

CHAPTER 3

AFFECTED ENVIRONMENT

Chapter 3 describes environmental components that influence the resolution of planning issues or that would be affected by the management actions presented in Chapter 2. Environmental components that would not be affected or that are not important to the resolution of planning issues are not covered in detail.

More detailed information about the affected environment is available at the Rock Springs Field Office.

CLIMATE AND AIR QUALITY

Climate

The climate of the Jack Morrow Hills area is classified as semi-arid or steppe (Brown 1980; Martner 1986). Steppe climate is characterized by large seasonal variations in temperature (cold winters and warm summers) and precipitation that is slight but still sufficient for the growth of short sparse grass. The dryness of the mid-latitude steppe climate of southwestern Wyoming is mainly 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. Also, annual rainfall amounts may vary greatly from year to year (Trewartha and Horn 1980).

Mean annual temperatures at weather stations in the planning area range from 37 degrees F in Farson (about 4 miles from the planning area) to 44 degrees F in Rock Springs (about 15 miles from the planning area). Summer highs are usually in the 70's and 80's, but may reach the high 90's. Winter lows are generally in the minus single digits, but may reach the minus 40's. Figure 2 shows mean monthly temperatures at Farson and Rock Springs (Martner 1986).

Mean annual precipitation is generally 8 to 9 inches. Figure 3 shows mean monthly precipitation at Farson and Rock Springs (Martner 1986).

Atmospheric stability is a measure of the atmosphere's capacity to disperse pollutants. Figure 4 shows that 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 (BLM 1999c).

Winds in Rock Springs are relatively strong and are generally from the west and west-southwest. Figure 5 shows wind speed and direction at Rock Springs (USDI 1999c).

Air Quality

This section describes existing air quality in the Jack Morrow Hills region. See Appendix 7 for more detailed information.

Air quality in the planning area is considered excellent; however, current and complete ambient air quality data for the planning area and the immediate vicinity are not available. Concentrations of criteria pollutants (pollutants for which Wyoming and/or federal standards have been set) monitored in the region are well below 40 percent of the established Wyoming and National ambient air quality standards (see Chapter 4, Air Impacts).

In Chapter 4, estimates of background air pollutant concentrations are combined with potential air quality impacts from the proposed Jack Morrow Hills projects. These total estimated concentrations can then be compared with applicable air quality standards. It is important to note that the background concentration of each pollutant is based on the same averaging period as the model predictions and applicable air quality standards.

Pollutants

Criteria pollutants are those for which national standards of concentration have been established. Pollutant concentrations greater than these standards represent a significant risk to human health. Criteria pollutants include carbon monoxide (CO), nitrogen dioxide (NO₂), ozone (O₃), sulphur dioxide (SO₂), particulate matter (TSP, PM-10, PM-2.5), and lead (Pb). Other pollutants of concern are hazardous air pollutants (HAP), a broad class of several pollutants including benzene, toluene, asbestos, beryllium, and hydrogen sulfide (H₂S).

Carbon monoxide (CO) is an odorless, colorless gas formed during any combustion process, such as operation of engines, fireplaces, furnaces, etc. High concentrations of carbon monoxide affect the oxygen-carrying capacity of the blood and can lead to unconsciousness and asphyxiation.

Nitrogen dioxide (NO₂) is a red-brown gas formed during operation of internal combustion engines. Such engines emit a mixture of nitrogen gases, collectively called nitrogen oxides (NO_x). Nitrogen dioxide can contribute to "brown cloud" conditions, and can convert to ammonium nitrate particles and nitric acid which can cause visibility impairment and acid rain.

Ozone (O₃) is a faintly blue gas that is generally not emitted directly into the atmosphere, but is formed from NO_x and volatile organic compounds (VOC) emissions. As stated above, internal combustion engines are the main source of NO_x. Sources of VOC include oil vapors and turbine mist. The faint acrid smell common after thunderstorms is due to ozone formation by lightning. Ozone is a strong oxidizing chemical that can burn lungs and eyes, and damage plants.

Sulphur dioxide (SO₂) forms during combustion from trace levels of sulphur in coal or diesel fuel, and can convert to ammonium sulfate and sulphuric acid which can cause visibility impairment and acid rain.

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Particulate matter (e.g., soil particles, hair, pollen, etc.) is essentially the small particles suspended in the air which settle to the ground slowly and may be re-suspended if disturbed. Separate allowable concentration levels for particulate matter are based on the relative size of the particle:

total suspended particles (TSP) are all particles small enough to be suspended in the air, and are generally less than 30 micrometers in diameter (about the size of human hair),

PM-10, particles with diameters less than 10 micrometers, are small enough to be inhaled and can cause adverse health effects.

PM-2.5, particles with diameters less than 2.5 micrometers, are so small that they can be drawn deeply into the lungs and cause serious health problems. These particles are also the main cause of visibility impairment.

Before the wide use of unleaded fuel for automobiles, lead particles were emitted from tailpipes. Lead is not considered in this EIS because no proposed projects are expected to emit lead.

There are a wide variety of hazardous air pollutants (HAP) which have no applicable air quality standards, but are typically evaluated for potential cancer risks from long duration exposures. Also, Wyoming maintains a concentration standard for H₂S.

Wyoming and National Ambient Air Quality Standards

Wyoming Ambient Air Quality Standards (WAAQS) and National Ambient Air Quality Standards (NAAQS) set the absolute upper limits for criteria air pollutant concentrations at all locations to which the public has access. The WAAQS and NAAQS are legally enforceable standards. Concentrations above the WAAQS and NAAQS represent a significant risk to human health.

The Environmental Protection Agency has developed standards for each criteria pollutant for a specific averaging time. Short averaging times (1, 3, and 24 hours) address short-term exposure while the annual standards address long-term exposure. Annual standards are set to lower allowable concentrations than are short-term standards to recognize the cumulative effects of long-term exposure.

Prevention of Significant Deterioration

The goal of the Prevention of Significant Deterioration (PSD) program is to ensure that air quality in areas with clean air does not significantly deteriorate, while maintaining a margin for future industrial growth. Under PSD, each area in the United States is classified by the air quality in that region:

- PSD Class I Areas: Areas with pristine air quality, such as wilderness areas, national parks and Indian reservations, are accorded the strictest protection. Only very small incremental increases in concentration are allowed in order to maintain the very clean air quality in these areas.

- PSD Class II Areas: Essentially, all areas that are not designated Class I are designated Class II. Moderate incremental increases in concentration are allowed, although the concentrations are not allowed to reach the concentrations set by Wyoming and federal standards (WAAQS and NAAQS).

- PSD Class III Areas: No areas have yet been designated Class III. Concentrations would be allowed to increase all the way up to the WAAQS and NAAQS.

In the Jack Morrow Hills region, there are four PSD Class I areas (Bridger, Fitzpatrick and Washakie Wilderness Areas, and Grand Teton National Park) and two Class II areas (Popo Agie Wilderness Area and the Wind River Indian Reservation Roadless Area). The Jack Morrow Hills project area is also classified as PSD Class II.

Estimates of concentration increases are compared with the PSD increments in each of the five sensitive areas listed (Appendix 7). These comparisons, shown in Chapter 4, are intended only to evaluate a "threshold of concern" and do not represent a regulatory PSD Increment Consumption analysis. Consumption analyses are applied to large industrial sources and are solely the responsibility of the State and the Environmental Protection Agency.

Air Quality Related Values: Visibility and Acidification of Lakes

Air Quality Related Values (AQRV), including the potential air pollutant effects on visibility and the acidification of lakes and streams, are applied to sensitive areas such as wilderness areas. The land management agency responsible for the sensitive area sets each Air Quality Related Value as the level of acceptable change (LAC). The Air Quality Related Values reflect the land management agency's policy and are not treated as legally enforceable standards.

Visibility can be defined as the distance one can see and the ability to perceive color, contrast, and detail. Fine particulate matter (PM_{2.5}) is the main cause of visibility impairment. Visual range, one of several ways to express visibility, is the furthest distance a person can see a landscape feature. If there were no humans living on the Earth, visual range in the western United States would be about 140 miles. Presently, the best visibility in the United States is in the Bridger Wilderness Area. Visual range monitoring there shows that one can see more than 70 miles 70 percent of the time (USDI 1999a). Monitoring over the last 10 years shows that the visibility on the most impaired days and average days stayed the same; however, monitoring also shows an increase in impairment on the cleanest days over the last 3 years (Figure 6).

The acidification of lakes and streams is caused by atmospheric deposition of pollutants (acid rain). Lake acidification is expressed as the change in acid neutralizing capacity (ANC), the lake's capacity to resist acidification from acid rain (Appendix 7) (USDI 1999a).

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CULTURAL

Only a limited amount of formal cultural resources inventory has been conducted in the planning area. Even so, several very significant resources are known in the region, and some important patterns of spatial distribution of archaeological resources have become apparent. The area also has important historical resources including the South Pass National Historic Landmark, portions of four congressionally designated historic trails as well as regionally significant Expansion Era networks and sites related to early settlement, and agricultural and industrial development. A number of localities important to Native Americans have also been identified.

Several legislative mandates require that cultural resources be taken into consideration when future development in the region is contemplated. These laws include the National Historic Preservation Act, the Archaeological Resources Protection Act, the American Indians Religious Freedom Act, the Native American Graves Protection and Repatriation Act, and the National Trails System Act of 1968, as well as FLPMA and NEPA. Executive Order 13007, issued by President Clinton on May 25, 1996, requires the Federal government to take positive steps to identify and manage places and values that are of importance to Native American people for sacred and religious reasons. Some tribal representatives refer to such locations as “respected places.” Departmental and BLM guidance, especially the Programmatic Agreement (PA) among the BLM, the Advisory Council on Historic Preservation, and the National Council of State Historic Preservation Officers and its corollary protocol between the BLM and the Wyoming State Historic Preservation Officer (W-SHPO) require that certain procedures be followed prior to authorizing Federally licensed, funded, or assisted undertakings.

Procedures required to comply with these Federal mandates include some level of inventory to identify historically, archaeologically, and/or culturally significant resources. Federal agencies are also required to assess the potential effects of their actions upon these resources. An array of measures may be implemented to ameliorate or mitigate adverse effects that an undertaking may have upon these resources which generically are referred to as ‘cultural resources.’

