is low, but there is often evidence of other users. The area is managed in such a way that minimum onsite controls and restrictions may be present but are subtle. Motorized use is not permitted.

3.4.5.1.3 Semiprimitive Motorized

This area is characterized by a predominantly natural or natural-appearing environment of moderate to large size. Concentration of users is low but there is often evidence of other users. The area is managed in such a way that minimum onsite controls and restrictions may be present but are subtle. Motorized use is permitted.

3.4.5.1.4 Roaded Natural

The roaded natural area is characterized by a predominantly natural appearing environment with moderate evidence of the sights and sounds of man. Such evidence usually harmonizes with the natural environment. Interaction between users may be low to moderate, but with evidence of other users prevalent. Resources modification and utilization practices are evident, but harmonize with the natural environment. Conventional motorized use is provided for in construction standards and design of facilities.

3.4.5.1.5 Rural

The rural area is characterized by a substantially modified natural environment. Resource modification and utilization practices are to enhance specific recreation activities and to maintain vegetative cover and soil. Sights and sounds of humans are readily evident, and the interaction between users is often moderate to high. A considerable number of facilities are designed for use by a large number of people. Facilities are often provided for special activities. Moderate densities are provided far away from developed sites. Facilities for intensified motorized use and parking are available.

3.4.5.1.6 Urban

The urban area is characterized by a substantially urbanized environment, although the background may have natural appearing elements. Renewable resource modification and utilization practices are to enhance specific recreation activities. Vegetative cover is often exotic and manicured. Sights and sounds of humans onsite are predominant. Large numbers of users can be expected, both onsite and in nearby areas. Facilities for highly intensified motor use and parking are available with forms of mass transit often available to carry people throughout the site.

3.4.5.2 ROS Experience Characterization

3.4.5.2.1 Primitive

Extremely high probability of experiencing isolation from the sights and sounds of human, independence, closeness to nature, tranquility, and self-reliance through the application of woodsman and outdoor skills in an environment that offers a high degree of challenge and risk.

3.4.5.2.2 Semiprimitive Nonmotorized

High, but not extremely high, probability of experiencing isolation from the sights and sounds of humans, independence, closeness to nature, tranquility, and self reliance through the application of woodsman and outdoor skills in an environment that offers challenge and risk.

3.4.5.2.3 Semiprimitive Motorized

Moderate probability of experiencing isolation from the sights and sounds of humans, independence, closeness to nature, tranquility, and self-reliance through the application of woodsman and outdoor skills in an environment that offers challenge and risk. There is opportunity to have a high degree of interaction with the natural environment. There is opportunity to use motorized equipment while in the area.

3.4.5.2.4 Roaded Natural

About equal probability of experiencing affiliation with other user groups for isolation from sights and sound of humans. There is opportunity to have a high degree of interaction with the natural environment. Challenge and risk opportunities associated with more primitive types of recreation are not very important. Practice and testing of outdoor skills might be important. Opportunities for both motorized and non-motorized forms of recreation are possible.

3.4.5.2.5 Rural

Probability of experiencing affiliation with individuals and groups prevalent, as is the convenience of sites and opportunities. These factors are generally more important than the setting of the physical environment. Opportunities for wildland challenges, risk-taking, and testing of outdoor skills are generally unimportant except for specific activities like downhill skiing, for which challenge and risk-taking are important elements.

3.4.5.2.6 Urban

Probability of experiencing affiliation with individuals and groups is prevalent, as is the convenience of sites and opportunities. Experiencing natural environments, having challenges and risks afforded by the natural environment, and using outdoor skills are relatively unimportant. Opportunities for competitive and spectator sports and for passive uses of highly human-influenced parks and open spaces are common.

Within the Jack Morrow Hills planning area, ROS classifications include semiprimitive nonmotorized, semiprimitive motorized, roaded natural, and rural (Map 72).

3.5 MINERALS AND ALTERNATIVE ENERGY RESOURCES

3.5.1 Regional Geologic Setting

The planning area falls within a broad region of subdued relief that has been termed the Wyoming Basin physiographic province (Fenneman 1931). The Greater Green River Basin lies within this province, and the planning area lies in the north-central part of this basin (Figure 1). The planning area includes the north end of the Rock Springs Uplift, extends east into the Great Divide Basin, west into the main part of the Green River Basin, and northward across the southern end of the Wind River Range. Surface features reflect erosion by wind and water in an arid, cold temperature environment. Landforms in portions of the planning area have been modified by sand movement, faulting, and volcanic activity. Figure 2 lists formations present in the planning area and gives a brief lithologic description of each unit.

Precambrian era rocks in the planning area include outcrops of granitic rock in the Wind River Range (dated at 2.6 billion years) and metamorphic rocks that may be more than 3 billion years old. Precambrian rocks are the deepest buried rocks in the planning area, forming the crystalline basement, and are also found near the surface in the area to the north of the thrust fault bounding the Wind River Range.

For most of the Paleozoic era, the planning area was covered by shallow seas at the eastern margin of a marine basin. The area was also close to the equator and was frequently covered by warm shallow seas where limestone and fine-grained sediments were deposited. Mississippian and Permian age strata were deposited in the area during this time, including the Madison Limestone and the Phosphoria Formation. These units do not outcrop in the planning area, as they are buried under younger sedimentary rocks. The Phosphoria Formation is exposed west of the planning area and has been mined for phosphate minerals in districts along the Wyoming-Utah border and in central Idaho. The Phosphoria Formation has not been considered for mining in the Green River Basin because of the depth of occurrence and related costs that would be required to mine phosphate. The Phosphoria Formation also contains significant organic matter, and this unit may also be a source for oil and gas accumulations in southwest Wyoming. Madison Limestone well tests in the area have yielded carbon dioxide-rich gas.

Most of the Mesozoic era rocks within the planning area were deposited in a northern subtropical region. Sea level fluctuated during this period because of periods of eastward fault movement in the Thrust Belt and mountain-building events in surrounding areas. Deposition of sediment took place in alternating marine and nonmarine environments. At the end of the Mesozoic era, mountain building caused the complete withdrawal of the sea, and the North American continent was approaching its present-day latitudes.

Most of the Mesozoic sequence is composed of Cretaceous-age strata, including the Dakota Sandstone, Frontier Formation, Baxter Shale, Mesaverde Group, Lewis Shale, and Lance Formation. The Baxter Shale is a thick marine shale with lenses of fine-grained sandstone. The Mesaverde Group includes marginal marine and nonmarine deposits of the Blair Formation, Rock Springs Formation, Ericson Sandstone, and Almond Formation. The Rock Springs and Almond Formations contain significant coal seams; however, most of the coal beds in Cretaceous rocks in the planning area are at depths below practical limits for mining. The uppermost part of the Cretaceous section is composed of the Lewis Shale and the embedded sandstone and shale of the Lance Formation, which also contains thin coal seams.

At the onset of the Cenozoic era, the Thrust Belt was in a late stage of development, and the ancestral structures of the Uinta Mountains, Wind River Range, Sierra Madre Range, and Granite Mountains had formed on the margins of the Green River, Great Divide, and Washakie Basins (Figure 1). These basinal areas were then largely filled with river and lake deposits, nearly burying the surrounding mountain ranges. The lake deposits and other nonmarine strata formed the Fort Union, Wasatch, and Green River formations. The Fort Union and Wasatch formations are both coal bearing, and the Green River Formation contains oil shale. Coal is mined south of the planning area at the surface and in underground mines, but Tertiary coal resources have not been economically viable for mining in the planning area.

3.5.2 Present-Day Land Forms

During the late Tertiary and Quaternary periods, uplift of the region continued, and igneous activity approximately 1.1 million years ago resulted in the formation of lava flows, volcanic necks, and cinder cones. The igneous rocks are resistant to erosion and have resulted in some of the prominent landforms in the area, including Boars Tusk, Steamboat Mountain, and the Leucite Hills. The rocks are potassium rich and were mined as a source of potassium at nearby Zirkel Mesa during World War I.

The widespread erosion that has shaped the planning area has resulted in the development of considerable areas of badlands. The main area of badlands is within the Honeycomb Buttes and Oregon Buttes WSAs. Badlands are best developed in soft, weak mudstones, which are relatively impervious and preclude infiltration of rainwater. As a result, runoff erodes intricate networks of rills and gullies. As the gullies deepen, the ground surface becomes highly dissected. Erosion and aerial deposition have produced sand dunes in other parts of the planning area. Dune activity ranges from active migration with loose sand present at the ground surface to stabilized dunes that are vegetated and not migrating. Other surficial deposits include alluvium in stream valleys and debris and landslide deposits along steep slopes in the area. These deposits have been weathered to produce the soils present across most of the planning area. Where the water table is present in these surficial deposits, they form the uppermost aquifer in the planning area.

3.5.3 Geologic Hazards

Several types of geologic hazards are present within the planning area (Map 66). Hydrogen sulfide, earthquakes, landslides, and windblown sand hazards are of primary concern. Hydrogen sulfide is present with the hydrocarbons in some deep producing oil and gas wells farther south on the Rock Springs Uplift and could be present in the planning area in formations deeper than those that presently produce hydrocarbons. Additional discussion of this hazard is on file in the Rock Springs Field Office (USDI 1992).

The only significant fault that demonstrates recent displacement is the Continental Fault area on the north perimeter of the planning area. Historical seismicity shows no major earthquakes within the planning area; however, earthquakes in adjacent regions may directly affect this area. Hazard assessments including seismic modeling have ranked the planning area as having the potential for ground movement at 4 to 8 percent of the acceleration because of gravity. This is a relatively moderate ground motion risk; the highest classification in the continental United States is up to 32 percent of the acceleration because of gravity.

Active landslides are relatively scarce in the planning area because of the relatively arid climatic conditions and the competent rocks underlying most steep slopes. The area of steep slopes around Steamboat Mountain and Oregon Buttes has the most potential for landslides or rock falls. These areas have been impacted by past landslides and are susceptible to development of unstable slope conditions where the ground surface is disturbed. The areas that are vulnerable to earth movement are shown on the map of potential landslide areas (Map 66).

Windblown sand deposits occur throughout the southern part of the planning area. The Killpecker Dune field encompasses about 170 square miles, extending beyond the planning area boundary. Prevailing wind direction is from the west-northwest, and dune migration follows prevailing winds. Hazards are increased when dunes are migrating. No volcanic hazards exist within the area (Wright and Pierson 1992).

Several mappable faults occur in the planning area. The Continental Fault is approximately 55 miles long and roughly parallels the buried thrust fault (Wind River thrust fault) at the north edge of the planning area (Figure 1).

3.5.4 Leasable Minerals

Fluid minerals such as oil and gas are leased under the Mineral Leasing Act of 1920 and its amendments of 1987. Leases are offered by competitive bid. Leases within the planning area include stipulations to mitigate impacts of development on wildlife, including seasonal restrictions on drilling activity. Other

lease stipulations include restrictions on surface disturbances, wildlife, special resources (i.e., recreational areas and historic features), and no surface occupancy requirements. The purpose of these stipulations is to protect the environment and to inform the lessee about special requirements that may restrict development. Additional information about wells that have produced can be found in the Hydrocarbon Occurrence and Development Potential Report (Appendix 13). Methods and procedures for conducting geophysical exploration leasing, well permitting, drilling operations, development, production, and subsurface practices are described in Appendix 14.

3.5.4.1 Oil and Gas

Oil and natural gas are fluid minerals available for lease within the planning area (Map 67).

3.5.4.1.1 Historical and Current Production

Between 1900 and 1916, a number of shallow oil exploration wells were drilled on the Rock Springs Uplift. A number of oil and gas shows were encountered, but no wells were productive. The first production in the region occurred with the discovery of the South Baxter Basin field in August 1922. Exploration continued in the JMH CAP planning area, and the first producing well in the planning area was drilled in 1961. This Frontier Formation well was the discovery well for the Nitchie Gulch Field. Development of Nitchie Gulch and other producing units occurred through the early 1990s. Petroleum exploration and development is active in the Greater Green River Basin, and there is interest in additional development in the planning area. Through July 2001 there have been 153 wells drilled in the planning area. The well locations, unit designations, depths, and deepest formation tested for each well are listed in Table 3-24 at the end of Chapter 3.

Five active producing units have been designated in the planning area: Buccaneer, Nitchie Gulch, Rim Rock, Steamboat Mountain, and Treasure units (Map 68). Three exploratory units have been designated in the planning area (Map 68). The Gold Coast Exploratory Unit was approved effective January 30, 1998. The first well commenced drilling in the fall of 1998 and is temporarily shut in. The Johnson Gap Exploratory Unit was approved effective February 2, 1994. The West 187 Exploratory Unit was approved effective February 25, 1998. Development of these exploratory units has been deferred until management actions for the JMH CAP planning area are selected.

Three exploratory units that were partially within the planning area were approved, and exploration wells were drilled outside the planning area in the 1990s. The Riva Exploratory Unit extended across the eastern boundary of the planning area; the Lewis Shale was tested and abandoned in this unit. The Encore Exploratory Unit extended into the southeast part of the planning area. This unit was terminated in 1998 after an exploration well was tested in the Almond Formation, Lewis Shale, and Ericson Sandstone. The Jade Exploratory Unit extended into the eastern part of the planning area and was tested in the Almond Formation and the Lewis Shale.

All other units listed in Table A13-1 originally were part of exploratory unit proposals that were later terminated because economic quantities of oil and gas were not discovered. The large number of producing units and exploratory unit wells drilled in the planning area shows that unitization has been a popular method for exploration and orderly development.

Five producing units are classified by the Wyoming Oil and Gas Conservation Commission as “fields.” The limits of these fields may extend beyond the unit boundaries. Other fields in the planning area are Pine Canyon Field south from the edge of the planning area, Essex Mountain and unnamed fields, and the abandoned Freighter Gap and Saddle Bag fields. In addition three other wells have been completed as

coalbed gas wells but have not generated production in an unnamed field. The wells in each of these fields are listed in Table A13-1.

All fields in the planning area are developed over stratigraphic traps and produce gas and occasionally some oil or condensate from the lower Cretaceous Frontier, Dakota, and Mowry formations. Only four other productive wells have been drilled, all in the upper Cretaceous section. Three of these were coalbed gas wells completed in the Mesaverde Group, and one oil well was completed in the Rock Springs Formation. A number of other younger Tertiary formations and older Mesozoic and Paleozoic age formations produce oil and gas outside the planning area in other parts of the Greater Green River Basin.

3.5.4.1.2 Undeveloped Reserves

Oil and gas development potential (Map 69) was determined for the Green River Final EIS RMP (USDI 1996) by geologic analysis of data from United States Geologic Survey publications and databases and a survey of industry interest in development within the planning area. The map has been updated to show increased potential for development based on the drilling of a well with a significant show of gas just outside the northwest boundary of the planning area. The area of high potential for oil and gas development has been extended north from areas of existing production to the northwest part of the planning area based on the results of exploration activity in 2001 and 2002. Resource estimates, potential recovery rates, and possible development scenarios are evaluated in the Hydrocarbon Occurrence and Development Potential Report (Appendix 13) that has been prepared for the planning area.