In some cases, it is appropriate for the BLM to consult with Native American traditional elders to identify resources that may be important to the people they represent. Management of locations important for religious or sacred purposes, or “respected places,” identified by traditional elders is a developing process, and specific management prescriptions are not well established at present. A dialog is developing between several tribal governments (or their designees) and the Rock Springs Field Office. The tribes that have been most involved in this dialog are the Eastern Shoshone Nation, the Uintah-Ouray bands of the Northern Ute Tribe, the Shoshone-Bannock Tribes, and the Northern Arapaho Tribe. In some cases, other tribal entities may also be involved in consultation with the BLM.

The limited inventory in the planning area has identified about 1,000 cultural resources localities within the region. Since only about two percent of the region has been formally

inventoried, a much larger number of resources should be expected in the area. Despite the limited amount of inventory, some important patterns of resource, particularly archaeological site, distribution are apparent.

A region of soil deposition dating back over ten thousand years to the end of the Pleistocene Ice Ages, or immediately thereafter, occurs in the western portion of the planning area. There are some indications 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 within this part of the planning area. Since the soil unit occurs across broad regions of the planning area, similar sites of great antiquity and tremendous scientific significance should be expected where this stable soil regime is preserved.

Archaeological sites like Finley and Krmpotich are not ‘typical’ of archaeological sites in this region. They hold cultural evidence from some of the earliest inhabitants of the North American continent. Furthermore, they are some of the most intact manifestations of such archaeological evidence known anywhere on the continent (Frison 1998). For this reason, data recovery mitigation at sites of this importance could be expensive, and more critically very time consuming.

Many of these sites are deeply buried and have little if any surface manifestation. It should be anticipated that the usual techniques for discovery, such as surface inventory, will not successfully identify these resources. For this reason, 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 industrial development. Methods that may be appropriate include, but are not limited to, extensive subsurface testing by hand and mechanical means, remote sensing techniques including magnetic resistivity, ground penetrating radar and other methods, and perhaps, most importantly more intensive study of the preserved soil deposit itself. 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 moment. Before mineral resources exploitation proceeds in areas where these soil deposits would be disturbed methodologies should be developed to locate and manage these very important archaeological resources.

The planning area also has a number of archaeological sites that are younger than the PaleoIndian-aged Finley and Krmpotich sites. Several ‘archaic’ sites, ranging from 2,000 to 7,000 years in age are known to occur in the region. The CK Adams site is an example. At the CK Adams site a series of archaeological manifestations were located both on the surface and buried in stratigraphic contexts. A limited excavation at the site was undertaken to salvage several hearth features that were rapidly eroding and to test the area for in place buried materials. Since the effort was undertaken in an

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emergency situation the BLM has not fully studied and reported the results of the effort. The State Archaeologist, who conducted part of the salvage has reported his results and they are due to be published soon (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 cross-cut by modern drainage channels including Pacific Creek. In some cases, like at the CK Adams site, archaeological manifestations are being exposed by stream cutting. 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, while sites along Pacific Creek do hold archaeological deposits back to about 7,000 years they do not appear, from present evidence, to have PaleoIndian deposits (e.g., from 7,000 to 12,000 years before present). Nonetheless, stratified deposits are the best source of information about changes in human behavior over long periods of time. Thus, sites like the CK Adams site, which are to be expected in this portion of the planning area are quite significant. Furthermore, previously discussed issues regarding archaeological materials not being evident from observations of the modern surface also apply in this region.

Yet another kind of archaeological manifestation observed in the planning area is represented by the proto-historic Eden-Farson site (Frison 1971). This 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 which were apparently a major portion of the people's 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 these cultures had not occurred, in this region, at the time the Eden-Farson site was occupied even though Europeans had been on the North American continent for nearly 300 years prior to the dates of the site. However, journals (Morgan 1964) from early Euro-American traders including William Ashley's men, especially Jedediah Smith, mention the presence of two large Native encampments in this region. Smith identifies one camp as Crow and the other as Shoshone.

University of Wyoming archaeologist George Frison (1971) postulates that pottery recovered from the Eden-Farson site was made by Shoshone people. Whether this is the camp described by Jedediah Smith is impossible to say, but we do know that several Native American tribes were present in this region in the late Eighteenth and early Nineteenth Centuries including the Shoshone, Ute, Bannock, Crow, Blackfoot, and Arapaho. A few years later numerous tribes from the Northern Plains, Great Basin, and Columbia Plateau and European

Americans participated in fur trade rendezvous throughout the central Rocky Mountains. Many rendezvous were held along the Green River within a hundred miles of the planning area. There is speculation among anthropologists (Wood 1980) that the Euro-American traders simply 'tapped into' a vast Native American trade network, one center of which was located in what is now southwestern Wyoming. 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.

Archaeological manifestations of any or all of these diverse Native American cultures should be expected in the planning area. The White Mountain Petroglyphs site, 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 of the rock art is thought to have been drawn in the past 500 or so years (Tanner and Vlcek 1995), or during what archaeologists call the Firehole Phase. Not surprisingly, Native American traditional elders have expressed interest in the White Mountain site and several other rock art locations in the greater Killpecker Creek area. Some management strategies recommended by traditional elders were incorporated into the Green River Resource Management Plan (RMP).

Administratively, the White Mountain Petroglyphs site and surrounding viewshed for 1/4 mile is protected. An existing two-track road going beyond the petroglyph site and to the top of White Mountain has been closed, although attempts to physically effect the closure have not been entirely successful. A cultural resource management plan for the site is required by the Green River RMP, but has not yet been written.

Traditional elders have also expressed interest in several landforms including Steamboat Mountain and Boars Tusk within the planning area, and North and South Table Mountains immediately to the south, 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 exact locations of these sites and the religious practices they represent are kept confidential at the request of tribal elders. However, at least some of the sites are probably Traditional Cultural Properties warranting special protective measures in compliance with the National Historic Preservation Act, the American Indian Religious Freedom Act, and Executive Order 13007.

During field visits several areas were also identified having landscape characteristics that typically are associated with respected sites. These areas have been roughly delineated; however, no attempt has been made to identify specific sites that may be of concern to traditional Native American peoples. Planning for development within the identified areas should include field inventory involving tribal representatives to identify respected sites. Consultation should be initiated with

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tribal elders in the event any sites important for sacred or religious purposes, or “respected places” are identified.

Tribal representatives have also expressed concern regarding development that would change the landscape encompassing the Killpecker Sand Dunes, Boars Tusk, Steamboat Rim, White Mountain Rim, Essex Mountain, and Monument Ridge (and much of the region from North Table Mountain to the Leucite Hills to the south and outside the planning area). For them the unique setting of mountain vistas, volcanic cones, and flat-top mesas against a backdrop of white drifting sand dunes is a spiritual experience. Their concerns should be addressed if development is proposed.

Another site of concern to traditional elders is an historic trail between the Ute Reservation in Utah and the Eastern Shoshone Reservation in the Wind River Basin. This trail is shown on the 1884 General Land Office plat for the area known as Indian Gap. Indeed, the name ‘Indian Gap’ undoubtedly was applied for the presence of this Native American trail which passed through the ‘gap’ between Essex Mountain and Steamboat Mountain. The precise antiquity of the trail is unknown. It is shown on the 1884 plat, and was mentioned by a Native American historian as having been used until about 1906. Another informant 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 which should be the next steps in managing this important historic resource.

Historic transportation corridors are also the primary type of historical resource known in the planning area. Beginning in the winter of 1812-1813, the physical geography of South Pass, in the northeastern part of the planning area, “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 not available at any other place on the continent. While not a water route, like the fabled Northwest Passage which was the quest of Lewis and Clark, South Pass was the singular overland passage that 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. All these, by now practically mythical, images of the American west would not exist were it not for South Pass.

First, South Pass allowed fur traders easy entry into the river basins of the central Rocky Mountain regions to trade with those Indian tribes mentioned above, and others. Fur traders became adept at navigating the vast regions of the American west, a skill that would enable many to earn a living guiding others from the east to these new regions of the United States. Eventually, over a half million people and probably five times that many livestock traversed South Pass.

Beginning in 1838, people moved into Oregon to claim fertile farmlands in the Willamette Valley. The drive to settle

the Pacific Northwest would eventually give the United States the upper hand in control of the region also claimed by the British Empire. By the mid-1820s, former Spanish possessions in North America came to be controlled by the newly independent nation of Mexico. The course of history, including documented meddling in local political affairs by American citizens living in Mexico’s territories of Alta California and Texas, led to the independence for those regions. Soon both fell under the influence and eventual political domination of the United States. By the time gold was discovered near Sutter’s Fort in northern California, the region was for all intents and purposes an American possession. Nonetheless, the swarm of American citizens who ventured to California’s gold fields beginning in 1849 insured that California would forever be part of the United States. The Oregon Trail and California Trail, which are 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.

In 1847, two years before the discovery of gold in California, several hundred pioneers of the Church of Jesus Christ of Latter-Day Saints, commonly known as Mormons, traveled over South Pass to settle in the valley of the Great Salt Lake, in present day Utah. This signaled the eventual migration of over a hundred thousand Mormons to what they considered to be their “Zion” in the Utah valley. 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. At one point, growing Mormon power in the region was challenged by the United States during what came to be called the “Utah Expedition”, in 1857-1858. It was even rumored, with some truth, that Mormon leader and governor of Utah Territory, Brigham Young intended to secede from the Union and form an independent State of Deseret. Although finally settled with almost no bloodshed, the dispute was the largest American military operation following the Mexican War and before the Civil War. Today, members of the Church of Jesus Christ of Latter-Day Saints are the largest, and probably most economically successful identifiable cultural group in the intermountain west. The pioneer route of the Mormon Trail was designated a National Historic Trail by Congress in 1978.

The Pony Express route was designated a National Historic Trail in 1992, in recognition of the significance, but more so because of the romance of this short-lived operation to carry the United States mail from settlements in the east to the west coast during the Civil War, thus helping to preserve political control over western regions by the United States government. Across southwestern Wyoming these four National Historic trails are in one general corridor, however many variants of the trails system developed in this area. One of the earliest and most important trail variants was established in 1859, when Army engineer Frederick Lander was dispatched to the west to construct a short cut from South Pass to Fort Hall. Although not within the planning area, the Lander Trail leaves the main Oregon Trail east of the summit of the Pass at Burnt Ranch and traverses the south side of the Wind River Mountain before heading westerly near Pinedale, Wyoming

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to cross over the Western Wyoming Ranges and into Idaho. As mentioned, there are several other trail variants, but none are within the planning area.

The National Historic Trails system is administered by the National Park Service. However, management of Federal lands containing Congressionally recognized trails resources is left to those agencies that have jurisdiction over the lands upon which the trails occur, in this case the BLM. The BLM approved the Oregon/Mormon Pioneer National Historic Trails Management Plan in 1986, which governs management of these resources in consultation with the Wyoming State Historic Preservation Office and the National Park Service.

The significance of South Pass in the development of the United States as a nation was cause for the area's designation in 1959 as a National Historic Landmark. The process of recognizing historic American places was in its infancy at that time and the National Historic Preservation Act would not be implemented for several more years. For that reason no attempt was made to designate precise boundaries for the South Pass National Historic Landmark for another quarter century.

The National Park Service proposed a boundary encompassing about 5,500 acres, in 1984. The proposed area included nearly 1,000 acres of privately owned land. Local landowners fearing the preservation mandate of the National Park Service protested the proposal which was eventually never pursued by that agency. Since all federally owned lands in the area are under the jurisdiction of the Bureau of Land Management, it fell to that agency to develop management prescriptions designed to protect the South Pass National Historic Landmark.

To ensure that the intent of the Congressional National Historic Landmark designation for those lands on the western slope of South Pass was not compromised, the BLM developed the South Pass Historic Landscape within the Green River RMP (USDI 1997). Management prescriptions for the South Pass Historic Landscape ACEC prohibit development that would be visible within three miles of the historic trails corridor. Geographic Information System (GIS) analysis of this area (viewshed) was conducted to determine what lands are visible from the historic trails corridor. GIS analysis of the vista indicates that within an arbitrary three-mile distance from the main National Historic Trail corridor about 24,000 acres are visible from the trails, while about 26,000 acres are shielded from view by topography. The Green River RMP sets forth special management prescriptions for the South Pass Historic Landscape and concentrates protective management upon areas visible from the trails corridor.

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 developed. The most important of the settlements was South Pass City which today is a State Historical Park. Since 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 the earlier historic trails network. However, this cer-

tainly did not mean that wagon roads were obsolete. Indeed, a network of roads soon developed to connect railheads on the Union Pacific Railroad in southern Wyoming with the South Pass region.

By 1870, roads to the gold fields were started from three railheads on the Union Pacific-Point of Rocks, Green River, and Bryan. These became the earliest of what are called Expansion Era roads that linked communities along the railroad with newly developing mining, agricultural, and military settlements in the hinterlands of the central Rocky Mountains. Physical evidence of the three "Expansion Era" roads to the South Pass region cross the planning area as do roads to ranching communities (like 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 Freightier's Gap, Fourteen Mile, and The Wells within the planning area.

During this expansion era, the planning area's namesake, Jack Morrow, entered the region. Very little historical information is available about Jack Morrow. However, one quote from this limited information may sum up what we know of Jack,

"Morrow started his career on the Plains as a common thief but his activities, as he became older, carried him into the upper brackets of swindling.....In a few years his eccentric ways of wasting money and his stupendous drunken sprees became legend from Omaha to the mountains and the mining towns. Then, after he had killed a man in a gun fight, his reputation as a bad man was established." (Miller 1962).

Soon after the expansion era road network began to develop, cattle ranching became important to the region's economy. Several early ranching related historic sites are within the planning area. The best known of these is the old Halter and Flick Ranch at Pacific Springs which is on private land. Pacific Springs was also an important watering spot on the historic trails corridor. The best preserved ranching related site on BLM 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. The stone building at Rock Cabin Creek, the Chilton and Houghton Ranch sites, the Washington Homestead, and Charlie Jameson's horse trap and cabin are examples. However, the most ubiquitous agriculture related site is the common sheepherder, or cowboy campsite which today consists only of a small scattering of historic artifacts across the landscape.

Although the generalities of the region's Expansion Era history (1870-1940) are known, no contextual study of this aspect of local history exists within which historic resources

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can be assessed for significance. Similarly, while 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 has generally not been evaluated. Thus the development of local documentary and oral history is seen as a primary need in the region. Without a research framework of this kind, it is difficult for the BLM to evaluate the National Register of Historic Places' eligibility of these kinds of resources, and to assess the potential effects of Federal undertakings to them.

ENVIRONMENTAL JUSTICE

Executive Order 12898, issued February 11, 1994, directs each federal agency to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations.

Minority population refers to individuals classified by Office of Management and Budget as Black/African American, Hispanic, Asian and Pacific Islander, American Indian, Eskimo, Aleut, or other non-white person. To be affected under Environmental Justice, the minority population of the affected area must either exceed 50 percent, or the minority population percentage of the affected area must be meaningfully greater than the minority population percentage of the general population (or other appropriate unit of geographic analysis), or if more than one minority group exists and by aggregating all minority groups together meets the above-stated thresholds.

Low-income populations are determined by using two tests: Department of Health and Human Services poverty guidelines or Department of Housing and Urban Development statutory definition for very low-income for the purposes of housing benefits programs.

Social-economic analysis area for the JMHCAP includes the incorporated and unincorporated communities located within Sweetwater, Fremont, and Sublette Counties. There are no communities within the JMHCAP analysis area. There are no groups of minorities or aggregated group of minorities found within the three counties that meet the first criteria (exceed 50 percent) minority threshold including the city of Riverton, Wyoming. Riverton is within the Wind River Indian Reservation and approximately 26 percent of the Reservation population, or 5,676 individuals out of a total of 21,851, are considered minority (American Indian, Eskimo, or Aleut) (U.S. Census 1997) which mirrors the minority population found in Fremont County (State of Wyoming 1998a). The number of minority individuals living in Fremont County is greater than the minority populations found in the general population within the adjacent counties of Sublette and Sweetwater. Therefore, portions of Fremont County could be considered an Environmental Justice community under certain circumstances. However, because that portion of Fremont County within the planning area has low potential for oil and gas and other mineral activity, and the South Pass Historic Landscape Area of Critical Environmental Concern places additional restrictions on development within its bound-

ary, we anticipate that any direct, indirect, and cumulative health and environmental impacts of management actions on the minority population in Fremont County would likewise be minor. We conclude therefore, that minority populations would not be affected by any alternative identified in the JMHCAP in a disproportionately high manner, nor would there be high and adverse impacts upon minority populations found in the three-county area when compared to the general population.

Determining the number of individuals who meet the threshold for qualifying income levels is more difficult to ascertain. Based upon information provided by the U.S. Census Bureau (Statistical Abstract of the U.S. 1997), shows that approximately 12.2 percent of the population in Wyoming in 1995 had incomes at or below the poverty level. The percentage of the population that falls within the federal criteria for low-income includes approximately three percent in Sweetwater County, five percent in Sublette County, and eight percent in Fremont County (determined using data provided by Wyoming Department of Family Services at their Internet site, see State of Wyoming 1998e). Within the Wind River Indian Reservation, approximately 60 percent of the households make below \$10,000 per year (Moss 1998); many would meet the federal income criteria to be considered low-income. Again, because of the low potential for mineral activity in the Fremont County portion of the planning area, and the additional restrictions placed on development actions within the South Pass Historic Landscape Area of Critical Environmental Concern, the direct, indirect, and cumulative health and environmental impacts of actions on low-income persons within the Wind River Indian Reservation would likewise be minor. We conclude that low-income individuals would not be disproportionately affected by the alternatives identified in the JMHCAP, nor would high and adverse impacts upon the low-income population found in the three-county area be disproportionate when compared to individuals within other income levels.

FIRE

The planning area encompasses portions of two geographic fire management areas as described in the Fire Management Implementation Plan for the BLM-administered public lands in the State of Wyoming (USDI 1998b). These two fire management areas are the Big Sandy and Steamboat Mountain area and the Red Desert area.

The Big Sandy and Steamboat Mountain fire management area encompasses the majority of the planning area. The fire management planning objectives for this area are to reduce conifer and sagebrush encroachment into aspen and mountain shrub communities, promote healthy timber regeneration, and improve habitat for big game and sage grouse. Other objectives are to improve forage for livestock and wild horses and to protect public and private property by reducing hazardous fuels in the urban interface and near BLM-administered recreation sites and range improvements. Wildland and prescribed fire could be used to meet resource management objectives.

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Steamboat Mountain contains unique vegetative communities and high value wildlife habitat. The Steamboat Mountain vegetative communities include associations of sagebrush with Utah snowberry and basin wildrye, bluebunch wheatgrass, and lemon scurfpea. In these communities, the primary resource management objective is to protect wildlife habitat. Generally, wildland fire is not desired in the Steamboat Mountain area, although there may be opportunities for the use of prescribed fire. The BLM would attempt to confine or contain wildland fires to less than 5 acres in the Steamboat Mountain area because of important wildlife habitat. Use of prescribed fire would be the preferred method to meet resource management objectives (USDI 1998b).

Restrictions would be applied to the use of heavy equipment and other minimal impact suppression techniques would be followed in ACECs, WSAs, and along historic trails. In particular, "light on the land" techniques and restrictions on motorized and mechanized equipment may be applied to fire activities in WSAs. Restrictions on the use of chemical and dye retardants would be followed in the vicinity of petroglyphs.

Fire frequency in the Big Sandy and Steamboat Mountain area has been moderate with 27 fires recorded in 10 years, burning about 860 acres.

The Red Desert fire management area encompasses the portion of the Red Desert Watershed that is found within the planning area boundary. The resource management objectives for this area are to improve wildlife habitat, improve forage for livestock and wild horses, reduce conifer encroachment into aspen and mountain shrub communities, and promote healthy timber regeneration.

Restrictions on the use of heavy equipment and other minimal impact suppression techniques would be followed in ACECs and WSAs. Constraints to protect watershed and scenic values would apply too. In particular, "light on the land" techniques and restrictions on motorized and mechanized equipment may be applied to fire activities in WSAs.

Fire frequency in the Red Desert area has been low with two fires recorded in 10 years burning about 31 acres.