3.5.4.1.3 Existing Facilities

An extensive natural gas transmission system now exists in Wyoming and the Rocky Mountain region. Gathering lines and compression stations within the planning area are used to deliver gas to regional transmission pipelines. Most producers sell gas directly to local gas distribution companies, with the pipeline acting as a “common carrier” of natural gas.

3.5.4.2 Coal and Coalbed Gas

The southern part of the planning area is within the Coal Occurrence and Development Potential area. The focus of this designation is on the late Cretaceous and early Tertiary coal-bearing formations around the Rock Springs Uplift. Current information indicates that significant coal-bearing formations are present in the planning area. However, the depth to reach these formations and the thickness of the seams within the formations reduce the economic viability of mining. Map 56 shows the area with coal development potential that has been identified in the planning area. Coalbeds in this area are buried by overlying sediments. Exploration drilling data in this area indicate numerous coal seams, with thickness ranging from 0.3 to 8 feet at depths from 8 to 428 feet. One notable coalbed ranges in thickness from 3 to 8 feet and occurs at depths ranging from 11 to 283 feet in depth.

Presently there are no coal operations within the planning area boundary. Coal seams with sufficient thickness and suitable overburden ratios are present south of the planning area to support active mining. It is anticipated that future coal development in this part of Wyoming would focus on the extension of existing mining activities to develop additional resources. These resources would be economically favorable over coal mining within the JMH boundaries.

Potential for the occurrence of Tertiary coalbed gas and the occurrence of Upper Cretaceous coalbed gas were determined by Stilwell (1991) for the Green River RMP (1996). New information obtained while preparing this EIS caused modification of the area development potential for coalbed gas (Map 70). Information provided by the Wyoming Geological Survey was used to identify coalbed gas potential areas

based on the occurrence and distribution of coal seams in Cretaceous and Tertiary formations in the planning area.

3.5.4.3 Sodium

The planning area is not within any known sodium leasing area. Sodium brines exist in the Wilkins Peak Member of the Green River Formation near Eden and are open to exploration and consideration for leasing and development. However, previous efforts to process the brines for marketable commodities have not proved economically viable, and extensive trona resources are actively mined outside the planning area in other parts of the Green River Basin.

3.5.4.4 Oil Shale

Deposits of oil shale are known to occur in the Tipton, Wilkins Peak, and Laney members of the Green River Formation. The western part of the planning area officially has been classified as prospectively valuable for oil shale. This classification indicates that oil shale has priority for mineral resource development and that this area has been withdrawn from location of mining claims for other minerals under the Mining Act of 1872. However, development of oil shale has not proved economically viable, and there has been no interest in leasing oil shale resources in the planning area since the mid 1980s.

3.5.4.5 Potash

The Leucite Hills, including Boars Tusk and Steamboat Mountain, are known to contain potash. Schultz and Cross (1912) estimated that approximately 10 percent of more than 206 million tons of rock at Steamboat Mountain was potash. Boars Tusk was estimated to contain 2.9 million tons of potash. Potash was mined during World War I by the Liberty Potash Company on Zirkel Mesa, located south of the planning area. Potassium chloride was processed in a plant in Green River for fertilizer (Hausel, Sutherland, and Gregory 1995). Other sources of potash have been successfully developed in other areas where this commodity can be produced at lower costs than potash resources in the planning area. Based on these economic factors, potash mineral development is not anticipated in the planning area.

3.5.5 Salable Minerals

Salable minerals are those materials such as sand, gravel, and construction material that are sold or permitted under the Mineral Materials Sale Act of 1947.

3.5.5.1 Sand and Gravel

Lands open to development of salable minerals within the planning area lack good quality construction material, except for Steamboat Mountain, which is capped by volcanic lava. The South Pass Historic Landscape, Sweetwater River plus one quarter-mile buffer, and the Sand Dunes contain quality construction materials. However, the Green River RMP (USDI 1997) prohibits development of salable minerals in these areas.

Nearly all material used for construction and maintenance of constructed gravel and paved roads comes from outside the planning area. The exception is a Wyoming Transportation Department borrow site along Wyoming Highway 28. Approximately four acres of disturbance has occurred at this site.

3.5.5.2 Clay

The Cretaceous Lance Formation, Lewis Shale, and Mesaverde Group may contain clays and shales suitable for use in the manufacturing of structural clay products (Construction Materials Survey 1965). Potential products include brick tile, sewer pipe, and other items used in construction. Little testing of these clays and shales has been conducted. The sediments containing the potentially usable clays occur in the southern portion of the planning area. The scarcity of water supplies and lack of infrastructure in this part of the planning area would probably make clay mining and related manufacturing uneconomic.

3.5.6 Locatable Minerals

Locatable minerals are those that can be located and claimed under the Mining Act of 1872, including gold, diamonds, and uranium. Mining for these minerals requires staking a claim rather than receiving a lease issuance. In special management areas, a plan of operations is required for all mining activities. The plan of operations must describe surface disturbing activities, provide for mitigation of impacts to other resources, and provide for reclamation of surface disturbances. Outside of special management areas, plans of operation are required where mining activities disturb more than 5 acres of land. Casual use mining does not require a plan of operations for mining activity that does not use motorized equipment or powered hydraulic mining in streambeds.

3.5.6.1 Gold

Historically gold has been the primary locatable mineral explored for in the planning area. At present, active mining claims are located east of Dickie Springs, south of the Sweetwater River, and northwest of Honeycomb Buttes (USDI 1997). These claims are placer claims except for one lode claim on the pre-Cambrian outcrop in Section 4, Township 27 North, Range 100 West. Active mining claims are those that have been properly recorded, have annual filings completed for the current year, and may or may not have exploration and/or mining operations in progress (Map 71).

In the recent past, a few claims have been explored by trenching with a backhoe, but most exploration is done with pick and shovel. One notable exception is a small-scale trommel operation that is run by claimants in their free time. Weather restricts activity to the snow-free months, generally from May to mid-November. Current exploration activity disturbs less than 5 acres and is reflective of the amount of activity seen in the area since the placers were first worked in 1863.

Reconnaissance investigations of placer gold deposits in the northern part of the planning area have indicated that a significant quantity of gold may be present in the area, and it has been estimated that more than 28 million troy ounces of gold may be present in the Dickie Springs and Oregon Gulch areas. Later investigations have determined that the placer gold deposits are restricted to a thin stratigraphic zone approximately 1 foot thick within the gold-bearing sequence of sedimentary deposits. In addition, the lateral extent and continuity of the gold-bearing zone has not been determined. The initial resource estimate assumed that the gold is present throughout the thickness of the host sand and gravel deposits. The restricted vertical section of gold-bearing material revealed by detailed sampling at discrete depth intervals indicates that the actual resource in the area may be significantly less than previously estimated. However, other resources in addition to placer deposits may be present in the planning area, such as lode deposits that were the source material for the placer gold in the Dickie Springs and Oregon Gulch areas. Because of the large uncertainties associated with these potential resources, a reliable quantitative estimate of gold resources cannot be provided for the planning area.

3.5.6.2 Diamonds

Diamonds could potentially occur in association with the Quaternary volcanic rocks (lamproites) found in the southern part of the planning area (Hausel et al. 1995, 1997). Although no diamonds have ever been recovered from these lamproites, they exhibit characteristics similar to diamond-bearing lamproites found in Arkansas, Western Australia, and India. Additional exploration is needed to further define these structures and to search for diamonds. Detailed petrographic and geochemical analyses and evaluation of larger sample volumes will be necessary to determine the presence of diamonds in this rock type.

3.5.6.3 Uranium

Wyoming has been a major producer of uranium in the United States (Harris and King 1993). Harris and King report that uranium mineralization is widespread in Wyoming. Large deposits of uranium occur outside the planning area in several districts. In the northern part of the planning area, the U.S. Geological Survey (Patterson et al. 1987) reports the occurrence of uranium within coalbeds of the Wasatch Formation (Tertiary) and possible deposits within the conglomeratic lenses of the Cathedral Bluffs Tongue of the Wasatch Formation. Uranium exploration has occurred on claims staked in the northern part of the planning area and south of the planning area around the Rock Springs Uplift. These claims targeted the Rock Springs Formation and/or Ericson Formation of the Cretaceous Mesaverde Group. Based on results of previous exploration activity, the potential for development of uranium within the planning area is very low.

3.5.7 Alternative Energy Resources

Alternative energy resources include development of wind power and solar power.

3.5.7.1 Wind

The Wind Energy Resource Atlas of the United States (Pacific Northwest Laboratory 1986) provides wind power classifications on a regional basis. The planning area is generally within wind power class 6 (ranging from 1 to 7), with wind power densities of 300 to 400 watts per square meter. These data indicate that some locations within the planning area may be suitable for wind power development provided that suitable topographic locations could be developed and that access to the power grid and transmission line ROWs could be developed. However, interest in developing wind power facilities within the planning area has not been expressed to date.

3.5.7.2 Solar

The University of Oregon maintains a series of solar power research stations throughout the northwestern United States, including a station located at Green River, Wyoming (http://solardat.uoregon.edu/). Data from this station indicate that average daily photovoltaic cell output measured in kilowatt-hours per square meter per day range from 3.21 in January to 8.18 in June, based on data collected from 1994 to 2000. These data indicate that the area has some development potential for solar power conversion to electricity. Development of solar power facilities would depend on accessibility to suitable locations and ROW access to power distribution lines, along with technological developments to decrease the costs and increase the efficiencies of photovoltaic cells. However, interest in developing solar power facilities within the planning area has not been expressed to date.

3.6 VISUAL RESOURCES

Visual resources include the physical (natural and artificial) and biological features of the landscape that contribute to the scenic quality of an area. Scenic quality is a measure of the visual appeal of the landscape and is perhaps best described as the overall impression retained after driving through, walking through, or flying over an area. Although relative values can be used to evaluate scenic quality, visual appeal is subjective and can vary among observers.

3.6.1 Visual Resource Inventory

Scenic value is one of the resources for which public lands are to be managed in accordance with FLPMA. BLM manages this resource by determining visual values through a resource inventory process. The inventory consists of a scenic quality evaluation, sensitivity level analysis, and distance zones mapping.

Visual resources are best described using the physiographic provinces, which are large-scale geographical units of land. The scenic quality is evaluated against seven factors or common characteristics within the province: landform, vegetation, water, color, adjacent scenery, scarcity, and cultural modifications. The physiographic province helps establish a frame of reference with which to classify the relative scenic quality. Areas with more variety and harmonious composition tend to have greater scenic value.

The JMH CAP planning area lies mostly within the Wyoming Basin physiographic province. The landscape within the Wyoming Basin province is varied and characterized by highly erodible soils and multicolored, horizontally layered sedimentary bedrock. Colorful badlands landscapes are common throughout the planning area and are interspersed with low rolling or flat-topped hills. Low precipitation levels and localized occurrence of surface water provides for the following distinct vegetative communities: riparian vegetation found along perennial streams, intermittent surface water locations, and rivers; sparse vegetation located on well-drained soils of side slopes and hillsides; and alkaline vegetation in localized areas where evaporation rates exceed the volume of infiltrating surface water.

Scenic quality includes cultural modifications, which are artificial (human-made) changes to the land, water, or vegetation, or the addition of a structure that creates visual contrast to the natural character of the landscape. Cultural modifications within the physiographic province are primarily associated with oil and gas production (such as well facilities, pipelines, roads, and power distribution lines) and with livestock grazing operations (such as fences and water developments).

Evaluation of visual resources also considers sensitivity levels or measures of public concern for the maintenance of scenic quality. Sensitivity factors include type of user, amount of use, public interest, adjacent land use, and special management areas.

Scenic quality can also depend on sight distances. Landscapes are divided into distance zones based on relative visibility from travel routes or observation points. These zones are foreground-middle ground, background, and seldom seen. Distance zones are used to adjust visual classes in areas of overlapping resource uses. Foreground-middle ground zones are more visible to the observer and are more sensitive to change.

Lands are placed into one of four visual resource inventory classes. These classes represent the relative value of the visual resource as determined through the inventory process. Inventory Class I and Class II are the most valued, and Class III and Class IV represent moderate value and least value, respectively. Class I is assigned to areas where a management decision was made to maintain a natural landscape. The other classes are based on the combination of scenic quality, sensitivity level, and distance zones.

3.6.2 Visual Resource Management

The visual resource classes serve as a management tool in making land use decisions. Visual Resource Management (VRM) classes (I, II, III, IV) set standards for planning, designing, and evaluating projects by identifying various permissible levels of landscape alteration while protecting overall regional scenic quality. Management objectives for the classes are presented in Table 3-25.

Table 3-25. Visual Resource Management Class Objectives

Class	Objective
I	Existing character of the landscape should be preserved. Natural ecological changes should be provided for (does not preclude very limited management activity). Level of change to characteristic landscape should be very low and must not attract attention.
II	Existing character of the landscape should be retained. Level of change to characteristic landscape should be low. Management activities may be seen but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in predominant natural features of the characteristic landscape.
III	Existing character of the landscape should be partially retained. Level of change to characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of characteristic landscape.
IV	Management activities that require major modifications of the existing character of the landscape should be provided for. Level of change to characteristic landscape can be high. Management activities may dominate the view and be the major focus of viewer attention. Minimize the impact of activities through careful location, minimal disturbance, and repeating the basic elements.

The VRM classes in the JMH CAP planning area are shown on Map 13. WSAs would be managed as VRM Class I areas to preserve the natural setting and existing character of the landscape. VRM Class II areas include the southern portion of Steamboat Mountain ACEC, Greater Sand Dunes ACEC, South Pass Historic Landscape ACEC, White Mountain Petroglyphs ACEC, and areas adjacent to the WSAs. Land areas included in VRM Class III include the northern portion of Steamboat Mountain ACEC, the northern portion of the White Mountains (Petroglyphs area), Split Rock, Eden Valley, and the western part of the Red Desert watershed area. The remainder of the JMH CAP planning area is classified as VRM Class IV.

3.7 SPECIAL MANAGEMENT AREAS AND OTHER MANAGEMENT AREAS

A special management area is any area where an authorized officer has determined resources require special management and control measures for their protection. Special management areas within the JMH CAP planning area include WSAs, ACECs, SRMAs, and other areas such as watershed areas (Map 14).

3.7.1 Special Management Areas

3.7.1.1 Wilderness Study Areas

WSAs are roadless areas that have been inventoried and found to have wilderness characteristics as defined in Section 2(c) of the Wilderness Act of 1964. These characteristics require an area to generally appear in a natural state and be substantially unaffected by the actions of humans. The area should encompass at least 5,000 acres to make practicable its preservation and to offer opportunities for solitude or a primitive and unconfined type of recreation. Although not a required characteristic, the area may also contain ecological, geological, or other features of scientific, educational, scenic, or historic value.

Section 603 of FLPMA directed BLM to inventory, study, and recommend to Congress by 1991, through the Secretary of the Interior and the President, public lands suitable or unsuitable for wilderness designation. BLM lands in the Green River Resource Management Area were inventoried for wilderness characteristics, and 13 areas were evaluated in the Final Rock Springs Wilderness EIS for suitability as WSAs (USDI 1990). Within the JMH CAP planning area, seven WSAs were determined to meet wilderness characteristics: Buffalo Hump, Sand Dunes, Alkali Draw, South Pinnacles, White Horse Creek, Oregon Buttes, and Honeycomb Buttes (Map 14). Table 3-26 outlines the results of these determinations.

Table 3-26. Wilderness Study Area Determinations

WSA	Wilderness Criteria Met (acres)	Suitable for Designation (acres)	Unsuitable for Designation (acres)
Buffalo Hump	10,300	6,080	4,220
Sand Dunes	27,109	21,304	5,805
Alkali Draw	16,990	0	16,990
South Pinnacles	10,800	0	10,800
Honeycomb Buttes	41,404	37,287	4,117
Oregon Buttes	5,700	5,700	0
Whitehorse Creek	4,002	0	4,002
Total[1]	**116,305**	**70,371**	**45,934**

Source: Final Rock Springs Wilderness Environmental Impact Statement, 1990.
[1]Total acres vary from GIS files.

The BLM Interim Management Policy and Guidelines for Lands Under Wilderness Review provides direction for managing the WSAs so as not to impair their suitability for designation as wilderness, subject to valid existing rights. Permissible activities under interim management guidelines are temporary uses that create no new surface disturbance nor involve permanent placement of structures. Temporary, nondisturbing activities, as well as activities governed by valid existing rights, may generally continue in WSAs.

Only Congress can designate areas as wilderness or release from interim management the areas that were placed under wilderness study. All wilderness recommendations within the JMH CAP planning area are pending congressional decision.

3.7.1.1.1 Buffalo Hump

Buffalo Hump WSA has no private or state inholdings. The primary topographic relief consists of sand valleys, blowouts, hills, and dunes with individual dunes exceeding heights of 100 feet. The interdunal areas contain ponds, grass-covered marshes, and playas. The WSA exhibits a natural condition of undisturbed sagebrush-grassland ecosystem intermingled with active sand dunes. The recreation values

are outstanding, with opportunities for hiking, backpacking, nature study, photography, hunting, and rockhounding.

3.7.1.1.2 Sand Dunes

Sand Dunes WSA comprises a large part of the Killpecker Sand Dunes and contains large areas of barren active dunes, wet meadows, greasewood, big sagebrush, and rabbit brush communities. A unique feature of the WSA is the Aeolian ice-cells that feed pools at the base of many of the large sand dunes. The naturalness of this WSA is considered exceptional because of the lack of humanmade intrusions. The flowing dunes virtually eliminate any evidence of human activity in the area. The Steamboat elk herd uses this area.

3.7.1.1.3 Alkali Draw

Alkali Draw WSA contains a remnant of the Great Divide Basin-Red Desert area. A series of draws or canyons extend through the WSA, creating a "washboard" topographic effect. Alkali Rim dominates the southern aspect and exhibits colorful blue rock escarpments. Big sagebrush is the dominant vegetation community, with greasewood common along the major drainages. The WSA contains habitat for mule deer and elk. The WSA is in a natural condition, and the humanmade intrusions are substantially unnoticeable and undergoing natural revegetation. However, the value of the area for oil and gas production and the degree of the wilderness values made the WSA unsuitable for wilderness designation.

3.7.1.1.4 South Pinnacles

South Pinnacles WSA contains mostly flat topography with an exposure of broken rim rocks and ridges. Greasewood communities occupy the draws, with big sagebrush in the open areas. The WSA is natural in character and provides opportunities for solitude and varied recreation. However, the potential for gas production and the manageability of the area made the WSA unsuitable for wilderness designation.

3.7.1.1.5 Honeycomb Buttes

Honeycomb Buttes WSA contains several terrain types, ranging from sagebrush hills and greasewood flats surrounding the badlands to eroding buttes, colored bluffs, and side canyons. This area is one of the best examples of badlands topography in the state and of fossil- and fossil cast-bearing formation in the region. These highly colorful and rugged desert badlands provide outstanding opportunities for solitude. The WSA is natural in character and relatively free of human activities because of the severe topography of the area.

3.7.1.1.6 Oregon Buttes

Oregon Buttes WSA contains no private or state inholdings. The buttes are a prominent feature rising out of the Red Desert, with historical significance as the major landmark for travelers of the Oregon Trail. Resources of the area consist of limber pine stands, small aspen stands, prime raptor habitat, and valuable big game habitat. Visibility from the buttes extends for miles and provides scenic vistas of the mountain ranges to the north and south. The WSA is in a natural state and provides outstanding recreation opportunities for birdwatchers and photographers.

3.7.1.1.7 Whitehorse Creek

Whitehorse Creek WSA contains no private or state inholdings. A large portion of the area contains eroding red, green, and gray buttes. The area supports various habitats and landscapes, including aspen

and limber pine stands, sheer sandstone cliffs, and badland topography. The WSA contains important raptor habitat. Opportunities for solitude and primitive recreation are high in areas of the WSA where large escarpments and buttes are located. The potential for gas production and the manageability of OHV use in the portion of the area with little topographic relief contributed to the determination of unsuitability for wilderness designation for this WSA.

3.7.1.2 Areas of Critical Environmental Concern

ACECs are areas of BLM-administered lands where special management attention is needed to protect and prevent irreparable damage to important resources. To be designated an ACEC, the area must meet the criteria of relevance and importance (43 CFR §1610.7-2 and BLM Manual 1613). Areas meeting the relevance criterion possess significant historic, cultural, or scenic values; fish or wildlife resources including T&E species; or natural hazards. To meet the importance criterion, the resource must have substantial significance and value. This generally requires qualities of more than local significance and special worth, consequence, meaning, distinctiveness, or cause for concern. A natural hazard can be important if it is a significant threat to human life or property.

There are five ACECs within the JMH CAP planning area: Greater Sand Dunes, Oregon Buttes, South Pass Historic Landscape, Steamboat Mountain, and White Mountain Petroglyphs (Map 14). Another ACEC within the Green River Resource Management Area, the Special Status Plant Species ACEC, does not currently contain acreage within the JMH CAP planning area; however, there is potential for other sensitive species within the planning area to be added.

3.7.1.2.1 Greater Sand Dunes

The Greater Sand Dunes ACEC met the relevance and importance criteria in 1982 for outstanding geologic features, prehistoric and historic values of national significance, and recreation values of regional and national importance. Management objectives preserve and protect the integrity of these unique values in the area for future public use and enjoyment. The ACEC is unique to the Wyoming Basin and contains values that are “geologically, aesthetically, and biologically interesting” (McGrew et al. 1974).

The Greater Sand Dunes are part of the larger Killpecker dune field, the largest active dune field in North America. The Killpecker dune field encompasses approximately 109,000 acres, extending 55 miles east from the Green River Basin across the Continental Divide into the Great Divide Basin. The ACEC comprises approximately 41,600 acres (approximately 38 percent of the Killpecker dune field). Boars Tusk, a remnant volcanic neck, is an unusual geologic feature that lies within the Greater Sand Dunes ACEC.

The dunes within the Greater Sand Dunes ACEC help to support the Steamboat elk herd known to occupy this unique desert habitat. Elk occupy the area during the spring and fall, using dunal ponds (flockets) as a source of water. The dunal ponds generally are not as alkaline as other water sources in the area and are known to provide an oasis for plants and animals. The dunal ponds also provide excellent habitat for waterfowl, amphibians, songbirds, and small mammals.

The western portion of Greater Sand Dunes ACEC encompasses some of the Sand Dunes and Buffalo Hump WSAs. These WSAs are managed under the BLM Interim Management Policy for Lands Under Wilderness Review (BLM Manual H-8550-1), as discussed above. The eastern portion of Greater Sand Dunes ACEC incorporates the boundary of the Greater Sand Dunes SRMA, which offers outstanding motorized and nonmotorized recreational values. The historic Crookston Ranch is also located within the ACEC.

3.7.1.2.2 Oregon Buttes

Oregon Buttes ACEC was designated in 1982 to protect its scenic integrity as a historic landmark and to protect the significant wildlife values found in the area. The ACEC lies on a structural platform that joins the Rock Springs Uplift to the Wind River Mountain Range (Zeller and Stephens 1969). At Oregon Buttes, the Continental Divide splits into east and west rims, which rejoin at Bridgers' Pass, south of Rawlins, and encloses an area known as the Great Divide Basin.

The Buttes are a dominating landform and were often noted by emigrants using the Oregon Trail, marking the halfway point in their journey from Independence, Missouri, to the Pacific Ocean. The buttes also denoted the Continental Divide and the point where they crossed into the Pacific watershed.

The ACEC provides excellent wildlife habitat. The area is used heavily by big game species, and the buttes themselves are occupied by many raptors. Deer fawning and elk calving also occur in the area.

Honeycomb Buttes, Oregon Buttes, and Whitehorse Creek WSAs overlap the ACEC, thus the ACEC is managed under the BLM Interim Management Policy for Lands Under Wilderness Review (BLM Manual H-8550-1).

3.7.1.2.3 South Pass Historic Landscape

The South Pass Historic Landscape ACEC was designated in 1997. Management priority and emphasis was given to maintaining and enhancing the visual and historic integrity of the historic trails and their surrounding viewscape.

South Pass is located on the northwest edge of the Wyoming Basin. The pass was the site where emigrant travelers traversed the Continental Divide, and thus it roughly marks the halfway point in the epic westward journey. The scenic vista of South Pass is among the most important historic landscapes, because South Pass served as the primary mountain gateway to the West along the Oregon, Mormon Pioneer, Pony Express, and California National Historic Trails. This viewscape includes the top rim of Pacific Butte on the south and the divide between waters flowing to Pacific Creek and the Sweetwater River on the north and east.

The site on the pass where several commemorative markers have been placed is listed on the National Register of Historic Places. In 1959 the National Park Service designated South Pass a National Historic Landmark. The National Park Service proposed a boundary for the landmark in 1984; however, an official boundary has not been delineated.

3.7.1.2.4 Steamboat Mountain

The Steamboat Mountain ACEC was designated in 1997 to protect wildlife and cultural values of national significance and unique habitat features. The area is the year-round home of the Steamboat desert elk herd and has highly varied topographic features and unique habitats of stabilized sand dunes that are found nowhere else in the resource area.

Tall sagebrush of up to 8 to 12 feet provides escape cover, shelter, thermal protection, and birthing areas for big game. Limber pine and aspen communities provide habitat to a wide variety of wildlife but are limited in size and localities. Other mountain shrub communities, such as serviceberry and mountain mahogany, provide forage in deep snow conditions. Grass-covered ridgetops offer additional forage for elk during crucial winter periods.

The Steamboat Mountain ACEC, along with a portion of the Greater Sand Dunes ACEC and overlapping crucial winter range, is part of what is called the "core area" within the planning area. The core area is approximately 90,700 acres in size and is considered the most crucial habitat for many of the species (especially elk and deer) that inhabit the planning area.

3.7.1.2.5 White Mountain Petroglyphs

The White Mountain Petroglyphs ACEC was designated in 1982 to protect cultural values of national significance. Native American drawings associated with the early ancestors of the present Shoshone Tribe and perhaps other tribes are contained within the ACEC. Common drawings include human figures, elk, buffalo, feather headdresses, and human stick figures.

Several times during consultations both tribal councils and elders pointed out the importance of wildlife, especially elk in the Jack Morrow Hills area. The time depth of Native American appreciation of the Steamboat elk herd seems evident at White Mountain Petroglyphs. A number of renditions of elk are depicted in an amplified scale compared to warriors on horseback, bison, tipis and other features. The fact that these drawings of elk are very detailed, and that they are roughly five times larger than people and other animals depicted at the site reinforces the contention by modern Native Americans that the Steamboat elk herd has long been important to Native people of the area.

3.7.1.2.6 Special Status Plant Species

The Special Status Plant Species ACEC was designated in 1997. Special status plants are those listed, proposed for listing, or candidates for listing as T&E under the ESA, identified by the state in a category implying potential endangerment or extinction, or species designated by the BLM State Director as sensitive.

Management priority and emphasis for the ACEC was given to maintain or enhance these species and their habitats. Although no species associated with the ACEC occur within the planning area, there is potential for other sensitive species to be added to the ACEC as provided in the Green River RMP.

3.7.1.3 Special Recreation Management Areas

SRMAs include areas where a commitment has been made to provide specific recreation activity and experience opportunities. These areas usually require a high level of recreation investment and management. There are two areas within the planning area designated as SRMAs: (1) Greater Sand Dunes and (2) Oregon, Mormon Pioneer, California, and Pony Express National Historic Trails.

3.7.1.3.1 Greater Sand Dunes

The Greater Sand Dunes SRMA incorporates the boundary of the Greater Sand Dunes ACEC and provides outstanding motorized and nonmotorized recreational values. In 1983, an ACEC management plan was completed that also serves as the Recreational Activity Management Plan for the SRMA. Located within the eastern portion of the SRMA is the Greater Sand Dunes Recreation Area, which carries an "open" OHV designation on 10,020 acres. The SRMA also contains an OHV parking lot and camping area that were built in the mid-1980s.

3.7.1.3.2 Oregon, Mormon Pioneer, California, and Pony Express National Historic Trails

The National Trails System Act provides for the designation and protection of original trails or routes of travel of national historic significance and historic remnants and artifacts for public use and enjoyment.

National Historic Trails are designated through criteria established in the act, and only those parts of the trail that meet the criteria and are contained on federal lands are provided protection.

The Rock Springs Field Office manages hundreds of miles of the best traces of 19th century emigration trails, including the Oregon, Mormon Pioneer, California, and Pony Express trail systems. These trails represent the main overland routes of people, property, and information available during the nation's westward expansion. The National Historic Trails SRMA is within the South Pass Historic Landscape ACEC and is managed for a range of visitors, from local dedicated OHV users to the transient visitor that is simply passing through the area. The National Park Service prepared a comprehensive management and use plan in 1999 for the California and Pony Express National Historic Trails and an update to the Oregon and Mormon Pioneer National Historic Trails Management Plan. The trails are described in Section 3.2, Heritage Resources.

3.7.2 Other Management Areas

3.7.2.1 Red Desert Watershed Management Area

The Red Desert Watershed was identified as a watershed management area in the Green River RMP. The management objective established for the watershed is management of all resource values in the Red Desert area, with emphasis on protection of visual resources, watershed values, and wildlife resources, and the provision of large areas of unobstructed views for enjoyment of scenic qualities.

The Red Desert Watershed comprises one of the last undeveloped high desert regions in the west. It contains unique landforms, colorful badlands, and shifting sand dunes. Much of the Red Desert Watershed still looks the same way it did when the pioneers passed through the Continental Divide on the Oregon and Mormon Pioneer Trails. The Red Desert Watershed also contains portions of four WSAs within the planning area: Alkali Draw, Honeycomb Buttes, Oregon Buttes, and South Pinnacles. Portions of the Oregon Buttes and Steamboat Mountain ACECs are also within the Red Desert Watershed.

The Red Desert Watershed falls within the Great Divide Basin, which is a hydrologically closed basin. Most streams are intermittent and flow toward the center of the basin into playa lakes, where they either recharge the aquifers or evaporate. Artesian groundwater and unconfined groundwater are found throughout the watershed area.