GROUNDWATER

The planning area lies within portions of two basins, the Great Divide Basin and the Green River Basin. The Wind River Range marks the northern boundary of both basins, and the Rock Springs Uplift hydrographically separates the two within the planning area. In general, groundwater flows from the elevated basin periphery (recharge area) to the lower basin centers (discharge area) under both unconfined and confined groundwater conditions. Where groundwater is overlain by permeable material extending upward to the land surface, unconfined groundwater conditions exist. However, at depth groundwater can be confined by overlying impermeable rock, creating confined or artesian conditions. Away from the basin periphery, 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 aquifers are not well defined in either basin

because of the sporadic nature of occurrence in each geologic layer. However, 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 in the Eden-Farson area, a number of water wells have been known to produce or still produce from the Tertiary, Laney Member of the Green River Formation. South of Eden, a couple of wells produce from the Tertiary, Tipton Member of the Green River Formation. Farther to the west, in T. 26 N., R. 103 W. and T. 27 N., R. 101 W., at least two water wells have produced from the Tertiary, Wasatch Formation. In the South Pass area, one water well is known to have produced from the Tertiary Undifferentiated. On the Great Divide Basin side of the Rock Springs Uplift, groundwater data indicate usable water in the Tertiary, Wasatch Formation and Tertiary, Laney and Tipton members of the Green River Formation (Collentine, et al. 1981).

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, where it crops out, the Lewis Formation (Cretaceous). Quaternary sand dune deposits are likely to contain usable water, but more importantly may act as a recharge zone for underlying aquifers and produce seeps and springs used by wildlife. Quaternary volcanic lava flows may also have springs and seeps of usable water.

Water quality standards for domestic, agricultural, and livestock uses can be found in Table 3-1. Very few of the constituents in Table 3-1 have been monitored with any frequency within the planning area. Available water quality data is taken from the Water Resources Research Institute's evaluation of the occurrence and characteristics of groundwater in the Green River and Great Divide Basins (Collentine, et al. 1981).

In general, water quality in both basins decreases away from the basin margin and with increased depth. Quality may also decrease in heavily faulted areas due to the inability of the groundwater to circulate and/or the upward migration and comingling of lower quality water with higher quality water. In both basins, the highest quality water 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.

On the Green River Basin side of the Rock Springs Uplift, the major ion composition in the Wasatch Formation changes from calcium bicarbonate to sodium bicarbonate to sodium sulfate in a down gradient direction or away from the basin margin (Collentine, et al. 1981). The most dramatic change in major ion composition occurs where the Wasatch Formation intertongues with the Laney member of the Green River Formation, which typically has a major ion composition of sodium sulfate. On average, the Laney Member aquifer is higher in total dissolved solids (TDS-ranging from 2,000-7,000 mg/l) than the Wasatch Formation (TDS-ranging from

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100-6,600 mg/l) because of the evaporite deposits formed during the existence of ancient Lake Gosuite. Where water quality is poorest in the Wasatch Formation, water from the Laney Member aquifer is thought to be co-mingling with the Wasatch Formation water. Quaternary aquifers generally contain the highest quality water, with TDS ranging from 100-200 mg/l in the headwaters to 700 mg/l along the Green River. Within the planning area, it is anticipated TDS levels would be on the high end of the range due to local influences of the Green River Formation.

On the Great Divide Basin side of the Rock Springs Uplift, groundwater data exists for shallow Tertiary aquifers (maximum depth of about 1,500 feet and generally less than 500 feet) along the basin margin, with little data available down gradient. In general however, available data suggests water quality decreases away from the basin margin as it does in the Green River Basin. This is especially true for the stratigraphically lower aquifer systems, such as those within the Cretaceous, Almond, and Ericson formations of the Mesaverde Group. Groundwater within these formations sharply increases in salinity a short distance from the Rock Springs Uplift. Shallow Tertiary aquifers have TDS levels ranging from 400-1,800 mg/l. Similar TDS levels could be expected in areas closer to the Wind River Range. Major ion composition of the Wasatch Formation aquifers is similar to that in the Green River Basin, except that changes in major ion composition with increased salinity is sporadic and vague. The major ion composition in the Laney member is sodium sulfate.

HAZARDOUS MATERIALS

The planning area is not as developed as other oil and gas fields. There are no known hazardous materials sites within the planning area. Small oil and gas fields exist which could contribute hazardous materials to the environment. There have been accidental releases of petroleum hydrocarbons and produced water over time. They have been cleaned up under 43 CFR 3160 regulations. Under the Resource Conservation and Recovery Act of 1976, the products involved in these events are exempt from federal hazardous materials rules.

A few old abandoned pits remain scattered throughout the area. They are in various stages of natural revegetation. These pits have not been tested for hazardous materials. The Wyoming Department of Environmental Quality does not have any hazardous material (hazmat) situations in the area.

LANDS

The majority of the planning area (surface and mineral) is comprised of solid blocked public lands owned by the federal government. Principal non-federal landowners are the State of Wyoming and private landowners.

No communities are located within the area. The City of Rock Springs and the Town of Superior are the nearest incorporated cities and Eden-Farson is the nearest unincorporated populated area.

Rights-of-Way

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.

The majority of rights-of-way are for county and BLM roads and pipelines. There is an abandoned railroad line, a communication line, and a power line which cross the width of the planning area. There are also two communication sites located on public lands. There has been a minor interest in film permits.

Avoidance and exclusion areas were established in the Green River RMP (USDI 1997) (see Table 2-9). Avoidance areas are those areas on public lands where future rights-of-way may be granted only when no feasible alternative route or designated right-of-way corridor is available. Exclusion areas are those areas on public lands where future rights-of-way may be granted only when mandated by law.

Exchanges

The following exchanges are proposed:

- a. Acquire 1,920 acres of State inholdings in the Sand Dunes WSA.
- b. Acquire 640 acres of State lands in the Greater Sand Dunes ACEC.
- c. Acquire 2,072 acres of State lands on Steamboat Mountain.

Withdrawals

Withdrawals are used to preserve sensitive environmental values, protect major federal investments in facilities, support national security, and provide for public health and safety. They segregate a portion of public lands and suspend certain operations of the public land laws such as disposals or mineral location. It is now federal policy to restrict all withdrawals to the minimum time required to serve the public interest; maximize the use of withdrawn lands consistent with their primary purpose; and eliminate all withdrawals that are no longer needed.

Existing Withdrawals

- a. Oil Shale Withdrawal: recommended for revocation. This withdrawal has been modified to allow conveyance under FLPMA and the R&PP Act.
- b. Oregon Trail/Parting of the Ways: 480-acre parcel (secs.4 and 5, T. 27 N., R. 101 W.)
- c. White Mountain Petroglyphs: 20 acres (secs. 11 and 12, T. 22 N., R. 105 W.)
- d. Classification Withdrawal: recommended for revocation.
- e. Coal Withdrawal: recommended for revocation.
- f. Public Water Reserves: 4,130 acres

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Proposed Withdrawals

The Green River RMP (USDI 1997) decided that the following withdrawals be processed:

- a. Greater Sand Dunes ACEC: 23,870 acres
- b. South Pass Historic Landscape: 4,790 acres (actual acreage to be determined upon consultation with other parties of interest).
- c. Steamboat Mountain Area: (actual acreage to be determined upon completion of site specific management plans).
- d. Tri-Territory Marker: 10 acres
- e. Special Status Plants: 2,680 acres
- f. Crookston Ranch: 40 acres
- g. Public Water Reserves: 5,900 acres

Access/Transportation

Several unpaved county roads crisscross the area providing access to recreational areas and private landholdings.

The BLM transportation system serves resource programs. BLM-maintained roads provide access to range improvements, recreation areas, community pits, etc.

Access needs: Bush Rim (sec. 36, T. 24 N., R. 102 W.) and White Mountain Petroglyphs (sec. 19, T. 22 N., R. 104 W., and sec. 13, T. 22 N., R. 105 W.).

LIVESTOCK GRAZING

Livestock grazing is authorized in 16 grazing allotments (see Table 3-2) on approximately 574,800 acres of BLM-administered public lands, 15,830 acres of private, and 29,720 acres of State lands in the planning area. There are 35 livestock operators permitted to graze livestock within this planning area. Most allotments contain some lands unsuitable for livestock grazing and areas suitable only for certain classes of livestock. The allotments within the planning area, either partially or wholly are: 4th of July, Pacific Springs, Johnson Place, Crookston Ranch, Hay Meadow, Pacific Creek, Bar X, Continental Peak, Red Desert, Bush Rim, Steamboat Mountain, Sands, Rock Springs, Middle Hay, Chilton Place, and Houghton Ranch (Map 41).

Livestock grazing on BLM-managed public land in the planning area is authorized under section 3 of the Taylor Grazing Act of 1934. "Section 3" permits authorize grazing on lands inside of grazing district boundaries. The current authorized preference within the Jack Morrow Hills planning area is 22,767 cattle AUMs and 3,265 sheep AUMs (see Table 3-3).

Due to changes in available forage, environmental conditions, business decisions by operators, and livestock prices, livestock grazing in the Jack Morrow Hills area has varied over time. Total permitted use for the area was 26,032 AUMs (22,767 cattle and 3,265 sheep). Yet the actual use for the last

five years (1993-97) averaged 9,851 AUMs (8,861 cattle and 990 sheep). However, grazing use has trended up since 1997 with actual use for the baseline year of 1998 at 13,038 AUMs (11,991 cattle and 1,047 sheep) (see Table 3-4).

Congress has enacted a yearly fee allowing grazing on public lands (43 CFR 4130.8-1). This amount changes with the economic cost of producing livestock. It 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 1998 grazing fee is set at \$1.35 per AUM.

Surcharge rates are rates charged a non-permittee for livestock grazing on public lands (43 CFR 4130.8-3(d)). This means that if a livestock operator doesn't have a valid permit, he or she may enter into an agreement with another operator who has a grazing permit. The cost for this surcharge in 1998 was \$3.73 plus the grazing fee of \$1.35 for a total of \$5.08 per AUM.

The rangeland program in the planning area 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 and are being 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.

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 consist of; water developments, vegetative manipulations, windmills, and fences. Map 42 displays all of the range improvement projects in the planning area. All projects have been authorized under cooperative agreements or permits, depending on overall benefits and objectives and private investment levels. The construction of range improvement projects in conjunction with a suitable grazing system began and has continued primarily in high priority allotments.

Since the creation of the Green River Resource Area in 1986 (now called the Rock Springs Field Office), rangeland monitoring efforts under way in the Big Sandy and Salt Wells Resource Areas have continued. Appendix 9-5 of the Green River RMP reflects the type of monitoring information that has been collected in each allotment. In the Sandy EIS area, which encompasses the planning area, a majority of the monitoring studies were established between 1981 and 1984, primarily in allotments with completed Allotment Management Plans (AMPs). These studies included actual use, vegetative utilization, rangeland condition and trend, and precipitation.

The rangeland monitoring effort for the Salt Wells-Pilot Butte EIS area began during the 1984 field season. The high priority allotments were given first attention, followed by the lower priority allotments.

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Appendix 9-1 of the Green River RMP shows the allotment monitoring and categories for the Rock Springs Field Office area. More trend studies have been added in other allotments and many have also had data collected on riparian area condition and trend.

Rangeland monitoring information has been analyzed for all of the allotments in the planning area. Appendix 9-7 in the Green River RMP contains a description of the current allotment situations according to this analysis. In addition, range specialists, in conjunction with resource specialists in other programs, have identified specific conflicts or problems that currently exist or have potential to exist in each allotment. Appendix 9-6 in the Green River RMP contains a list of these conflicts and problems. Specific descriptions of uses and conflicts are on file in the Rock Springs Field Office.

Twenty-four reservoirs are identified within the planning area for either cleaning out or reconstruction. The locations of these reservoirs are as follows: 7 located in the core area, 9 are located in calving areas and 7 are located outside the core area. These reservoirs are located mostly in the Pacific Creek Allotment. There are probably numerous other reservoirs or pits located throughout the planning area which are not addressed in this document. By cleaning out these reservoirs or pits, proper distribution could take place augmenting their operations by increasing distribution, reducing over-utilization of riparian areas and improving both upland and riparian vegetation through the use of expanded watering sources to keep livestock in areas that have not been used for some time.

The following allotments within the Jack Morrow Hills Activity Plan were evaluated in FY 99 for Standards for Healthy Rangelands and Guidelines for livestock grazing management. Table 3-5 shows standards are met, not met, or are unknown (Appendix 8).

The following allotments within the JMHCAP have not been evaluated under Standards and Guidelines criteria: Chilton Place, Crookston Ranch, Hay Meadow Pasture, Houghton Ranch, Johnson Place, Middle Hay Place, and Pacific Springs.

MINERALS AND GEOLOGY

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 7). The planning area lies across the north end of the Rock Springs Uplift, extending east into the Great Divide Basin, west into the main part of the Green River Basin, and northward across the thrust fault that bounds the southern end of the Wind River Range. Surface features reflect erosion by wind and water in an arid, cold-temperature environment. Parts of the planning area have been modified by sand movement, faulting, and volcanic activity.

Historical Geology

Figure 8 lists formations present in the planning area and gives a brief lithologic description of each unit.

Precambrian

The Precambrian era is evidenced in 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 and are also found near the surface in the area to the north of the thrust fault bounding the Wind River Range.

Paleozoic

For most of the Paleozoic era, the planning area was situated just east of a marine basin located close to the equator. It was frequently covered by warm shallow seas and was mainly the site of carbonate deposition with a high percentage of clastic sediment. Depositional sequences were interrupted by several withdrawals of the sea, followed by erosional periods. The boundary between marine basin and shallow water parallels the present arcuate trend of the Thrust Belt (Figure 7).

Mesozoic

During the Mesozoic era, the North American continent gradually drifted to northern latitudes. Most of the Mesozoic rocks within the planning area, therefore, were deposited in a northern subtropical region. Sea level fluctuated during this period due to periods of eastward faulting in the Thrust Belt and mountain building events. Deposition of sediment took place in alternating marine and non-marine 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.

Cenozoic

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 7). These basinal areas were then largely filled with river and lake deposits nearly burying these mountain ranges. Volcanism to the north contributed large amounts of volcanic sediment to these basins. Climate started out warm-humid to arid-subtropical but gradually cooled. During late Tertiary time major uplift of the Rocky Mountains stopped deposition. With uplift, streams that had been flowing southward across the plain-like surfaces began to cut downward. Gradually, our modern landscape began to develop as the older structures were exposed below the sediment cover.

Quaternary

During the Quaternary period, final touches were made to the landscape of the region. The surrounding mountains were exhumed and the basins re-excavated to their present form. The high mountains were glaciated several times during the Ice Ages. Some of the glaciers may have reached the edge of the basin and deposited sediment around its margin. Local volcanic centers developed, as well as the Killpecker Dune Field.

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General Geology

The main part of the Green River Basin is a large structural and topographic basin (Figure 7) drained by the Green River and its tributaries. The floor of the basin lies between 6,000 and 8,000 feet (1,820 to 2,430 meters) above sea level, and is primarily a flat to gently rolling plain. The outer margin of the Green River Basin is defined by a series of escarpments formed by tilted beds of the Green River and Wasatch formations (Bradley 1964). North of the town of Green River, the main escarpment forms a conspicuous bluff, known as White Mountain, that extends northward into the western part of the planning area.

Three watersheds are represented in the planning area (Map 43). The main drainages in the western part of the planning area are Killpecker Creek, Jack Morrow Creek, and Pacific Creek. All are part of the Green River watershed, which is part of the Colorado River Basin. Small streams on the north edge are part of the Sweetwater River watershed, which is part of the Missouri River Basin. That area of the planning area south and east of the continental divide lies in the Great Divide Watershed. This watershed is part of the Great Divide Basin which has internal drainage due to splitting of the continental drainage divide around this basin. Most streams flow east toward the center of the basin and no precipitation leaves as surface runoff.

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 rain water. As a result, runoff erodes intricate networks of rills and gullies. As the gullies deepen, the ground surface becomes highly dissected.

The vast majority of surface rocks in the planning area are uncut by faults. The Continental Fault is approximately 55 miles (88.5 kilometers) long (Bradley 1964) and roughly parallels the buried thrust fault (Wind River thrust fault) at the north edge of the planning area (Figure 7). It begins east of the Field Office area and passes between South Pass City and Oregon Buttes.

The Rock Springs Uplift (Figure 7) is a broad, elliptical anticline that began to form after the Lance Formation was deposited in the Late Cretaceous (Roehler 1965). Erosion has uncovered a sequence of Tertiary and Upper Cretaceous rocks. The rocks exposed on the uplift are cut by a number of faults and data indicate that the west flank of the uplift is bounded by a thrust fault that does not reach the surface (Love and Christiansen 1985; Bradley 1964). The planning area straddles the northern plunge of the uplift.

The Leucite Hills, at the north end of the Rock Springs Uplift, are the remnants of a Quaternary volcanic field. They form a series of buttes that rise precipitously above the surrounding plains. Steamboat Mountain is capped by lava flows and Boars Tusk is the remnant of a volcanic neck. These two features lie within the planning area.

At the far northern end of the Rock Springs Uplift and on the south part of the planning area, is an extensive dune field

called the Killpecker Dunes. This dune field is at the western end of a narrow belt of dunes that stretches 150 miles (240 kilometers) to the east. The outer margins of the field are occupied primarily by dormant dunes, while active dunes are found in the central portion of the field.

The Great Divide Basin is a structural basin (Figure 7) underlying a topographic and internally drained basin (Love 1961). The Continental Divide splits near the southeast end of the Wind River Range and converges again at the north end of the Sierra Madre Mountains. Lake, swamp, and stream deposits of Tertiary age make up most of the bedrock and surficial deposits are predominantly soft and weak, causing the basin to be nearly flat and featureless, with occasional intermittent lakes and dry flats in the lowest areas. The youngest features are the Killpecker Dunes which extend across this basin.

The dominant feature of the southern Wind River Range in the planning area is a very gently dipping erosion surface comprised of Tertiary sediments (Bayley, et al. 1973). This surface blends the Precambrian core of the range with the Rock Springs Uplift and Green River Basin to the south and southwest. Relief in these foothills is 300 to 500 feet (90 to 150 meters). This range is one of the most spectacular of the Precambrian uplifts in the state. It is basically a huge block of granite that has been moved by faulting south-westward over the Green River Basin. This fault is called the Wind River thrust fault and is covered by sediments on its southern end where it extends into the planning area.

Oil and Gas Geology

Historical Background

Between 1900 and 1916, a number of shallow wells were drilled on the Rock Springs Uplift in search of oil. A number of oil and gas shows were encountered but no wells were productive. Additional work began in the 1920s with the first discovery being the South Baxter Basin field in August of 1922. Drilling activity has occurred almost continuously since this discovery and has resulted in the location of a large number of gas and oil fields along the axis of the Rock Springs Uplift.

The first test in the planning area was the Boars Tusk Oil Company #1 (sec. 16, T. 23 N., R. 104 W.) abandoned in 1927. Thirteen more nonproductive wells were drilled and abandoned before the first producing well was completed in 1961. Trigood Oil Company drilled the first Frontier Formation producer in sec. 17, T. 23 N., R. 103 W. The well later added production from the Dakota Formation.

Exploration and development continues today. Through August 31, 1997, there have been 153 wells completed in the planning area. Information on these wells is presented in Table 3-6. Additional information about those wells that have produced can be found in the RFD (on file in the Rock Springs Field Office). Methods and procedures to conduct geophysical exploration leasing, well permitting, drilling operations, development, production, and subsurface practices are described in Appendix 9.

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Origin of Oil and Gas

Crude oil and natural gas are composed chiefly of hydrocarbon compounds and are found primarily in sedimentary rocks. The earliest formed petroleum compounds tend to be very heavy, viscous oils. With increasing temperature and pressure, the heavy oils are “cracked,” forming lighter oils and natural gas. The lighter constituents are more mobile and may migrate away from the rocks containing the organic debris, called the “source rocks,” into more porous and permeable rocks called “reservoir rocks.” Oil and gas are “trapped” when they migrate to a place where further movement is barred by a structural and/or stratigraphic feature, e.g., faults, impervious beds, etc. Both source and reservoir rocks are present in the planning area as evidenced by the production so far discovered. The planning area thus has a high potential for the occurrence of oil and gas in economic amounts.

Trapping Mechanisms

Figure 9, a cross-section through the Rock Springs Field Office area, portrays the most common trap types. A structural trap, as illustrated on the Rock Springs Uplift, has a closure in which oil and gas accumulate after migrating up-dip through strata. An impervious cap rock seals the accumulations against further vertical movement while water generally underlies and confines the hydrocarbon accumulation against the cap rock. Exposed structures are readily apparent and thus received the earliest and most extensive exploration effort. That is why the area to the south of the planning area was drilled and developed at an early date.