The Great Divide Basin is a cold, high-elevation desert environment that provides habitat for a variety of wildlife species. Along Bush Rim, Freighter Gap, and other rims surrounding the basin, vegetation is highly variable and provides the most cover and forage. Aspen and limber pines provide cover for big game. South-facing slopes containing serviceberry, mountain mahogany, and currants are favored as big game winter range. Raptors can also be found throughout the watershed area, although most are concentrated in the Oregon Buttes ACEC and the Honeycomb Buttes WSA.

3.7.2.2 Pinnacles Geographic Area

The Pinnacles Geographic Area includes approximately 8,900 acres in the southeast portion of the Red Desert Watershed. The area is identified as having values of naturalness, solitude, and a primitive unconfined type of recreation. The Pinnacles Geographic Area includes the Pinnacles Geologic Feature, which is a 1,344-acre scenic, geologic, and watershed sensitive area that contains the actual Pinnacle monoliths, identified as the Pinnacles Proper (approximately 660 acres). The Pinnacles are visually interesting compared with other landforms in the surrounding area. Most landforms in this area are horizontal rims, whereas the Pinnacles are vertical and protrude upward from the desert floor, providing a very interesting contrast. The Pinnacles themselves are nesting grounds for the ferruginous hawk.

3.8 AIR RESOURCES

Air resources are affected predominantly by existing concentrations of various pollutants and the climatic and meteorological conditions that influence their fate and transport in the atmosphere.

3.8.1 Climate and Meteorology

The climate of the JMH CAP planning area is classified as semi-arid steppe (Trewartha and Horn 1980). 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 dryness of the mid-latitude steppe climate of southwestern Wyoming is due to the distance from the Pacific Ocean, the main source of precipitable water for North America. This aridity is further intensified by the Rocky Mountains, which block the eastward flow of humid coastal air. In addition, annual rainfall amounts vary greatly from year to year (Trewartha and Horn 1980).

Weather stations in the planning area include those located in Rock Springs and Farson in Sweetwater County, Wyoming. Rock Springs is at an elevation of 6,741 feet and is about 15 miles south of the JMH CAP planning area. Farson is at an elevation of 6,675 feet and is about 4 miles northeast of the JMH CAP planning area.

3.8.1.1 Temperature

Mean annual temperatures range from 36 degrees ºF in Farson to 43 degrees ºF in Rock Springs. Summer highs are usually in the 70s and 80s but may reach the high 90s. Winter lows are generally in the minus single digits but may reach the minus 20s in Farson. Rock Springs winter lows are generally in the teens.

3.8.1.2 Precipitation

Mean annual precipitation is 8 and 9 inches in Farson and Rock Springs, respectively. Annual precipitation ranges from 3 or 4 inches in drought years to as much as 17 inches in wet years. Mean monthly precipitation is greatest in spring. Mean annual snowfall in Farson averages about 3 feet, with most snow occurring from November through April. Mean annual snowfall in Rock Springs averages just under 4 feet, with most snow occurring from October through April. Average snow depth is 2 or 3 inches.

3.8.1.3 Dispersion

Atmospheric stability is a measure of the atmosphere=s capacity to disperse pollutants. Mean annual stability at Rock Springs is high (leading to low dispersive capacity) less than 20 percent of the time, low (leading to high dispersive capacity) about 20 percent of the time, and neutral (leading to fair dispersive capacity) more than 60 percent of the time (USDI 1999a).

3.8.1.4 Wind Velocity

Winds in Rock Springs are relatively strong and are generally from the west and west-southwest.

3.8.2 Air Quality

Elements of air quality addressed in this study include concentrations of air pollutants, visibility, and atmospheric deposition. See Appendix 15 for more detailed information.

3.8.2.1 Pollutant Concentrations

Pollutant concentration refers to the mass of pollutants present in a volume of air and is reported in units of $\mu g/m^3$. Air quality in the planning area is considered excellent; however, current and complete concentration data on criteria air pollutants for JMH and the immediate vicinity are not available. The State of Wyoming has used monitoring to determine that the JMH region is in compliance with Wyoming Ambient Air Quality Standards (WAAQS) and National Ambient Air Quality Standards (NAAQS) (Table 3-27, Figure A15-10, and Figure A15-11).

Table 3-27. Background Concentrations of Criteria Air Pollutants

Pollutant	Averaging Time	Background Concentration ($\mu g/m^3$)	Percent NAAQS (%)	Percent WAAQS (%)
Carbon Monoxide (CO)	8 hour	1,500	15	15
	1 hour	3,500	9	9
Nitrogen Dioxide (NO_2)	Annual	3.4	3	3
Sulfur Dioxide (SO_2)	Annual	9	11	5
	24 hour	43	12	17
	3 hour	132	10	19
Ozone (O_3)	8 hour	147	94	94
	1 hour	169	72	72
Particulate Matter (PM_{10})	Annual	16	32	32
	24 hour	40	27	27
Fine Particulate Matter ($PM_{2.5}$)	Annual	5	33	33
	24 hour	13	20	20

Refer to the Pinedale Anticline Oil and Gas Exploration and Development Project for description of data sources.

3.8.2.1.1 Carbon Monoxide

Carbon monoxide data were collected in Colorado in conjunction with the proposed oil shale development in the 1980s (USDI 1983). Because CO data are generally collected only in urban areas where automobile traffic levels are high, recent data are often unavailable for rural areas.

3.8.2.1.2 Nitrogen Dioxide

Nitrogen dioxide data were collected at the Green River Basin Visibility Study site from January 1 to December 31, 2001. Monitoring of other nitrogen-containing pollutants shows that concentrations at Pinedale, Wyoming, of nitric acid (HNO_3), nitrate (NO_3), and particulate ammonium (NH_4) are low and not increasing over time.

The Clean Air Status and Trends Network (CASTNet) has measured concentrations of nitric acid, nitrate, and ammonium, as well as ozone, sulfur dioxide, and sulfate, in the United States since the late 1980s. There are three CASTNet stations in Wyoming: Centennial, Yellowstone National Park, and Pinedale. Figure A15-1 shows mean annual concentrations of nitrogen-containing pollutants in Pinedale from 1989 through 1999 to be 0.5 $\mu g/m^3$ or less.

The Wyoming Air Resources Monitoring System (WARMS) has measured concentrations of nitrate and particulate ammonium, as well as sulfur dioxide and particulate sulfate, in Wyoming since 1999. There are four WARMS stations in Wyoming: Centennial, Buffalo, Sheridan, Newcastle, and Pinedale. Weekly concentrations of NO_3 are below 1.5 $\mu g/m^3$, and concentrations of NH_4 are below 0.5 $\mu g/m^3$.

Because the chemistry of nitrogen-containing pollutants is very complex, it would be inappropriate to infer NO_2 concentrations from concentrations of HNO_3, NO_3, and NH_4. However, it would be unlikely that high NO_2 concentrations would occur with low concentrations of other nitrogen-based pollutants.

3.8.2.1.3 Sulfur Dioxide

Sulfur dioxide data were collected at the La Barge study area in the 1980s. More recent SO_2 data were collected by CASTNet and WARMS in Pinedale. Figure A15-2 shows mean annual CASTNet concentrations of SO_2 in Pinedale from 1989 through 2001 to be about 0.5 $\mu g/m^3$. Weekly WARMS concentrations of SO_2 from mid-1999 through 2001 are approximately 1.5 $\mu g/m^3$ or less. Although it may not be appropriate to compare mean annual CASTNet SO_2 concentrations with national or Wyoming standards, the CASTNet concentrations do suggest that SO_2 concentrations are well below NAAQS and WAAQS.

3.8.2.1.4 Ozone

Ozone concentration data were collected at the Green River Basin Visibility Study site from June 10, 1998, to December 31, 2001. Ozone data were also collected by the CASTNet station at Pinedale. Concentrations are relatively high but in compliance with NAAQS and WAAQS. Figure A15-3 shows mean annual O_3 concentrations have remained steady from 1989 through 2001.

3.8.2.1.5 Particulate and Fine Particulate Matter

Particulate matter (PM_{10}) data were collected at the Carbon County Underground Coal Gasification site in 1994 and 1995. Fine particulate matter ($PM_{2.5}$) data were estimated at half PM_{10} concentrations, as recommended by the Environmental Protection Agency (EPA). Mean annual PM_{10} concentrations were 32 percent of NAAQS and WAAQS, and mean annual $PM_{2.5}$ concentrations were 33 percent of NAAQS.

3.8.2.2 Visibility

The Inter-Agency Monitoring of Protected Visual Environments (IMPROVE) has measured visibility in national parks and wilderness areas in the United States since the 1980s. Six IMPROVE stations are located in Wyoming. The IMPROVE station closest to the JMH CAP planning area 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 just perceptible to an average person, about a 10 percent change in light extinction. Monitored aerosol concentrations are used to reconstruct visibility conditions.

- 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 A15-4 shows annual visibility in the Bridger Wilderness from 1988 through 1999. Visibility on the 20 percent cleanest days varies from 5 to 3 dv (visual range of about 136–68 miles). Average visibility varies from 8 to 6 dv (about 96 to 114 miles). Visibility for the 20 percent haziest days varies from 12 to 10 dv (about 56–6 miles). Trend analysis of Bridger visibility data reveals no significant worsening trend in visibility from 1989 through 2001.

3.8.2.3 Atmospheric Deposition

Atmospheric deposition refers to the processes by which air pollutants are removed from the atmosphere and deposited on terrestrial and aquatic ecosystems and is reported as the mass of material deposited on an area (kilogram per hectare [kg/ha]). 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). Substances deposited include—

- Acids such as sulfuric acid (H_2SO_4) and nitric acid (HNO_3), sometimes referred to as "acid rain"
- Air toxics such as pesticides, herbicides, and volatile organic compounds (VOC)
- Nutrients such as nitrate (NO_3) and ammonium (NH_4).

Estimation of atmospheric deposition is complicated by the contribution to deposition of several components: rain, snow, cloud water, particle settling, and gaseous pollutants. Deposition varies with precipitation, which in turn varies with elevation and time.

3.8.2.3.1 Wet Deposition

The National Atmospheric Deposition Program (NADP) assesses wet deposition by measuring the chemical composition of precipitation (rain and snow). Figure A15-5 shows the precipitation pH in Pinedale from 1982 through 2002. The natural acidity of rainwater is generally represented by a range of pH values from 5.0 to 5.6. Mean annual pH at Pinedale is generally within this range, although from 1994 through 1998 pH values dropped. During this period, pH ranged from 4.9 to 5.0. These lower values may be the result of anthropogenic acidification of precipitation in Pinedale, Wyoming.

Figure A15-6 shows mean annual wet deposition of ammonium (NH_4), nitrate (NO_3), and sulfate (SO_4). Deposition values are low: approximately 0.5 kg/ha for NH_4^+, less than 3 kg/ha for NO_3, and less than 4 kg/ha for SO_4. Deposition values from 1982 through 2000 are low and steady, indicating that deposition has not worsened during that time.

3.8.2.3.2 Dry Deposition

Dry deposition refers to the transfer of airborne gaseous and particulate material from the atmosphere to the Earth=s surface. CASTNet measures dry deposition of ozone (O_3), sulfur dioxide (SO_2), nitric acid (HNO_3), sulfate (SO_4), nitrate (NO_3), and ammonium (NH_4). Figure A15-7 shows mean annual dry deposition of sulfur- and nitrogen-containing compounds for Pinedale, Wyoming, from 1990 through 2001. Deposition values are low and steady, indicating that deposition has not worsened during this time.

3.8.2.4 Lake Chemistry

Acid deposition can cause acidification of lakes and streams. One expression of lake acidification is change in acid neutralizing capacity (ANC), the lake=s capacity to resist acidification from acid rain. Acid neutralizing capacity is expressed in units of micro-equivalents per liter (µeq/l). Lakes with ANC values of 25 to 100 µeq/l are considered to be sensitive to acid rain, while lakes with ANC values of less than 25 µeq/l are considered to be extremely sensitive.

3.8.2.5 Summary of Existing Air Quality

Table 3-28 provides a summary of air quality monitoring and dispersion modeling, which shows that air quality in the JMH region is generally good.

Table 3-28. Air Quality Summary

Air Quality Component	Status
Air Pollutant Concentration	
Criteria Air Pollutants	Concentrations are in compliance with NAAQS and WAAQS
Nitrogen Compounds	• Nitric acid (HNO_3): Concentrations are slightly higher than typical for remote areas • Nitrate (NO_3) and ammonium (NH_4): Concentrations are typical for remote areas
Sulfur Compounds	• Sulfur dioxide (SO_2): Concentrations are well below concentrations typical in remote areas • Sulfate (SO_4): Concentrations are typical for remote areas
Visibility	
Bridger Wilderness	• 20% cleanest: 136–168 miles • Average: 96–114 miles • 20% haziest: 56–76 miles
Atmospheric Deposition	
Precipitation pH	Slight acidification from 1994 to 1998 (pH varied from 4.9 to 5.0)
Total Deposition	• Nitrogen: Deposition from ammonium (NH_4) and nitrate (NO_3) is less than 2.6 kg/ha[1] • Sulfur: Deposition from sulfate (SO_4) and sulfur dioxide (SO_2) is less than 1.7 kg/ha[2]

[1]Proposed acceptable level of total nitrogen deposition is 3 to 5 kg/ha/year (USFS 1989)
[2]Proposed acceptable level of sulfur deposition is 5 kg/ha/year (USFS 1989)

3.9 SOCIOECONOMICS

The JMH is located in southwest Wyoming in portions of Sweetwater, Fremont, and Sublette Counties. Activities in the planning area have the potential to affect all three counties; thus, the socioeconomic study area includes these three counties. Data on economic characteristics have been obtained where possible for the past 20 years to examine trends in the study area.

3.9.1 County Characteristics

The characteristics of the planning area reflect those of the State of Wyoming as a whole. The three counties in the area encompass a rather large landmass with a dispersed population and few urban areas. Federal public lands also dominate this area, as summarized in Figure 3. Within the three counties, federal agencies control 65 percent of the surface acreage, with BLM managing the majority of these acres. The JMH CAP planning area comprises approximately 622,000 surface acres, which is 4 percent of the socioeconomic study area. Land ownership within the planning area is split between federal, state, and private entities, as shown in Figure 3.

3.9.2 Demographic Characteristics

Demographic characteristics of the area include study area population trends and trends in personal income levels.

3.9.2.1 Population

Annual population estimates for each of the three counties for 1980 to 2000 are plotted in Figure 4. Population within the study area declined by more than 9 percent during the 1980s, unlike the State of Wyoming as a whole, which experienced a population increase. The opposite situation occurred during

the 1990s, when population in the study area increased by 5.2 percent, exceeding population growth in the state.

Population changes occur from both "natural changes" (i.e., the net result of births and deaths) and from "net migration" (i.e., the net result of persons moving in and out of the area). Natural changes caused an increase in the study area population of nearly 14 percent in the 1980s and of 6.6 percent during the 1990s. However, net migration led to more people leaving this same area over the past two decades. All three counties reported significant decreases in population due to net migration during the 1980s, with nearly 20,000 people leaving the area. Net migration led to increases in population in Sublette and Fremont Counties during the 1990s, while Sweetwater County reported a nearly 7 percent decline.