Stratigraphic traps, as illustrated in the Red Hill and Patrick Draw areas of the Great Divide Basin, may depend upon a change in the amount of space between grains of sediment (porosity) and/or how well those spaces are connected (permeability) to block the migration of petroleum hydrocarbons, allowing an accumulation of hydrocarbons to develop. Changes in porosity and permeability occur as a result of depositional history, such as the deposition of sand bars and alluvial stream deposits, or the truncation of permeable strata with subsequent deposition of an overlying impermeable formation. The discovery of stratigraphic traps depends on detailed and time consuming geologic study.

Oil and Gas Occurrences

Producing units in the planning area are: Buccaneer; Nitchie Gulch; Rim Rock; Steamboat Mountain; and Treasure (Map 44). Wells drilled in these units are listed as part of Table 3-6. The Johnson Gap Exploratory Unit (Map 44) was approved effective February 2, 1994. Drilling of the first unit well is delayed until this CAP is completed.

The Gold Coast Exploratory Unit (Map 44) was approved effective January 30, 1998. The first well, located in section 6 of T. 25 N., R. 102 W., commenced drilling in the Fall of 1998 and is temporarily shut-in. The West 187 Exploratory Unit (Map 44) was approved effective February 25, 1998. Drilling of the first unit well is delayed until this CAP is completed.

Three recently terminated exploratory units lie partially within the planning area and the first well for each was drilled outside the planning area. Riva Exploratory Unit overlapped the planning area on its eastern boundary and terminated June 22, 1995. The Lewis Shale was tested and abandoned in the unit well. The Encore Exploratory Unit overlapped the planning area on its southeast edge and terminated February 17, 1998. The Almond Formation, Lewis Shale, and Ericson Sandstone were tested and abandoned in the unit well. The Jade Exploratory Unit overlapped the planning area on its eastern boundary and terminated July 1, 1998. The unit targets were the Almond Formation and Lewis Shale. The first well was completed as a low volume gas producer in the Lewis, causing unit termination.

All other units shown on Table 3-6 were originally part of exploratory unit proposals that were later terminated either because non-productive wells or low volume producing wells were drilled. 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 for orderly development.

Each of the five producing units are also classified as Fields by the Wyoming Oil and Gas Conservation Commission. Their areal extent can cover an area larger than that of the linked unit area. Other fields in the planning area are: the Pine Canyon Field which extends south beyond the planning area boundary; the productive Essex Mountain and unnamed (Section 7 of Township 25 North, Range 102 West) fields; and the abandoned Freighter Gap and Saddle Bag fields. In addition, three other wells were technically completed as coalbed methane wells but have not produced. A field name for these wells has not been determined. The wells lying within each of these fields are listed on Table 3-6.

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 completed in the Rock Springs Formation. A number of other younger Tertiary formations and older Mesozoic and Paleozoic age formations produce to varying degrees in the Greater Green River Basin, outside the planning area.

Much of the area has been leased for oil and gas. Leases are issued for a 10-year period, and several are currently held by production activity. All WSAs are closed to leasing. These are non-discretionary closures in accordance with 43 CFR 3100. As other leases in the planning area terminate they are being held in abeyance until this plan is completed.

Pipelines and Natural Gas Storage

An extensive natural gas transmission system now exists in Wyoming and the Rocky Mountain region. The state has more than 12 major natural gas pipelines. Six natural gas storage facilities were active as of December 1994 (WOGCC 1995). In addition, seven major pipelines are regulated by the Federal

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Energy Regulatory Commission and transport natural gas from the region in all directions in the interstate system.

The planning area production is serviced by one main gathering pipeline that brings gas south to the east-west corridor of pipelines that lie along the I-80 transportation corridor (Barlow & Haun 1994). Most gas is sold by producers directly to local gas distribution companies, with the pipeline acting as a “common carrier” of natural gas.

Storage facilities have been used by utilities and pipelines to manage peak loads of gas and other sudden changes in consumption and production. At these facilities, gas is stored underground until needed. The Brady Field is the only gas storage facility located in the Rock Springs Field Office area. The Clay Basin storage facility, in Utah, lies south of the planning area and receives a large portion of its gas from fields lying within the Field Office area.

Oil and Gas Development Potential

Oil and gas development potential (Map 45) was determined for the Green River Final EIS RMP (USDI 1996) by geologic analysis from United States Geologic Survey sources and a survey of the industry. This map is expected to still be accurate for the planning area.

Potential for the occurrence of Tertiary coalbed methane and the occurrence of Upper Cretaceous coalbed methane was determined by Stilwell (1991) for the Green River RMP-EIS (1996). That analysis is expected to still be accurate for the planning area. New information obtained while preparing this CAP caused modification of the area development potential for coalbed methane (Map 46).

Geophysical exploration activities have occurred throughout much of the area. Geophysical exploration is a method of mapping subsurface geology. A number of geophysical exploration methods are used. See Appendix 9 for a description of various geophysical exploration methods. The most popular types of geophysical methodologies involve the use of shothole, vibroseis, and explosive charges. The Green River RMP closed the following areas to geophysical vehicle use and explosive charges: Boars Tusk, Special Status Plant Species locations, Crookston Ranch, White Mountain Petroglyphs, and Wilderness Study Areas (about 119,890 acres). Seismic activity has occurred in the planning area in the past, although not recently. Activity could occur in the future.

Coal

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. The Green River RMP (USDI 1997) provided management direction on coal development in certain areas to facilitate management of other resources. The table of areas with coal development restrictions (Table 3-7) coal development restrictions shows derived from the Green River RMP.

Map 47 shows the area with coal development potential. Coal beds in this area are buried by overlying sediments. Limited drill data exist for a few sections within these townships: T. 23 N., R. 103 W. and R. 104 W. and T. 22 N., R. 104 W. Data indicate numerous coal seams with thicknesses ranging from 0.3 to 3 feet occur at depths from 8 to 428 feet. One notable coal bed ranges in thickness from 3 to 8 feet and occurs at depths ranging from 11 to 283 feet in depth. Little data exist on the late Cretaceous coal beds deeper than 300 feet everywhere in this relatively unrestricted area and even less data exist for T. 23 N., R. 102 W., and T. 22 N., R. 105 W. Additional exploration drilling is needed before surface and/or subsurface mining could be deemed feasible. The Green River RMP closed portions of the planning area to coal exploration and sodium prospecting. These areas are listed in Table 3-8. About 35,600 acres in the core area are closed to coal exploration.

Currently, there are no leases within the planning area and no coal development is currently projected. Existing mines, especially those in the Powder River Basin, and coal reserves elsewhere in the state are expected to meet the demand for coal during the planning period. About 44,990 acres of federal coal lands within the Coal Occurrence and Development Potential area would be open to further consideration for coal leasing and development (i.e., new competitive leasing, emergency leasing, lease modifications, and exchange proposals, under the Federal Coal Management Program) with appropriate and necessary conditions and requirements for protection of other land and resource values and uses (see Appendix 3).

About 21,990 acres of federal coal lands, within that portion of the Coal Occurrence and Development Potential area that is within the core area, would be open to further consideration for coal leasing and development (i.e., new competitive leasing, emergency leasing, lease modifications, and exchange proposals, under the Federal Coal Management Program) with appropriate and necessary conditions and requirements for protection of other land and resource values and uses (see Appendix 3).

Presently, there are no coal operations within the planning area boundary. Outside the planning area, two companies operate strip surface coal mines and two companies operate underground coal mines (USDI 1997). The surface mines include the Bridger Coal mine and Black Butte/Pit 22 mine, and the subsurface mines include the Lion Coal and Pilot Butte mines. These mines would continue to operate, and areas of high interest and development potential would be defined as lease tracts.

Sodium

The planning area is not within any Known Sodium Leasing Area. However, 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. The brine originated from lake water trapped within permeable rock lenses near the bottom of ancient Lake Gosuite (Dana and Smith 1976). Dana and Smith report tested samples contain soda ash (about 30 weight percent) and oil (about 70

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weight percent). Combustible carbon and noncondensable gas are additional products included with the oil.

The potential for producing multiple products from a single well has generated some commercial interest. At least one company produced brine from six drill holes, but was unsuccessful in finding a market for the brine or finding a suitable process for producing soda ash or organic matter from it. Eventually they abandoned the effort. In 1991, another company obtained permits to conduct a pilot project to determine the economic feasibility of commercializing the brine. The project was never implemented, reportedly because the beneficiating cost could not compete in the existing trona (soda ash) and oil and gas markets. Currently, oil and gas can be produced more efficiently through conventional means. As conventional oil and gas sources are exhausted, alternate sources will be investigated.

The five trona mines located west of Green River produce about 16 million tons annually, which supplies 30 percent of the world's trona. If it is assumed that yearly production was 20 million tons, and only 35 percent of the 127 billion tons could be recovered then it would take over 2,200 years to mine all of the trona resources in the Green River Basin. Consequently, brine development potential is low. Any development of brine within the brine potential area would occur slowly and in phases and likely occur in the last five to ten years of the planning period.

Areas closed to sodium prospecting are the same as those listed above for coal resources.

Oil Shale

Deposits of oil shale are known to occur in the Tipton, Wilkins Peak, and Laney Members of the Green River Formation. The oil shale was formed in association with Lake Gosuite and occurs as nearly horizontal layers of fine-grained lacustrine shales, marlstones, mudstones, and claystones containing solid combustible organic rich matter, also known as kerogen (Culbertson, Smith, and Trudell 1980). Approximately 2.9 million acres of Wyoming land has been officially classified as prospectively valuable for oil shale in Oil Shale Classification Order Wyoming No. 1 (Federal Register, Vol. 47, No. 224). In Wyoming, these oil shale reserves are only found in the Green River and Washakie Basins.

The western edge of the planning area is included within Oil Shale Classification Order Wyoming No. 1. The primary effect of this Order is to withdraw these lands from mineral location and land disposal and to reserve them for development of shale oil. Current efforts are underway to lift the Order. The Green River RMP (USDI 1997) made the decision to revoke the classification at such time as the classification is lifted, but not before evaluating whether an area should remain withdrawn from mineral location for the purpose of protecting other resource values.

Available technology falls short of being able to extract and prepare the oil for market in a way that is competitive with today's oil markets. Therefore, no oil shale development is expected anywhere in this area.