3.9.2.2 Personal Income Trends

Personal income data were obtained for each of the counties in the study area from the U.S. Bureau of Economic Analysis (BEA). Table 3-29 summarizes components of personal income for 1979 and 1999 for the three combined counties in inflation-adjusted dollars for 2001. Total personal income was more than $2 billion in 1999, up from $1.7 billion in 1979. During this 20-year period, personal income grew by more than 14 percent, with all of the growth occurring during the 1990s.

Personal income can be broken down into three categories: labor income, investment income, and transfer payments income. Labor income is derived through wages, salaries, and self-employment income. Investment income includes income in the form of rents, dividends, and interest earnings. Transfer payments income is largely derived from Social Security benefits, Medicare and Medicaid benefits, and other income support and assistance.

Table 3-29. Estimated Personal Income

Personal Income by Source ($1,000)			Percentage of Total Personal Income	
(1)	(2)	(3)	(4)	(5)
	1979	1999	1979	1999
Transfer payments	$111,686	$273,353	6.4%	13.5%
Manufacturing	$47,485	$110,045	2.7%	5.4%
Mining	$574,033	$332,537	32.9%	16.5%
Investment income	$67,002	$135,760	3.8%	6.7%
Agriculture	$2,961	$4,620	0.2%	0.2%
Federal and State Government	$64,793	$91,243	3.7%	4.5%
Total income earned from basic industries and outside sources	$867,960	$947,558		
Total Personal Income	**$1,742,472**	**$2,019,817**	**49.8%**	**46.9%**

Source: U.S. Department of Commerce, Bureau of Economic Analysis, Regional Accounts Data, Table CA05 Personal Income by Major Source and Earnings by Industry, 1979–1999.

The study area is showing signs of shifting patterns of income growth. Labor income now accounts for 64 percent of total personal income, down from nearly 81 percent in 1979. Income from nonlabor sources has grown from 19 percent in 1979 to 36 percent in 1999. This change in how individuals earn income is not unlike national or state trends. For the nation as a whole, labor income fell from 73 percent in 1979 to 68 percent in 1999. Similarly, labor income as a percentage of total income in Wyoming fell from 82 percent in 1979 to 66 percent in 1999.

The study area has consistently reported lower than average per capita income than the national and state averages. By 1999, per capita income for the study area was $24,836, which was below the national ($27,358) and state ($27,528) averages.

3.9.3 Economic Characteristics

This section focuses on trends associated with certain economic characteristics in the study area. This includes changes in the labor force and unemployment and trends in employment and earnings by industry.

3.9.3.1 Labor Force and Unemployment

Change in the labor force and unemployment can provide information on the health of the local economy. The average annual unemployment rates for each of the three counties, for Wyoming, and for the United States are summarized in Figure 5. Unemployment in the study area was consistently higher than unemployment for the State of Wyoming during the 1990s. In addition, unemployment in this area has been higher than the national average since 1993. Fremont County reported the highest unemployment during this time, followed by Sweetwater County. Sublette County consistently reported unemployment levels below the state and national averages during the 1990s.

3.9.3.2 Employment and Earnings by Industry

The BEA estimates annual employment and earnings for counties throughout the United States. Total annual employment includes both full-time and part-time jobs, so individuals with more than one job would be counted twice. Employment estimates include people employed by businesses and public entities, as well as persons who are self-employed. Data were obtained from BEA for total annual employment for each county within the study area, for Wyoming, and for the United States for 1979, 1989, and 1999 to examine trends in employment by industry over this 20-year period. A summary of this information is provided in Appendix 16.

Total employment in the study area increased by 9 percent over the 20-year period, from 45,028 jobs in 1979 to 49,048 jobs in 1999. This lags behind the employment growth rate for the State of Wyoming and the United States as a whole. For example, over the same 20-year period, total employment grew by 19 percent in Wyoming and 36.4 percent nationwide.

Employment by industry for 1999 is summarized in Figure 6. Services, government, and trade constitute the largest percentage of total employment for this area. These three industries accounted for more than 60 percent of total employment in 1999. Industries showing the greatest increase in employment between 1979 and 1999 include services, government, and retail trade. Manufacturing also reported an increase in employment during this same period. Industries showing the greatest decline in employment between 1979 and 1999 were mining, construction, and farming.

Typically, rural areas such as southwest Wyoming are more dependent on traditional natural resource-based industries, such as mining and agriculture. The study area is more dependent on mining for employment than is the State of Wyoming. Mining jobs accounted for 10 percent of total employment in the study area in 1999, compared with 5.5 percent throughout the state. However, this area is slightly less dependent on farm employment than is the rest of the state. In 1999, farm employment accounted for 3.5 percent of total employment in the study area and 3.8 percent throughout Wyoming.

Total earnings by industry in the study area, in Wyoming, and in the United States for 1979, 1989, and 1999 were also obtained from BEA (Appendix 16). Total gross earnings for all industries (private

nonfarm, farm, and government) fell by 8 percent between 1979 and 1999, with all the decrease occurring during the 1980s. However, earnings have been increasing over the past decade.

Figure 7 provides a summary of gross earnings by industry for the study area in 1999. Mining provided the largest percentage (24 percent) of earnings of any industry in the area. This category includes metal, nonmetallic, coal mining, and oil and gas operations. Of these subcategories, oil and gas operations made up approximately 45 percent of mining earnings in 1999 for this area.

Although mining remains important in terms of earnings for this area, the industry has reported significant declines in earnings between 1979 and 1999. Over the past 20 years, mining earnings declined by 90 percent, with most of this decline occurring during the 1990s. Other industries reporting declines in earnings between 1979 and 1999 include construction and farm services. Other industries important to this area in terms of earnings during 1999 include government, services, and trade. Industries reporting gains in earnings for the study area include manufacturing; finance, insurance, and real estate; and services. However, these three industries combined only accounted for 14 percent of total earnings for the study area in 1999.

Another method of examining the importance of certain industries is to evaluate the trends in average earnings per job. Industries paying the highest earnings per job in 1999 were mining ($68,000), transportation and utilities ($46,000), and manufacturing ($46,000), whereas mining, manufacturing, and government industries reported the greatest increase in earnings per job between 1979 and 1999. Several industries reported declines in real earnings per job, with the greatest decline reported in agricultural services, construction and trade industries, followed by farming and services.

3.9.3.3 Economic Base

An area's economic base is made up of the industries primarily responsible for bringing outside income into the local economy. Certain sectors within the economy are thought to be "basic" in nature, 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, such as federal and state government, are considered basic in nature 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 example 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, when income of this type is received, spent, and respent in the area, it generates additional income for the local economy. This is also true of investment income. Because it is not known for certain what percentage of investment income is generated from outside sources, an assumption was made that 30 percent was generated from such 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 study area. Table 3-29 provides a breakdown of the components of the study area's economic base and outside sources of income for 1979 and 1999.

Columns 4 and 5 show that the percentage of total income earned from outside sources declined by 3 percent between 1979 and 1999. In addition, there appeared to be a shift in the sources of outside income during the study period. Mining continued to account for the largest percentage of outside income, at 16.5 percent but had declined in importance since 1979, when the industry accounted for 33 percent of outside income. In 1999, transfer payments were the second largest source of outside income, followed by investment income, manufacturing, and government. As of 1999, transfer payments made up more than

13 percent of personal income for the study area, up from 6.4 percent in 1979. Over the study period, agriculture consistently provided a very small percentage of outside income for the study area.

Examination of these data indicates that the economy in the study area is lacking diversity, with a heavy dependence on one industry: mining. The mining industry has experienced declines over the past 20 years; thus, other sources of income are now becoming more important. Data indicate that the study area is becoming more dependent on nonlabor sources of income, such as transfer payments and investment income, which now account for more than 20 percent of outside income.

However, these data do not shed light on how the economy may be diversifying into other industries that are capable of bringing outside income into the local economy. For example, other industries, such as construction, real estate, and some service sectors, will bring outside income into the economy. It is possible that certain service sectors and the financial, insurance, and real estate sector have brought in additional outside income because of the nature of their business and the modest growth during the study period. The construction sector is likely not contributing to any economic diversification given its decline in the study area.

3.9.4 Property Valuation and Taxation

Total property valuation for 2001 for each of the three counties in the study area is summarized in Figures 8 and 9. This valuation includes property assessed by the State of Wyoming and locally assessed property. The State of Wyoming assesses taxes on both mineral and nonmineral property. Nonmineral property assessed by the state includes airlines, utilities, pipelines, gas distribution systems, railroads, and phone service (Wyoming Department of Revenue Annual Report 2001). During fiscal year 2001, the valuation of property assessed by the state was $2.2 billion for the study area. Local government also assesses four categories of property: agricultural land, residential and commercial land, improvements and personal property, and industrial property. The value of property assessed by local governments in the study area exceeded $584 million, whereas the total value of assessed property during fiscal year 2001 was $2.9 billion.

Mineral production in the study area is a major source of tax revenue for government entities. During fiscal year 2001, minerals accounted for 80 percent of the property value assessed in the study area. In addition oil and gas production and operations provided a significant percentage of the assessed value of minerals. Table 3-30 summarizes the assessed value of oil and gas production and property for fiscal year 2001 for each of the counties in the study area. Oil and gas production accounted for 85 percent of all mineral valuation for 2001 as assessed by the state. For Fremont and Sublette Counties, oil and gas production accounted for nearly 100 percent of all assessed mineral production. The physical assets of the oil and gas industry (property) constituted 19 percent of all property assessed by local governments. Of all property and production assessed by state and local governments, oil and gas operations accounted for 67 percent of assessed value in the three-county study area during fiscal year 2001.

Table 3-30. Assessed Value of Oil and Gas Production and Property Fiscal Year 2001

County	Oil and Gas Valuation– Production	Oil and Gas Valuation As % of Total Mineral Valuation	Oil and Gas Valuation– Property	Oil and Gas Property As % of Total Property Valuation	Oil and Gas Valuation As % of Total State and Local Assessed Property Valuation
Fremont	$352,327,499	99.92%	$26,556,445	16%	70%
Sublette	$736,577,260	99.95%	$42,147,672	39%	91%
Sweetwater	$670,371,775	68.39%	$42,161,137	17%	51%
Total for Study Area	**$1,759,276,534**	**85.00%**	**$110,865,254**	**19%**	**67%**

3.9.4.1 Ad Valorem Taxes—Counties

Estimated ad valorem taxes from mineral production for each county during fiscal year 2001 are summarized in Table 3-31. The counties generated more than $129 million in tax revenues from mineral production, of which $110 million, or 85 percent, was derived from oil and gas production. Table 3-32 provides an estimate of the ad valorem taxes assessed on property associated with oil and gas operations. During fiscal year 2001, the three counties generated an estimated $7 million in property taxes associated with oil and gas extraction assets.

Table 3-31. Estimated Mineral Ad Valorem Tax Revenues Fiscal Year 2001

County	Natural Gas	Crude Oil	Stripper Oil	Coal	Trona	Sand and Gravel	Total
Fremont	$19,307,950	$4,016,437	$837,264	$0	$0	$20,468	$24,182,119
Sublette	$38,224,451	$4,734,654	$387,730	$0	$0	$19,830	$43,366,665
Sweetwater	$35,541,587	$6,938,002	$51,925	$6,544,036	$13,083,494	$28,479	$62,187,523
Total for Study Area	**$93,073,988**	**$15,689,093**	**$1,276,919**	**$6,544,036**	**$13,083,494**	**$68,777**	**$129,736,307**

Table 3-32. Estimated Ad Valorem Tax Revenues on Oil and Gas Property Fiscal Year 2001

County	Assessed Valuation	Average Tax Levy*	Estimated Ad Valorem—Property
Fremont	$26,556,445	68.58	$1,821,168
Sublette	$42,147,672	58.85	$2,480,348
Sweetwater	$42,161,137	63.44	$2,674,899
Total for Study Area	**$110,865,254**		**$6,976,415**

*Tax levy applied to every $1,000 of assessed value.

Table 3-33 estimates the importance of oil and gas operations in terms of local government property tax revenues. The three counties in the study area generated $117 million in tax revenues from oil and gas operations, which accounted for approximately 66 percent of property taxes generated for fiscal year 2001.

Table 3-33. Oil and Gas Tax Revenues As Percentage of Total County Property Taxes for Fiscal Year 2001

County	Ad Valorem Tax Revenue–Oil and Gas	County Property Tax Revenues	Oil and Gas Tax Revenue As % of County Property Tax Revenues
Fremont	$25,982,819	$37,234,045	70
Sublette	$45,827,184	$49,800,369	92
Sweetwater	$45,206,413	$89,145,656	51
Total for Study Area	**$117,016,416**	**$176,180,070**	**66**

3.9.4.2 Mineral Severance Taxes

Local government entities also benefit from severance taxes collected on mineral production throughout the State of Wyoming. The state assessed $2.1 billion for mineral production in the three-county study area. However, severance taxes collected on mineral production are distributed within the state according to a formula published in the state statutes. Severance tax revenues are distributed to a variety of sources, including the state general fund, water development account, state highway fund, counties, and cities and towns. Therefore, government entities will only benefit from a percentage of severance taxes collected on production within the study area, although these entities will also benefit from severance taxes collected on mineral production in other parts of the state. Table 3-34 summarizes the total severance tax revenues that were distributed to the local government entities within the study area during fiscal year 2001.

Table 3-34. Total Severance Tax Distributions for Government Entities Fiscal Year 2001

Area	Severance Tax Distributions
Counties in Study Area	$2,313,489
Total Severance Taxes Distributed to All Counties in WY	$13,843,706
Percentage Distributed to Study Area Counties	17%
Cities and Towns in Study Area	$5,518,054
Total Severance Taxes Distributed to All Cities and Towns in WY	$35,370,306
Percentage Distributed to Study Area Cities/Towns	16%

Source: Annual Report of the Treasurer of the State of Wyoming, June 30, 2001.

Table 3-35 estimates the severance taxes that are generated from mineral production originating within the study area. The estimated severance taxes for each mineral type are based on production and assessed values and the effective tax rates, all of which were obtained from the Wyoming Department of Revenue, Mineral Tax Division. Natural gas production generated the most severance tax revenue in the study area, accounting for approximately 75 percent of all severance taxes generated.

Table 3-35. Severance Tax Revenue Fiscal Year 2001

County	Natural Gas	Crude Oil	Stripper Oil	Coal	Trona	Sand and Gravel	Total
Fremont	$16,893,022	$3,514,084	$488,363	$0	$0	$5,969	$20,901,438
Sublette	$38,972,065	$4,827,257	$263,542	$0	$0	$6,739	$44,069,603
Sweetwater	$33,611,891	$6,561,310	$32,737	$7,220,190	$8,248,759	$8,978	$55,683,865
Total	**$89,476,978**	**$14,902,651**	**$784,642**	**$7,220,190**	**$8,248,759**	**$21,686**	**$120,654,906**
% Severance Tax	74.2	12.4	0.7	6.0	6.8	0.02	100

3.9.4.3 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, distribution of the federal royalties is based on a formula promulgated by the Wyoming State Statutes (W.S. 9-4-601). The state allows a percentage of the federal royalties to be distributed to cities and towns for planning, construction, and maintenance of public facilities, for capital construction funds, and for transportation projects. Local school districts may benefit from federal royalty payments through advanced entitlement grants for capital construction funds. Total federal royalties distributed to local government agencies in the study area for fiscal year 2001 were $3.28 million (Wyoming State Treasurer 2001).

3.9.4.4 Mineral Taxation of Production—Jack Morrow Hills

Tables 3-36 through 3-38 provide an estimate of the mineral tax revenues associated with oil and gas production within the planning area for production year 2000. Actual production was obtained from the Wyoming Oil and Gas Conservation Commission and was 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. Oil and gas production occurring within the planning area generated an estimated $1.58 million in mineral tax revenues to the county, the state, and the Federal Government during fiscal year 2001.

Figure 10 shows an estimate of the ad valorem taxes generated from gas production throughout the study area and the JMH CAP planning area. This graph demonstrates that JMH has historically accounted for a small fraction of gas production in the study area, which equates to a small percentage of ad valorem taxes generated in these counties. In addition, production has been declining over time in the planning area, making it less important to the counties as a source of mineral tax revenues relative to other producing areas.

Table 3-36. Estimated Ad Valorem Tax Production From JMH

Product	Annual Production (BBLs/MCF)	Taxable Valuation Per Unit	Assessed Valuation	Average Tax Levy	Estimated Ad Valorem
(1)	(2)	(3)	(4) = (2)*(3)	(5)	(6) = (4)/1000*(5)
Oil	302	$24.47	$7,390	63.445	$469
Natural Gas	2,012,000	$2.60	$5,231,200	63.445	$331,892
Total			**$5,238,590**		**$332,361**

Source: Wyoming Department of Revenue Annual Report—Fiscal Year 2001, Cheyenne, WY; Wyoming Taxpayers Association, Wyoming Property Taxation 2001, Cheyenne, WY.

Table 3-37. Estimated Severance Tax Production from JMH

Product	Annual Production (BBLs/MCF)	Taxable Valuation Per Unit	Assessed Valuation	Average Tax Per Unit of Production	Estimated Severance Tax
(1)	(2)	(3)	(4) = (2)*(3)	(5)	(6) = (4)*(5)
Oil	302	$24.47	$7,390	0.060	$443
Natural Gas	2,012,000	$2.60	$5,231,200	0.060	$313,872
Total			**$5,238,590**		**$314,315**

Source: Wyoming Department of Revenue Annual Report—Fiscal Year 2001, Cheyenne, WY.

Table 3-38. Estimated Federal Royalties Production From JMH

Product	Annual Production (BBLs/MCF)	Taxable Valuation Per Unit	Assessed Valuation	Federal Royalty Rate	Estimated Federal Royalties
(1)	(2)	(3)	(4) = (2)*(3)	(5)	(6) = (4)*(5)
Oil	302	$22.92	$6,921	0.125	$865
Natural Gas	2,012,000	$2.10	$4,234,656	0.125	$529,332
Total			$4,241,577		$530,197

Source: Wyoming Department of Revenue Annual Report—Fiscal Year 2001, Cheyenne, WY.
Note: The taxable valuation for oil and gas was decreased to account for allowable cost deductions taken by operators before paying federal royalties. Therefore, the taxable valuation per barrel of oil is 93.66% of total valuation and 80.95% of total valuation per mcf of natural gas.

3.10 ENVIRONMENTAL JUSTICE

Federal agencies are directed to consider the effects of their actions on minority populations and to determine the potential for the federal action to have disproportionately high and adverse human health or environmental impacts on such populations. E.O. 12898, Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations, guides this determination.

An environmental justice (EJ) population is defined by minority or low-income status. A minority is defined as Black or African American, Hispanic or Latino, Asian American, Native American, Alaska Native, Native Hawaiian, and other Pacific Islander. Low-income is defined by using annual statistical thresholds from the Bureau of the Census Current Population Reports.

The first step in evaluating potential environmental justice issues associated with BLM land management actions is to identify potential minority or low-income populations within the affected study area. Census data for Sublette, Fremont, and Sweetwater Counties and for the State of Wyoming were used to identify minority and low-income status. To determine whether the minority or low-income populations residing within the three counties constitute an EJ population, the following criteria were considered:

- At least one-half of the population is of minority status.
- At least one-half of the population is of low-income status.
- Minority status population in the study area is at least 10 percentage points higher than for the State of Wyoming.
- Low-income status population in the study area is at least 10 percentage points higher than for the State of Wyoming.

The population distribution by minority status in the three counties is summarized in Table 3-39. Figure 11 shows the minority population for each county in the State of Wyoming. Fremont and Sweetwater Counties have minority populations above the state average, whereas the minority population in Sublette County is well below the state average.

Table 3-39. Percent Population By County

County	White	Black or African American	American Indian and Alaska Native	Asian	Native Hawaiian and Other Pacific Islander	Hispanic or Latino
Sublette	97.5	0.2	0.5	0.2	0.1	1.9
Fremont	76.5	0.1	19.7	0.3	0.0	4.4
Sweetwater	91.6	0.7	1	0.6	0.0	9.4
Wyoming	92.1	0.8	2.3	0.6	0.1	6.4

Source: U.S. Bureau of Census, 2000.

The minority population of Fremont County is more than 10 percentage points above the state average because of the Native American population that resides in the county on and near the Wind River Reservation. Further analysis of the population by race by census track for 2000 indicated that the Native American population within Fremont County is concentrated in the northeast corner of the county and that minority populations in census tracks nearest the planning area are very small. Although portions of Fremont County would be defined as an EJ population, these areas are not likely to be impacted by actions within the planning area, given the geographic distance between the reservation and the planning area. Sublette and Sweetwater Counties do not meet the criteria for an EJ population in terms of minority communities.

Figure 12 summarizes the median household income and poverty rates for each county in Wyoming based on the 2000 Census. The median household income in Sublette and Sweetwater Counties is above the state average, while poverty levels are lower than elsewhere in the state. This indicates the absence of low-income populations within these two counties. Fremont County has a lower median household income and higher poverty rates than throughout Wyoming. However, the low-income population in Fremont County does not meet one of the four criteria for classification as an EJ population.

It is concluded that the study area does not support an EJ population; thus, no such population would be affected by any management alternative in a disproportionately high or adverse manner compared with the general population. Therefore, no further discussion or analysis of impacts will be conducted.

Table 3-1. Estimated Acres for JMH Resources

Resource Category	Resources	Acres
General Planning Area	JMH CAP planning area	622,340
	Core area	90,740
Land Status	Bureau of Land Management	574,810
	Bureau of Reclamation	1,980
	State of Wyoming	29,720
	Private	15,840
Wild Horse Herd Management Area	Great Divide Basin HMA (within JMH CAP planning area)	221,930
Water Resources	Wetlands, riparian areas, and 100-yr floodplains + 500-foot buffer	112,990
	Wetlands, riparian areas, and 100-yr floodplains + 250-foot buffer	59,110
	Wetlands, riparian areas, and 100-yr floodplains + ¼-mile buffer	273,510
	Recharge areas	80,640
	Great Divide Basin Watershed	190,940
	Colorado-Green River Watershed	376,360
	Platte-Sweetwater River Watershed	54,950
	Public water reserves	6,740
Big Game Sensitive areas	Elk crucial habitat	175,020
	Deer crucial habitat	52,070
	Antelope crucial habitat	81,550
	Elk birthing areas	91,470
	Deer birthing areas	36,350
	Connectivity area	301,320
Sensitive Avian Resources	Raptor nest sites (active)	930
	Raptor nest sites + ¼-mile buffer	8,550
	Raptor nest sites + ½- to 1-mile buffer	46,150
	Greater sage-grouse leks + ¼-mile buffer	3,900
	Greater sage-grouse leks + ½-mile buffer	14,270
	Greater sage-grouse leks + 2-mile buffer	149,980
	Potential greater sage-grouse nesting habitat (leks + 1 mile)[1]	33,150
	Potential greater sage-grouse nesting habitat (leks + 2 miles)[1]	98,400
	Potential greater sage-grouse nesting habitat (Proposed JMH CAP)[1]	266,440
	Greater sage-grouse concentration areas	170,590
	Greater sage-grouse winter concentration areas	420
	Greater sage-grouse winter range[2]	72,920
	Mountain plover aggregation areas	120
	Mountain plover aggregation areas + ¼-mile buffer	1,410
Sensitive Plant Resources	Aspen	2,570
	Basin big sagebrush/lemon scurfpea	23,600
	Special status plants	3,240
	Large-fruited bladderpod	3,080
	Meadow pussytoes	70
	Nelson's milkvetch	80

Table 3-1. Estimated Acres for JMH Resources (Continued)

	Special status plants potential habitat	5,640
	Cushion plant communities	4,340
Grazing Allotments	Bar X	6,550
	Bush Rim	98,790
	Chilton Place	210
	Continental Peak	89,940
	Crookston Ranch	50
	Fourth of July	7,270
	Hay Meadow	720
	Houghton	370
	Johnson Place	90
	Middle Hay	400
	Pacific Creek	196,390
	Red Desert	77,150
	Rock Springs	3,550
	Sands	104,860
	Steamboat Mountain	35,770
Special Management Areas		
Wilderness Study Areas (WSA)	All WSAs	119,340
	Buffalo Hump	9,520
	Sand Dunes	28,170
	Alkali Draw	17,950
	South Pinnacles	10,860
	White Horse Creek	4,700
	Oregon Buttes	5,820
	Honeycomb Buttes	41,920
Areas of Critical Environmental Concern (ACEC)	All ACECs	146,930
	Steamboat Mountain ACEC	48,350
	Northern portion	8,760
	Southern portion	39,620
	Lava rock portion	3,050
	Greater Sand Dunes ACEC	41,640
	Eastern portion	13,380
	Western portion	28,260
	Oregon Buttes ACEC	3,440
	South Pass Historic Landscape ACEC	53,480
	Visible portion	23,740
	Portion not visible	29,740
	White Mountain Petroglyphs ACEC	20
Special Recreation Management Areas (SRMA)	Greater Sand Dunes	41,640
	Developed recreation sites and OHV parking lot	50
	Recreation Area	10,020
	National Historic Trails + ¼-mile buffer	19,940

Table 3-1. Estimated Acres for JMH Resources (Continued)

Resource Category	Resources	Acres
Other Management Areas	Red Desert Watershed Management Area	179,310
	Steamboat Mountain Management Area	95,400
Heritage Resources	Paleosol deposition area	19,840
	South Pass Summit	5,260
	Indian Gap	690
	Boars Tusk	30
	White Mountain Petroglyphs	20
	White Mountain Petroglyphs vista	510
	National Historic Trails + ¼-mile buffer	19,940
	Split Rock	13,300
	Tri-Territory Marker	20
	Crookston Ranch	40
	Expansion Era Roads + ¼-mile buffer	10,110
	Rock art sites	1
	Pinnacles Geographic Area	8,950
	Pinnacles Geologic Feature	1,340
	Pinnacles proper	660
Geologic Hazards	Slopes > 25%	30,500
	Geologic hazards	30,550
Mineral Status	All federal minerals	574,830
	State and privately owned minerals	45,520
	Federal coal	2,090
Minerals (general)	Coal classification lands (to be revoked)	396,380
	Oil shale classification lands (to be revoked)	125,660
	Existing valid oil and gas leases	233,030
	Land in core area not covered by existing leases	43,750
	Steamboat Mountain diamond potential area	960
Mining Claim Activity	Active mining claims (existing claims)	7,600
	Abandoned mining claims	386,280
Coal/Sodium Development Potential	Brine potential development area	11,410
	Coal occurrence and development potential area	53,310
Coalbed Gas Development Potential	Tertiary	69,060
	Cretaceous	203,910
Oil and Gas Potential	High potential	274,690
	Moderate potential	150,420
	Low potential	77,440
	Exploratory unit	54,710
	Producing unit	8,600

[1] Only 50 percent of the area is expected to be suitable nesting habitat.

[2] Only sagebrush vegetation is expected to be suitable habitat

Table 3-6. Underground Water Class

Use Suitability Constituent or Parameter	I Domestic Concentration[1]	II Agriculture Concentration[1]	III Livestock Concentration[1]
Aluminum (Al)	---	5.0	5.0
Ammonia NH_3-N)	0.5	---	---
Arsenic (As)	0.05	0.1	0.2
Barium (Ba)	1.0	---	---
Beryllium (Be)	---	0.1	---
Boron (B)	0.75	0.75	5.0
Cadmium (Cd)	0.01	0.01	0.05
Chloride (Cl)	250.0	100.0	2,000.0
Chronium (Cr)	0.05	0.1	0.05
Cobalt (Co)	---	0.05	1.0
Copper (Cu)	1.0	0.2	0.5
Cyanide (CN)	0.2	---	---
Flouride (F)	1.4-2.4	---	---
Hydrogen Sulfide (H_2S)	0.05	---	---
Iron (Fe)	0.3	5.0	---
Lead (Pb)	0.05	5.0	0.1
Lithium (Li)	---	2.5	---
Manganese (Mn)	0.05	0.2	---
Mercury (Hg)	0.002	---	0.00005
Nickel (Ni)	---	0.2	---
Nitrate (NO_3-N)	10.0	---	---
Nitrite (NO_2-N)	1.0	---	10.0
Nitrite (NO_3+NO_2)-N	---	---	100.0
Oil & Grease	Virtually free	10.0	10.0
Phenol	0.001	---	---
Selenium (Se)	0.01	0.02	0.05
Silver (Ag)	0.05	---	---
Sulfate (SO_4)	250.0	200.0	3,000.0
Total Dissolved Solids	500.0	2,000.0	5,000.0
Uranium (U)	5.0	5.0	5.0
Vanadium (V)	---	0.1	0.1
Zinc (Zn)	5.0	2.0	25.0
pH[2]	6.5-9.0 s.u.	4.5-9.0 s.u.	6.5-8.5 s.u.
SAR	---	8	---
RSC[3]	---	1.25 meq/l	---
Combined Total Radium 226 and Radium 228[4]	5 pCi/l	5 pCi/l	5 pCi/l
Total Strontium 90[4]	8 pCi/l	8 pCi/l	8 pCi/l
Gross alpha particle radioactivity (including radium 226 but excluding radon and uranium)[4]	15 pCi/l	15 pCi/l	15 pCi/l

[1] mg/l, unless otherwise indicated
[2] measured in standard units (s.u.)
[3] meq/l = milliequivalents per liter
[4] pCi/l = picoCuries per liter

Source: State of Wyoming, Department of Environmental Quality. "Water Quality Rules and Regulations," Chapter VIII.

Notes: Milligrams per liter, abbreviated mg/l, means milligrams of solute per liter of solution—equivalent to parts per million assuming unit density of water.

Standard unit (abbreviated s.u.) is the unit of measurement used to describe the numerical pH of a solution, fluid, or pollutant.

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Milliequivalents per liter (abbreviated meq/l) used to report the residual sodium carbonate concentration in water used for irrigation, is defined as 0.001 of the equivalent weight of the ion per liter volume.

Picocuries per liter (abbreviated pCi/l) is a measure of radioactivity of waters or fluids. A picocurie is equal to 10^{-12} curie; a curie is defined as 3.7×10^{10} disintegrations per second.

pH is a term to express the intensity of the acid or basic condition. A pH value of 7.0 at 25 degrees centigrade is neutral, with pHs of less than 7.0 progressively more acid and pHs of greater than 7.0 progressively more basic.