Potash

The Leucite Hills, including Boars Tusk and Steamboat Mountain, are known to contain potash. Chemical analyses of the rocks from Steamboat Mountain and Boars Tusk indicate a potash content of 12.66 and 9.81 percent, respectively (Hausel, Sutherland, and Gregory, 1995). Hausel, et al reports Steamboat Mountain had the highest potash content of any of the 24 samples collected from the Leucite Hills volcanic field. Schultz and Cross (1912) estimated 20,618,180 tons of potash occur within an estimated 206,181,800 tons of rock at Steamboat Mountain. Boars Tusk was estimated to contain 2,899,438 tons of potash. Potash was mined during the first world war 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). Though Steamboat Mountain and Boars Tusk contain considerable amounts of potash, development of this resource in these areas is unlikely during the planning period given the existing surface use constraints and the amount of potash contained elsewhere in the Leucite Hills.

Locatable Minerals

Gold

Historically, gold has been the primary locatable mineral explored for in the planning area. At the present time, active mining claims are located east of Dickie Springs, south of the Sweetwater River, and northwest of Honeycomb Buttes (USDI 1997). These 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 and have annual filings completed for the current year and may or may not have exploration and/or mining operations in progress (Map 48).

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, which is run by claimants in their free time. Weather restricts activity to the snow-free months, which generally runs 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. Similar levels of activity are anticipated during the planning period.

Public lands open to mineral entry within the planning area are shown in Map 25. The Green River RMP requires a plan of operations for all locatable mineral activities within ACECs, WSAs, potential additions to the Wild and Scenic River System, and areas closed to off-road vehicle use, to protect associated resource values. The following areas require a Plan of Operations: Boars Tusk; Oregon Buttes ACEC; Greater Sand Dunes ACEC; South Pass Historic Landscape ACEC; South Pass Historic Landscape (about 4,970 acres); Steamboat Mountain ACEC (pending completion of the site specific implementation plan); Special Status Plant Species Sites; and Crookston Ranch.

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Diamonds

Besides gold occurrences in the northeastern portion of the planning area, there is the potential for diamonds to occur in association with the Quaternary volcanic rocks (lamproites) found in the southern part of the study area. Though no diamonds have ever been recovered from these lamproites, they exhibit characteristics similar to diamondiferous lamproites found in Arkansas, Western Australia, and India.

Additional exploration is needed to further define these structures and to search for diamonds. Either detailed petrographic and geochemical analyses or larger sample volumes will be necessary to make this determination. It is anticipated that such exploration may occur during the planning period. About 2 acres of disturbance is anticipated from these activities.

Uranium

Wyoming has been a major producer and reserve holder of uranium in the United States (Harris and King 1993). Harris and King report that almost every stratigraphic unit and every county in the state contains uranium mineralization. The largest and most important deposits of uranium occur outside the planning area in the Gas Hills, Shirley Basin, Crooks Gap, southern Powder River Basin, and Pumpkin Buttes uranium districts. In the northern part of the planning area, the U.S. Geological Survey (Patterson, et al, 1987) reports the occurrence of uranium within coal beds of the Wasatch Formation (Tertiary) and possible deposits within the conglomeratic lenses of the Cathedral Bluffs Tongue (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 were located over the Rock Springs Formation and/or Ericson Formation of the Cretaceous Mesaverde Group. The potential for development of uranium within the planning area is very low. No development activity is projected during the planning period.

Salable Minerals (Mineral Materials)

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, the Sweetwater River and 1/4 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. Areas closed to development of salable minerals within the planning area are listed below: Boars Tusk; Oregon Buttes ACEC; Greater Sand Dunes ACEC; South Pass Historic Landscape ACEC; South Pass Historic Landscape (about 4,970 acres); Steamboat Mountain ACEC (pending completion of the site specific implementation plan); Occupied Raptor Nests; Special Status Plant Species Sites; Crookston Ranch, Rock art sites (including the White Mountain Petroglyphs ACEC), and Wilderness Study Areas.

Nearly all material used for construction and maintenance of designed gravel and paved roads comes from outside the planning area. The exception is a Wyoming Transportation Department borrow site along Wyoming Highway 28. About 4 acres of disturbance has occurred at this site. South of the planning area along the Tri-Territory Road is the Long Canyon community sand and gravel pit. Gravel deposits of marginal quality occur southeast of the planning area along the Bar X Road.

Clay

The Cretaceous Lance Formation, Lewis Shale, and Mesaverde Group could contain clays and shales usable in 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 potential for development of clays is very low given the existing land use restrictions and abundance of clay elsewhere. No activity is projected during the planning period.

Geologic Hazards

Several types of geologic hazards are present in the planning area (Map 49). Hydrogen sulfide, earthquake, landslides, and windblown sand hazards are of primary concern. Geo/Resource Consultants (1984) prepared an analysis of these hazards, with the exception of the hydrogen sulfide hazard.

Hydrogen sulfide is present with the hydrocarbons in some deep producing oil and gas wells further south on the Rock Springs Uplift and could be present in the planning area in formations deeper than those that presently produce hydrocarbons. Exposure to small quantities can cause death. Additional discussion of this hazard is on file in the Rock Springs Field Office (USDI 1992).

Active faulting is limited to 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.

Landslides are scarce in the planning area, due to 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.

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).

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OFF-ROAD VEHICLES

Off-road vehicle (ORV) designations for the planning area were made in the Green River RMP (USDI 1997) (Map 50). The designations have been instituted for resource protection of soils, vegetation, wilderness, wildlife, and water. Only the Sand Dunes ORV play area carries an “open” ORV designation of 10,500 acres. All seven of the Wilderness Study Areas, Boars Tusk, Crookston Ranch, and Special Status Plant Species found in the planning area are closed to off-road vehicles, encompassing about 119,890 acres. The remainder of the planning area falls within the “limited” use category (Table 3-9).

The limited ORV 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 limited seasonally (see the Glossary). Current limited designations in the planning area include limited to existing roads and trails and areas limited seasonally. Designations have not been made for the areas identified as limited to designated roads and trails. Designations would be done through site-specific activity planning with public input. Until the designations are completed, the areas are managed as limited to existing roads and trails.

PALEONTOLOGY

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 FLPMA, and such permits are generally issued only to qualified paleontologists.

The Tertiary volcanics 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 south edge of the 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*). The remains of a bird skeleton have reportedly been found at a site west and north of Boars Tusk (Geo/Resources 1984), and fossils may potentially be present elsewhere in the planning area.

Hundreds of flamingo-like bones have been collected from the Cathedral Bluffs Member of the Wasatch Formation. This was evidently the nesting site of a flamingo-like shore bird, *Presbyornis*. No other such sites are presently known within the report area. The Cathedral Bluffs Member is richly fossiliferous in many places in the planning area, yielding such vertebrates as crocodiles, turtles, fish, and mammals.

The Laney Shale Member of the Green River Formation is known to contain large numbers of *Knightsia*, *Diplomystus* and other fish of the Eocene Epoch. Several fossil fish localities have been found in the Laney Shale outside the planning area; fish are also locally common in the planning area.

The Bridger Formation has a large number of significant fossil localities in the general region outside the planning area. Primates, primitive horses and other Eocene-age mammals have been collected from the Bridger Formation from circa 1870 until the present day. The Bridger Formation includes the upper elevations around Oregon Buttes, Honeycomb Buttes, Tule Butte, and Buffalo Hump.

RECREATION

Recreation activities available on BLM-administered lands in the planning area are many and varied. A brief listing includes stream and river fishing; big game hunting for elk, deer, moose, and antelope; small game, upland bird, and waterfowl hunting; swimming; camping; backpacking; horsepacking and riding; dirt bike and other ORV use; mountain biking; rock and petrified wood collecting; sight seeing of historic trails and places; wild horse viewing; wildlife viewing; and general photography. Recreation use in the planning area predominantly occurs between May and October. Lack of maintained roads in the winter restricts recreational year-round access. Recreation use is anticipated to continue and increase in the future (see the Socioeconomics section).

Major recreation locations include the Greater Sand Dunes area, Steamboat Mountain, Oregon Buttes, White Mountain Petroglyphs, Honeycomb Buttes, Tri-Territory Monument, and the Oregon/Mormon Pioneer/California/and Pony Express National Historic Trails.

There are three Special Recreation Management Areas (SRMA) in the planning area: (1) Greater Sand Dunes (38,650 acres) (refer to Greater Sand Dunes ACEC); (2) the Oregon/Mormon Pioneer/California/and Pony Express National Historic Trails (27 miles); and (3) the Continental Divide National Scenic Trail.

Greater Sand Dunes Special Recreation Management Area

The Greater Sand Dunes Special Recreation Management Area incorporates the ACEC boundary. The area offers

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outstanding motorized and non-motorized recreational values which have the potential of increasing significantly. In 1983, an ACEC management plan was completed and this plan also serves as the Recreation Activity Management Plan for the area. The existing off-road vehicle parking and camping area was built in the mid-1980s and needs to have a project plan completed to address visitor conflict concerns. The Crookston Historic Ranch also is in need of a project plan to address resource concerns.

Oregon/Mormon Pioneer/California/ Pony Express National Historic Trails

After the Sand Dunes discussion add as a heading Oregon/Mormon Pioneer/California and Pony Express National Historic Trails followed by this discussion. “A complete discussion of the Oregon-Mormon Pioneer National Historic Trails special recreation management area can be found in the Oregon-Mormon Pioneer National Historic Trails Management Plan (USDI 1986). In 1999, a comprehensive management and use plan was developed by the National Park Service for the California/Pony Express National Historic Trails as well as an update to the Oregon/Mormon Pioneer National Historic Trails Management Plan. The SRMA is managed for a range of visitation intensities from dedicated trail buffs in four-wheel-drive off-road vehicles to the transient visitor in a family vehicle simply passing through the area.

Continental Divide National Scenic Trail

The Forest Service published a comprehensive management plan for the trail in 1985. The plan set broad goals and policy for local trail management. In 1998, BLM issued an Environmental Assessment for the designations 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 Jack Morrow Hills EIS to analyze the side trail along with other related resource issues.

On October 2, 1968, Congress passed the National Trails System Act. This Act called for the establishment of a system of national scenic trails “which will be extended trails so located as to provide for maximum outdoor recreation potential and for the conservation and enjoyment of the nationally significant scenic, historic, natural, or cultural qualities of the areas through which such trails may pass.” As a result of the 1978 amendment to this Act, Congress designated the Continental Divide National Scenic Trail (CDNST) as part of the National Scenic Trail system. The CDNST is a trail route traversing the length of the Rocky Mountains, in close proximity to the Continental Divide for approximately 3,100 miles, through the states of Montana, Idaho, Wyoming, Colorado, and New Mexico.