Residual sodium carbonate (abbreviated RSC) is defined as twice the concentration of carbonate or bicarbonate water would contain after subtracting an amount equivalent to the calcium plus the magnesium; RSC is a measure of the potential hazard that exists when waters high in carbonate and bicarbonate and relatively low in calcium and magnesium are used for irrigation.

Sodium adsorption ratio (abbreviated SAR) of water is defined by the U.S. Department of Agriculture Laboratory (1954) as—

$$SAR = \frac{(Na+)}{\sqrt{\frac{(Ca^{r\,2}) + (Mg^{r\,2})}{2}}}$$

where ion concentrations are expressed in milliequivalents per liter. The SAR predicts reasonably well the degree to which irrigation water tends to enter into cation-exchange reactions in soil.

Total dissolved solids (abbreviated TDS) is the sum of the dissolved mineral constituents in water, expressed as mg/l.

The Rock Springs Field Office does not routinely test for all parameters listed in the DEQ guidelines. The choice of test parameters is based on known potential hazards and information needed for ongoing studies and monitoring

Table 3-7. Allotment/Operator Data

Allotment	Operator	Class of Livestock	Permitted Use			5-year Historic Use	Percent of Allotment in JMH	Estimated Permitted Active Use in JMH	Estimated 5-Year Historic Use in JMH[a]
			Active	Suspended	Total				
4th of July	D. Mines	C	836	532	1,368	240	30	251	72
Johnson Place	D. Mines	C	10	0	10	10	100	10	10
Crookston Ranch	DeLambert	C	4	0	4	4	100	4	4
Hay Meadow	Blair & Hay	C	91	0	91	91	100	91	91
Pacific Creek	DeLambert	C	5	0	5[b]	5	100	5	5
	Magagna Brothers	S	22	0	22[b]	22		22	22
	Blair & Hay	C	8,859	4,526	13,385	3,925		8,859	3,925
	Robert & Martha Hellyer	S	10	0	10[b]	0		10	0
	G&E Livestock	S	38	0	38[b]	0		38	0
	Bar X Sheep	S	15	0	15[b]	0		15	0
	White Acorn	C	90	0	90[b]	0		90	0
Bar X	Bar X Sheep	C	468	0	468	446	99	468	442
Continental Peak	Robert & Martha Hellyer	C,S	5,728	1,001	6,729	1,697	100	5,728	1,697
	Bar X Sheep	S	41	0	41	0		41	0
	White Acorn	C	17	0	17[b]	0		17	0
Red Desert	Magagna Brothers	S	2,582	64	2,646	883	30	775	265
	Blair & Hay	C	4,171	6,539	10,710	427		1,251	128
	Robert & Martha Hellyer	S	716	0	716[b]	0		215	0
	Bar X Sheep	C	2,289	887	3,176	587		687	176
Bush Rim						38	100	63	38
	Magagna Brothers	S	63	0	63[b]	0		166	0
	Blair & Hay	S	166	0	166[b]	0		22	0
	Robert & Martha Hellyer	S	22	0	22[b]	921		3,026	921
	Bar X Sheep	C	3,026	2,456	5,482				

Table 3-7. Allotment/Operator Data (Continued)

Allotment	Operator	Class of Livestock	Permitted Use			5-year Historic Use	Percent of Allotment in JMH	Estimated Permitted Active Use in JMH	Estimated 5-Year Historic Use in JMH[a]
			Active	Suspended	Total				
Steamboat Mountain	Blair & Hay	S	80	0	80[b]	0		78	0
	D. Mines	C	848	1,210	2,058	260	97	823	252
Sands	Midland Dunton	S	217	20	237[b]	178	95	206	169
	DeLambert	C	1,257	354	1,611	1,257		1,194	1,194
	G&E Livestock	S	54	0	54[b]	20		51	19
	GZ Livestock-Chilton lease	C	1,789	866	2,655	1,615		1,700	1,534
	GZ Livestock	C	581	355	936	252		552	239
	Roberts Ranch	S	341	41	382	337		324	320
Rock Springs	Blair & Hay	C,S	1,637	133	1,770	1,818	0.22	3.6	0
	D. Mines-Chilton Lease	C	1,338	528	1,866			4	4
Middle Hay	Blair & Hay	C	16	0	16	16	100	16	16
Chiltons Place	D. Mines-Chilton Lease	C	15	0	15	15	100	15	15
Houghton Ranch	Chilton Land & Livestock	C	11	0	11	11	100	11	11
Total			44,818	19,512	55,430	15,107		26,830	11,569

Table 3-24. Wells Drilled in the JMH

SEC.	TWN.	DIR.	RNG.	DIR.	QTR/QTR	OPERATOR	UNIT/FIELD NAME	WELL NO.	SURF. ELEV.	ELEV. TYPE	TOTAL DEPTH	DEEPEST FORMATION	COMPL. DATE	COMP. STATUS
30	27	N	98	W	se se	CHORNEY OIL CO	CIRCLE BAR UNIT	1	7163	KB	10970	Mesaverde	19710914	P&A
3	27	N	99	W	sw nw	EUROPEAN SOUTHWEST CO	CONTINENTAL PEAK UNIT	1-3	7389	KB	5005	Tertiary	19820810	P&A
25	27	N	99	W	nw se	DAVIS OIL CO	HONEYCOMB BUTTES UNIT	1	7238	KB	13984	Rock Springs	19791008	P&A
26	27	N	99	W	sw sw	ENERGETICS INC	HARRIS SLOUGH UNIT	1-A	7241	KB	13620	Ericson	19810430	P&A
17	27	N	100	W	sw nw	AMOCO PRODUCTION CO	SOUTH PASS UNIT	1	7428	KB	22947	Morrison	19830413	P&A
30	27	N	100	W	c sw	BRITISH AMER OIL PROD CO		1	7742	KB	11012	Lewis	19600102	D&A
9	27	N	101	W	nw sw	SKINNER ROBERT E		1-9	7390	GR	3004	Tertiary	1978	D&A
9	27	N	101	W	ne sw	WEST COAST OIL CO iNC		1	7438	KB	9691		19770831	P&A
24	27	N	101	W	ne nw	SINCLAIR OIL & GAS CO	OREGON TRAIL UNIT	1	8085	GR	1858	Tertiary	19470821	P&A
24	27	N	101	W	sw nw	MOUNTAIN FUEL SUPPLY CO	DICKIE SPRINGS UNIT	1	8035	KB	12272	Mesaverde	19701003	P&A
29	27	N	102	W	se nw	SUPERIOR OIL CO		1	7034	GR	3458	Wasatch	19430825	
32	28	N	101	W	se nw	AMERICAN QUASAR PETR CO		1	7581	KB	15040	Mesaverde	19751106	P&A
36	28	N	102	W	nw se	AMERICAN QUASAR PETR CO	MONUMENT DRAW UNIT	36-33	7372	KB	3260	Tertiary	19811029	P&A
5	22	N	104	W	se sw	BRITISH AMER OIL PROD CO		1	6694	KB	3712	Ericson	19620120	D&A
1	22	N	105	W	sw sw	BRITISH AMER OIL PROD CO		1	7044	KB	5001	Ericson	19611119	D&A
5	22	N	105	W	lot 11	HUSKY OIL CO	EDEN UNIT	7-5	7233	KB	11036	Baxter	19730117	D&A
6	22	N	105	W	sw ne	HUSKY OIL CO	EDEN UNIT	7-6	6984	KB	9383	Ericson	19741013	P&A
11	22	N	105	W	sw nw	HUSKY OIL CO	EDEN UNIT	5-11	7693	KB	18150	Madison	19751030	D&A
1	23	N	101	W	ne ne	SUN RAY MID-CONT OIL CO	BIG DUNE UNIT	3	6996	KB	5720	Almond	19610929	D&A
4	23	N	101	W	se ne	DAVIS OIL CO	TREASURE UNIT	3	7204	KB	13966	Morrison	19810508	P&A
4	23	N	101	W	nw sw	CONOCO INC	BIG DUNE UNIT	4-1	7202	KB	5456	Ericson	19590211	D&A
3	23	N	102	W	se nw	WOODS PETROLEUM CORP	STEAMBOAT MOUNTAIN UNIT/FIELD	1	7632	KB	13044	Morrison	19781030	GAS
4	23	N	102	W	sw ne	WOODS PETROLEUM CORP	STEAMBOAT MOUNTAIN UNIT/FIELD	2	7855	KB	12850	Morrison	19790824	P&A
10	23	N	102	W	ne ne	WOODS PETROLEUM CORP		1	7996	KB	4517	Almond	19690809	D&A
11	23	N	102	W	se nw	WOODS PETROLEUM CORP	STEAMBOAT MOUNTAIN UNIT/FIELD	4	7862	KB	13025	Morrison	19811018	P&A
33	23	N	102	W	nw nw	TRITON OIL & GAS CORP	UNNAMED FIELD	3	7109	KB	4600	Blair	19900801	METH
33	23	N	102	W	ne ne	UNION PACIFIC RESOURCES	UNNAMED FIELD	2-33	7061	KB	4750	Blair	19950912	METH
1	23	N	103	W	se nw	MESA PETROLEUM CO		1	7980	DF	12091	Morrison	19731014	P&A
3	23	N	103	W	c sw	AQUITAINE OIL CORP	NITCHIE GULCH FIELD	13-3	7211	KB	10090	Lakota	19771118	GAS
4	23	N	103	W	ne sw	AQUITAINE OIL CORP	NITCHIE GULCH FIELD	1-4	7236	KB	10030	Dakota	19780325	GAS
5	23	N	103	W	nw nw	K W B PROPERTY MGMT INC	NITCHIE GULCH FIELD	2-5	7130	KB	9520	Morrison	19871229	GAS
5	23	N	103	W	sw ne	OKLAHOMA SILURIAN PTRS	NITCHIE GULCH FIELD	3-5	7205	KB	9693	Morrison	19900723	GAS
5	23	N	103	W	se sw	MCBRIDE W C INC	NITCHIE GULCH FIELD	1-5	7104	KB	9236	Dakota	19661119	GAS
6	23	N	103	W	se nw	TERRA RESOURCES INC	NITCHIE GULCH FIELD	2-6	6978	KB	9150	Morrison	19870222	GAS
6	23	N	103	W	ne ne	TERRA RESOURCES INC	NITCHIE GULCH FIELD	20-6	7087	KB	9361	Morrison	19890407	GAS
6	23	N	103	W	nw sw	PACIFIC ENT OIL CO USA	NITCHIE GULCH FIELD	30-6	6925	KB	9012	Morrison	19890918	O&G
6	23	N	103	W	c se	MCBRIDE W C INC	NITCHIE GULCH FIELD	1	7039	KB	9112	DakotA	19651107	GAS
7	23	N	103	W	se nw	TERRA RESOURCES INC	NITCHIE GULCH UNIT/FIELD	14-7	6999	KB	8400	Mowry	19841231	GAS
7	23	N	103	W	se nw	TERRA RESOURCES INC	NITCHIE GULCH UNIT/FIELD	19-7	7037	KB	9010	Morrison	19890315	GAS

Table 3-24. Wells Drilled in the JMH

SEC.	TWN.	DIR.	RNG.	DIR.	QTR/QTR	OPERATOR	UNIT/FIELD NAME	WELL NO.	SURF. ELEV.	ELEV. TYPE	TOTAL DEPTH	DEEPEST FORMATION	COMPL. DATE	COMP. STATUS
7	23	N	103	W	ne se	PACIFIC ENT OIL CO USA	NITCHIE GULCH UNIT/FIELD	22-8	6954	KB	9086	Morrison	19900411	GAS
7	23	N	103	W	ne se	AMAX PETROLEUM CORP	NITCHIE GULCH UNIT/FIELD	6-7	6968	KB	8950	Morrison	19650202	GAS
8	23	N	103	W	nw nw	TERRA RESOURCES INC	NITCHIE GULCH UNIT/FIELD	15-8	7002	KB	5840	Baxter	19850110	J&A
8	23	N	103	W	nw nw	TERRA RESOURCES INC	NITCHIE GULCH UNIT/FIELD	15-8X	7002	KB	8446	Mowry	19850606	GAS
8	23	N	103	W	nw se	AMAX PETROLEUM CORP	NITCHIE GULCH UNIT/FIELD	7-8	7031	KB	8930	Dakota	19651222	GAS
9	23	N	103	W	se nw	C R A INC	NITCHIE GULCH UNIT/FIELD	11-9	7064	KB	9150	Dakota	19680712	GAS
11	23	N	103	W	c nw	ELF AQUITAINE PETR INC		11-11	7322	KB	10254	Morrison	19780511	P&A
16	23	N	103	W	nw nw	TERRA RESOURCES INC	NITCHIE GULCH UNIT/FIELD	17-16	7063	KB	8870	Morrison	19870608	GAS
16	23	N	103	W	nw se	TRIGOOD OIL CO	NITCHIE GULCH FIELD	1	7096	GR	235	Tertiary	19620501	SUSP
16	23	N	103	W	se ne	C R A INC	NITCHIE GULCH FIELD	9-16	7184	KB	8966	Morrison	19671208	D&A
17	23	N	103	W	se se	TRIGOOD OIL CO	NITCHIE GULCH UNIT/FIELD	1	7134	KB	8713	Morrison	19611115	GAS
17	23	N	103	W	nw sw	AMAX PETROLEUM CORP	NITCHIE GULCH UNIT/FIELD	4-17	6949	KB	8750	Morrison	19631003	GAS
18	23	N	103	W	ne ne	TERRA RESOURCES INC	NITCHIE GULCH UNIT/FIELD	12-18	7031	KB	8200	Frontier	19831209	GAS
18	23	N	103	W	se nw	AMAX PETROLEUM CORP	NITCHIE GULCH UNIT/FIELD	8-18	6923	KB	8923	Morrison	19660124	GAS
19	23	N	103	W	se ne	PACIFIC ENT OIL CO USA	NITCHIE GULCH UNIT/FIELD	20-19	6925	KB	8660	Morrison	19890614	GAS
19	23	N	103	W	se nw	AMAX PETROLEUM CORP	NITCHIE GULCH UNIT/FIELD	5-19	6849	GR	8850	Morrison	19631231	GAS
20	23	N	103	W	nw nw	PACIFIC ENT OIL CO USA	NITCHIE GULCH UNIT/FIELD	13-20	7017	KB	8106	Mowry	19831206	GAS
20	23	N	103	W	nw se	TRIGOOD OIL CO	NITCHIE GULCH UNIT/FIELD	2-20	7084	KB	8596	Dakota	19620531	GAS
21	23	N	103	W	nw sw	PACIFIC ENT OIL CO USA	NITCHIE GULCH UNIT/FIELD	21-21	7145	KB	8620	Morrison	19900104	GAS
21	23	N	103	W	se nw	TRIGOOD OIL CO	NITCHIE GULCH UNIT/FIELD	3-21	7036	KB	8480	Dakota	19621201	GAS
22	23	N	103	W	sw nw	LUFF EXPL CO	PINE CANYON FIELD	3-22	7152	KB	8770	Morrison	19820215	P&A
22	23	N	103	W	se se	LUFF KENNETH INC	PINE CANYON FIELD	2-22	7265	KB	8849	Morrison	19771004	GAS
26	23	N	103	W	nw nw	LUFF KENNETH INC	PINE CANYON FIELD	4-26	7183	GR	8929	Morrison	19780510	GAS
27	23	N	103	W	ne nw	UNION PACIFIC RESOURCES	PINE CANYON FIELD	1	7420	KB	8830	Morrison	19870801	GAS
28	23	N	103	W	sw nw	TERRA RESOURCES INC	NITCHIE GULCH UNIT/FIELD	16-28	7290	KB	8731	Morrison	19860630	GAS
28	23	N	103	W	ne ne	B P EXPL INC	PINE CANYON FIELD	1-28	7427	KB	8875	Morrison	19890921	GAS
1	23	N	104	W	n/2 se	TEXAS OIL & GAS CORP	NITCHIE GULCH FIELD	1	6911	KB	9308	Morrison	19790303	GAS
1	23	N	104	W	ne ne	GULF OIL CORP	INDIAN GAP UNIT/NITCHIE GULCH FIELD	1	6936	DF	10066	Nugget	19551201	D&A
2	23	N	104	W	se se	TEXAS OIL & GAS CORP	NITCHIE GULCH FIELD	1	6442	GR	9770	Morrison	19790831	GAS
3	23	N	104	W	ne se	TEXAS OIL & GAS CORP	NITCHIE GULCH FIELD	1	6810	KB	9550		19801107	J&A
3	23	N	104	W	ne se	C & K PETROLEUM INC	NITCHIE GULCH FIELD	9-3	6830	KB	10765	Morrison	19810625	GAS
11	23	N	104	W	se ne	TEXAS OIL & GAS CORP	BOARS TUSK UNIT/NITCHIE GULCH FIELD	1	6891	KB	9554	Morrison	19810120	GAS
11	23	N	104	W	nw se	SUNSET INTL PETR CORP	NITCHIE GULCH FIELD	11-10	6829	KB	9585	Morrison	19670401	GAS
12	23	N	104	W	c ne	GRYNBERG JACK J	NITCHIE GULCH FIELD	20-12	6895	KB	8997		19890516	GAS
12	23	N	104	W	se se	AMAX PETROLEUM CORP	NITCHIE GULCH FIELD	1-12	6904	KB	8997	Morrison	19650911	GAS
13	23	N	104	W	sw ne	TERRA RESOURCES INC	NITCHIE GULCH FIELD	7-13	6876	KB	8400	Frontier	19730809	O&G
15	23	N	104	W	c se	F M C WYOMING CORP	BOARS TUSK UNIT/NITCHIE GULCH FIELD	1-15	6734	KB	10400	Morrison	19800313	D&A
16	23	N	104	W	sw sw	BOARS TUSK OIL CO		1	0		1529	Mesaverde	19271107	D&A
17	23	N	104	W	sw sw	HUSKY OIL CO		13-17	6717	KB	3300	Lance	19790604	P&A
23	23	N	104	W	w/2 se	F M C WYOMING CORP	NITCHIE GULCH FIELD	1-23	6763	BB	9681	Morrison	19790601	P&A

Table 3-24. Wells Drilled in the JMH

SEC.	TWN.	DIR.	RNG.	DIR.	QTR/QTR	OPERATOR	UNIT/FIELD NAME	WELL NO.	SURF. ELEV.	ELEV. TYPE	TOTAL DEPTH	DEEPEST FORMATION	COMPL. DATE	COMP. STATUS
26	23	N	104	W	w/2 sw	SOUTHLAND ROYALTY CO	NITCHIE GULCH FIELD	1-26	6713	KB	9914	Morrison	19770713	O&G
29	23	N	104	W	sw sw	HUSKY OIL CO		13-29	6732	GR	3117		19790514	P&A
31	23	N	104	W	se nw	HUSKY OIL CO		31-1	6849	KB	3382	Lance	19781129	P&A
2	24	N	100	W	lot 6	ROWAN DRLG CO INC		1	7077	KB	8970	Ericson	19620807	D&A
3	24	N	100	W	ne se	SOHIO PET CO		1	6946	KB	8660	Ericson	19700626	P&A
10	24	N	100	W	ne ne	CHEROKEE OIL & GAS CORP		1	6946	DF	218		19610809	D&A
12	24	N	100	W	sw sw	WOLF EXPL CO	PINNACLES UNIT	1	6999	KB	9000	Ericson	19670417	D&A
22	24	N	100	W	ne sw	WOODS PETROLEUM CORP	SADDLE BAG UNIT/FIELD	1	7058	KB	16542	Morrison	19821110	P&A
22	24	N	100	W	nw se	MONCRIEF W A JR	OASIS UNIT	1	7057	KB	16660	Morrison	19840515	P&A
28	24	N	101	W	se ne	H P C INC	TREASURE UNIT/FIELD	4	7544	KB	14930	Morrison	19820818	GAS
31	24	N	101	W	se nw	MOUNTAIN FUEL SUPPLY		1	7486	KB	5100	Almond	19640920	D&A
32	24	N	101	W	sw ne	HPC INC	TREASURE UNIT	2	7402	KB	14036	Morrison	19810909	P&A
33	24	N	101	W	ne sw	DAVIS OIL CO	TREASURE UNIT/FIELD	1	7673	KB	14426	Morrison	19800630	GAS
7	24	N	102	W	nw sw	GRYNBERG JACK & ASSOC		1-7	7406	KB	13676	Morrison	19730510	D&A
11	24	N	102	W	sw sw	SOUTHLAND ROYALTY CO		1	7267	KB	7000	Rock Springs	19730617	D&A
13	24	N	102	W	sw ne	WOODS PETROLEUM CORP	FREIGHTER GAP UNIT/FIELD	1	7610	KB	14623	Morrison	19810615	O&G
14	24	N	102	W	sw ne	WOODS PETROLEUM CORP	FREIGHTER GAP UNIT/FIELD	2	7340	KB	14130	Morrison	19840929	P&A
27	24	N	102	W	se ne	SAN JACINTO PETR CORP	MONUMENT RIDGE UNIT	1	7465	KB	7507	Blair	19630708	D&A
34	24	N	102	W	ne sw	WOODS PETROLEUM CORP	STEAMBOAT MOUNTAIN UNIT/FIELD	3	?	KB	13004	Morrison	19791129	P&A
2	24	N	103	W	ne nw	SHELL OIL CO	PLUNGE UNIT	21-2	7036	KB	5021	Ericson	19600316	D&A
4	24	N	103	W	se nw	WOLD JOHN S	INDIAN GAP UNIT	1	7081	DF	4011	Mesaverde	19570711	D&A
8	24	N	103	W	se nw	ENRON OIL & GAS CO	ESSEX MOUNTAIN FIELD	1-8	7298	KB	12281	Morrison	19920107	GAS
10	24	N	103	W	se nw	WOODS PETROLEUM CORP	RIM ROCK UNIT/FIELD	1	7171	KB	12657	Morrison	19801009	GAS
16	24	N	103	W	sw ne	MONCRIEF W A JR	RIM ROCK UNIT/FIELD	2	7278	KB	12230	Morrison	19871103	O&G
20	24	N	103	W	se nw	MCBRIDE W C INC		1	7227	KB	11421	Morrison	19670814	D&A
21	24	N	103	W	se nw	WOODS PETROLEUM CORP	NITCHIE GULCH FIELD	21-1	7443	KB	12042	Morrison	19820127	GAS
31	24	N	103	W	ne sw	TERRA RESOURCES INC	NITCHIE GULCH FIELD	30-31	6985	KB	9518	Morrison	19870803	GAS
31	24	N	103	W	nw nw	TERRA RESOURCES INC	NITCHIE GULCH FIELD	10-31	7056	KB	9872	Morrison	19880302	GAS
31	24	N	103	W	se se	TERRA RESOURCES INC	NITCHIE GULCH FIELD	40-31	7019	KB	9430	Morrison	19880505	P&A
31	24	N	103	W	ne sw	PACIFIC ENT OIL CO USA	NITCHIE GULCH FIELD	30-31F	6968	KB	8435	Frontier	19900504	GAS
32	24	N	103	W	ne nw	TERRA RESOURCES INC	NITCHIE GULCH FIELD	10-32	7065	KB	10038	Morrison	19880412	GAS
32	24	N	103	W	c se	ELF AQUITAINE PETR INC	NITCHIE GULCH FIELD	33-32	7098	KB	10051	Morrison	19810917	P&A
32	24	N	103	W	se sw	MCBRIDE W C INC	NITCHIE GULCH FIELD	1-32	7141	KB	9732	Dakota	19680623	D&A
33	24	N	103	W	c sw	AQUITAINE OIL CORP	NITCHIE GULCH FIELD	13-33	7215	KB	10465	Dakota	19780323	GAS
34	24	N	103	W	c sw	ELF AQUITAINE PETR INC	NITCHIE GULCH FIELD	13-34	7367	KB	11075	Dakota	19781007	GAS
1	24	N	104	W	se ne	BROWN H L JR		1-1	7605	KB	8104		19840701	P&A
24	24	N	104	W	se se	HOUSTON OIL & MIN CORP	ESSEX MOUNTAIN UNIT/FIELD	44-24	7056	GR	10700	Morrison	19801210	GAS
24	24	N	104	W	sw se	KIRBY ROYALTIES INC		1	7043	KB	5500	Baxter	19631114	D&A
25	24	N	104	W	se se	TERRA RESOURCES INC	NITCHIE GULCH FIELD	40-25	7046	KB	10049	Morrison	19880926	GAS
35	24	N	104	W	nw se	FLORIDA EXPL CO	NITCHIE GULCH FIELD	1-35	7019	KB	10100	Dakota	19810325	O&G

Table 3-24. Wells Drilled in the JMH

SEC.	TWN.	DIR.	RNG.	DIR.	QTR/QTR	OPERATOR	UNIT/FIELD NAME	WELL NO.	SURF. ELEV.	ELEV. TYPE	TOTAL DEPTH	DEEPEST FORMATION	COMPL. DATE	COMP. STATUS
36	24	N	104	W	sw ne	PERTO PACIFIC RESOURCES INC.	NITCHIE GULCH FIELD	1	7035	KB	752	Almond	19821025	P&A
36	24	N	104	W	c se	TERRA RESOURCES INC	NITCHIE GULCH FIELD	40-36	7056	KB	9500	Morrison	19870727	GAS
36	24	N	104	W	se ne	TERRA RESOURCES INC	NITCHIE GULCH FIELD	20-36	6985	KB	9650	Morrison	19871106	GAS
36	24	N	104	W	se sw	TERRA RESOURCES INC	NITCHIE GULCH FIELD	30-36	7085	KB	9700	Morrison	19880425	GAS
36	24	N	104	W	sw ne	ROCK HILL INDUSTRIES INC	NITCHIE GULCH FIELD	36-1	7026	KB	878	Almond	19690327	P&A
22	24	N	105	W	se nw	DAVIS OIL CO		1-2	6880	KB	7997	Ericson	19710111	D&A
20	25	N	99	W	ne sw	WOODS PETROLEUM CORP	LOST VALLEY UNIT	3	6944	KB	13738	Baxter	19791209	P&A
20	25	N	99	W	ne sw	MONCRIEF W A JR	LOST VALLEY UNIT	3	6944	KB	18723	Muddy	19830424	P&A
10	25	N	100	W	se ne	WOODS PETROLEUM CORP	CITATION UNIT	1	7013	KB	11000		19820413	P&A
19	25	N	100	W	sw sw	WOODS PETROLEUM CORP	CENTURION UNIT	1	7488	KB	8613	Almond	19810603	P&A
26	25	N	100	W	nw ne	SOHIO OIL CO		2	7037	KB	9250	Ericson	19710202	P&A
27	25	N	101	W	se nw	HUMBLE OIL & REFG CO	PARNELL CREEK UNIT	1	7531	GR	8500	Ericson	19611126	D&A
30	25	N	101	W	sw ne	DAVIS OIL CO	PIRATE UNIT	1	7339	KB	15590	Morrison	19810226	P&A
3	25	N	102	W	sw nw	PAN AMERICAN PETR CORP		1	7451	KB	5220	Lance	19640817	D&A
7	25	N	102	W	ne sw	SAXON EXPL CO	UNNAMED FIELD	7-11	7628	KB	6955	Mesaverde	19901111	METH
7	25	N	102	W	ne sw	H S RESOURCES INC	BIG BEAR UNIT/UNNAMED FIELD	11-7	7643	GR	15990	Morrison	19960107	OIL
9	25	N	102	W	sw nw	PAN AMERICAN PETR CORP		1	7372	KB	4901	Lance	19640801	D&A
17	25	N	102	W	sw nw	ATLANTIC REFG CO	PLUNGE UNIT	2	7501	KB	9803	Blair	19610823	D&A
26	25	N	102	W	se nw	SKELLY OIL CO		1	7229	DF	6998	Ericson	19581103	D&A
9	25	N	103	W	sw se	KERR MCGEE OIL IND INC	MORROW CREEK UNIT	1	7485	KB	7050	Lewis	19591019	P&A
13	25	N	103	W	ne ne	FREEPORT MINERALS CO		1-13	7506	GL	9868	Blair	19760828	P&A
23	25	N	103	W	sw se	SAXON EXPL CO		23-15	7606	GR	5955	Almond	19910724	P&A
24	25	N	103	W	nw se	WOODS PETROLEUM CORP	PACKSADDLE UNIT	1	7662	KB	14850		19790705	P&A
29	25	N	103	W	nw ne	EL PASO NATURAL GAS CO	MORROW CREEK UNIT	1	7153	KB	9598	Baxter	19541228	D&A
9	26	N	98	W	se nw	DAVIS OIL CO	SCOTTY LAKE UNIT	1	7086	KB	13150	Rock Springs	19790828	P&A
10	26	N	100	W	sw sw	WOODS PETROLEUM CORP	HOURGLASS UNIT	10-1	7247	KB	15300	Baxter	19801027	P&A
16	26	N	100	W	nw ne	MONCRIEF W A JR	SANDS OF TIME UNIT	1	7202	KB	11978	Rock Springs	19830518	P&A
25	26	N	100	W	n/2 ne	DAVIS OIL CO		1	7067	KB	11564	Rock Springs	19770408	P&A
8	26	N	101	W	sw sw	DAVIS OIL CO	MUSKETEER UNIT	1	7543	KB	19569	Morrison	19820321	P&A
23	26	N	102	W	sw se	DAVIS OIL CO	BUCCANEER UNIT/FIELD	1	7346	KB	17844	Dakota	19811114	GAS
30	26	N	102	W	sw sw	GULF OIL CORP	MORROW CREEK UNIT	1	7214	GR	8212	Ericson	19670116	D&A
34	26	N	102	W	se se	GULF OIL CORP	MORROW CREEK UNIT	2	7301	GR	8500	Ericson	19670715	D&A
3	26	N	103	W	n/2 n/2	RAINBOW RESOURCES INC	GREATER PACIFIC CREEK UNIT	1-3	6970	GR	15000		19800623	P&A
25	26	N	103	W	sw ne	WOODS PETROLEUM CORP	ROCK CABIN UNIT	1	7258	KB	18777	Morrison	19810926	P&A