A part of the CDNST is identified in the planning area. About 25 miles of existing roads and routes have been identified as a side trail for the CDNST. This route would partially occur in the South Pass Historic Landscape area (Map 51).

There are two Backcountry Byways identified in the planning area. The Tri-Territory Loop Backcountry Byway lies completely in the planning area while the Red Desert Backcountry Byway lies partially in the planning area. There are opportunities for interpretive sites along these byways to provide information and scenic views of the planning area.

Recreation Opportunity Spectrum

Public lands are managed to provide a broad spectrum of recreational opportunities. The recreation opportunity spectrum system provides the BLM with a framework for determining existing outdoor recreation opportunities and management potential, based upon a combination of activity, setting, and experience.

“The recreation opportunity spectrum is divided into six management classes which are described in Table 3-10 and shown on Map 52, if applicable. The recreation opportunity spectrum system describes probable physical settings, experiences, and activities for each class and identifies where these combinations occur within the planning area, but also allows flexibility. The use of this system on public lands will help recognize and meet the public’s growing demand for a wide variety of recreation activities and setting within the planning area.

SOCIOECONOMICS

General Setting

The planning area is located in southwest Wyoming and can be characterized as remote with very little development. The planning area sits in the north-central portion of Sweetwater County; however, small segments of the planning area affect Fremont and Sublette Counties. Therefore, the economies of Sweetwater, Sublette, and Fremont Counties will be discussed.

County Amenities

Sweetwater County

Sweetwater County has one hospital, several medical clinics, home health care, and two nursing homes. Two school districts and one community college with several outlying learning centers provide educational opportunities. Numerous parks and ball fields, which provide youth and adult sporting activities, can be found within or nearby the cities and towns. The cities of Rock Springs and Green River have recreational and community centers. Flaming Gorge National Recreation Area lies south and between the cities of Green River and Rock Springs. Other outdoor recreation opportunities are available including Seedskadee National Wildlife Refuge, historic trails, hunting, fishing, boating, hiking, backpacking, 4-wheeling, mountain biking, sight-seeing, etc.

Cultural attractions occur throughout the year including Flaming Gorge Days, Red Desert Rodeo, stock car races, festivals celebrating international cultures, and a balloon extravaganza, among others. There are several museums and

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libraries open to the public, and other visiting cultural events take place throughout the year. All major religious denominations are locally available and provide social services to the community.

Three shopping malls and three major discount stores can be found in Sweetwater County as well as numerous stores located away from shopping centers. Daily and weekly newspapers, several radio stations, cable and satellite television, and telephone service are available. Several businesses provide local Internet access.

Local government facilities and services are adequate for the current population. Public transportation is available including commercial airline, car rental, taxi, and local, regional, and national bus services. Train access is not currently available. The crime rate is well below the national per capita rate.

Fremont County

Fremont County has two hospitals, a medical clinic, home health care, and several nursing home facilities. Nine school districts and a community college with outlying learning facilities provide educational opportunities to residents. Numerous parks and ball fields provide youth and adult sporting activities within or near cities and towns. The communities of Riverton and Lander provide either recreational or community centers. The Wind River Indian Reservation is within the county.

Outdoor recreation opportunities are abundant in Fremont County including hunting, fishing, camping, hiking, backpacking, 4-wheeling, mountain biking, snowmobiling, etc. Cultural attractions take place throughout the year including winter festivals, rodeo, a balloon rally, and festivals celebrating Indian and Hispanic cultures among others. Several museums and libraries are available in the county and visiting cultural events occur during the year. All major religious denominations are locally available and provide social services to the community.

Shopping opportunities are readily available. One daily and several weekly newspapers, several radio stations, cable and satellite TV, telephone, and Internet access are available to county residents. Public transportation services include commercial airline, rental car, and local and regional bus service. The crime rate is well below the national per capita rate.

Generally speaking, governmental facilities and services are adequate for the current population.

Sublette County

Sublette County has two medical clinics, two senior citizen's centers, and a rural health care district. Two school districts and Western Wyoming Community College's outreach center, in conjunction with the Pinedale high school, provide educational opportunities. Several parks are available and school-related recreational facilities are open to the public. Organized sports are available for youths and adults.

Outdoor recreation opportunities are abundant in Sublette County including hunting, fishing, camping, hiking, backpacking, boating, cross-country and downhill skiing, 4-wheeling, mountain biking, snowmobiling, etc. Cultural attractions occur throughout the year including Green River Rendezvous, dog-sled races, rodeos, snowmobile hill climbs, etc. Two museums and libraries are open to the public. All major religious denominations are locally available and provide social services to the community.

Shopping opportunities are available if somewhat limited. One weekly newspaper, one biweekly newspaper, two local radio stations (one available to Pinedale residents only), cable or satellite TV, telephone, and Internet access are available to county residents. Limited public transportation in the form of shuttle service for senior citizens is available. No commercial airline, train, or bus service is available. However, commercial airline and bus services are available in Jackson or Rock Springs.

With construction of a new water treatment facility and pipeline for the Town of Pinedale, local government facilities and services are adequate for the current population.

Population

According to U.S. Census Bureau latest estimates, 1997 population for Wyoming decreased slightly to 479,743 from the 1996 estimate of 480,011 (WSDC Bulletin 1998). Wyoming ranks 50th in population size (U.S. Census Bureau 1997). Of the State population in 1996, 50.3 percent of the population was male and 49.7 percent was female. Median age was 34.9 (State of Wyoming 1998a). The three-county area had a combined population of 77,328 in 1990 (last census) and represents just over 17 percent of the population in Wyoming. July 1997 estimate released by the U.S. Census Bureau in March 1999, calculate the population of the three-county area at 81,332, an increase of 4,004 individuals.

Sweetwater County

Although it is difficult to ascertain exact numbers for population especially so far between census taking, population in Sweetwater County in July 1997 is estimated between 39,738 (WSDC Bulletin 1998) and 41,570 (SWEDA 1998a). Regardless, trends show that population has fluctuated in the last decade. In 1987, 42,118 individuals lived in Sweetwater County. By 1990, Sweetwater County lost approximately 3,300 individuals, leaving a population estimated at 38,823. Since 1990, the population has rebound to a total of between 39,738-41,570 depending upon the source of information, but still below 1987 population levels. Table 3-11 shows Sweetwater County population estimates in the last decade and estimates for the early millennium.

The main population centers in Sweetwater County include Rock Springs with 20,717 residents and Green River with 13,815 residents. Other nearby communities include Eden/Farson, Superior, and Point-of-Rocks with populations of 568, 256 and 82, respectively. Other communities in Sweetwater County include Bairoil with 165 members, Granger with a population of 140, Wamsutter with 274 members, and

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McKinnon/Burntfork with 84 persons. Approximately 5,700 persons lived outside population centers (SWEDA 1998b).

The estimated ethnic make up of Sweetwater County in 1996 includes 35,776 whites, 3,573 whites of Hispanic origin, 3,658 Hispanics, 316 African-Americans, 323 American Indian (category also includes Eskimo and Aleutian), 334 Asian or Pacific Islander (State of Wyoming 1998a). Others with ethnic backgrounds different than those mentioned above also live in Sweetwater County.

Fremont County

Population in Fremont County in July 1997 is estimated between 35,888 (WSDC Bulletin 1998) and 36,200 (Wyoming Almanac). Again, the population took a dip in the late 1980s and early 1990s. In 1987, 34,844 individuals lived in Fremont County. By 1990, the population dipped to approximately 33,662. Since 1990, the population has increased to somewhere between 35,888 and 36,200 (1997 estimate). In the last decade, population has increased by approximately 1,356 individuals. Table 3-12 shows Fremont County population estimates in the last decade and estimates for the early millennium.

The main population centers in Fremont County include Riverton with 10,050 members and Lander with 7,372 members. Other population centers include the communities of Dubois, Shoshoni, Hudson, and Pavillion with population of 1,018, 522, 411, and 135, respectively (1996 estimates, State of Wyoming 1998a). Approximately 16,500 individuals live outside the major population centers.

The estimated ethnic make up of Fremont County in 1996 includes 28,012 whites, 944 whites of Hispanic origin, 1,384 Hispanics, 62 African-Americans, 6,792 American Indian (category also includes Eskimo and Aleutian), 130 Asian or Pacific Islander (State of Wyoming 1998a). Others with ethnic backgrounds different than those mentioned above may also live in Fremont County.

Sublette County

Population in Sublette County in July 1997 is estimated between 5,640 (State of Wyoming 1998a) and 5,696 (WSDC Bulletin 1998). In 1987, 5,358 individuals lived in Sublette County. By 1990, the population dipped to approximately 4,843. Since 1990, the population has increased to 5,696 (1997 estimate). Overall, the population has increased by 853 individuals in the last 10 years. Table 3-13 shows Sublette County population estimates in the last decade and estimates for the early millennium.

The main population centers in Sublette County include Pinedale with 1,274 members, Marbleton with 689 members, and Big Piney with 478 members (1996 estimates, State of Wyoming 1998a). Almost 60 percent (3,136 individuals) of the population live outside of incorporated population centers.

The estimated ethnic make up of Sublette County in 1996 includes 5,406 whites, 68 whites of Hispanic origin, 68 Hispanics, 5 African-Americans, 81 American Indian (cat-

egory also includes Eskimo and Aleutian), 17 Asian or Pacific Islander (State of Wyoming 1998a). Others with ethnic backgrounds different than those mentioned above may also live in Sublette County.

Housing

Sweetwater County

In 1970, Sweetwater County's population was just under 18,400 people and by 1982, the population bloomed to almost 46,000 residents. Today (1997 estimate), the population stands at over 40,000. The cycle of growth and decline is reflected by changes in housing availability. Through the 1970s and early 1980s, much of the demand for housing was accommodated by mobile homes. When employment opportunities declined, many mobile home residents left the community or moved into site built homes. In addition, some company owned apartments in the area were removed.

Due to increased employment opportunities in the early 1990s, some 430 new single family and multi-family housing units were added between 1990 and 1993. By late 1997, approximately 16,400 housing units existed including 10,415 single family homes, 1,809 multi-family units (duplexes and apartments), and approximately 4,169 mobile homes (Sweetwater County 1998).

In Sweetwater County there were fewer vacancies for all types of housing in 1994 than in 1990. Rental rates have continued to climb since 1990 with average in December 1997 of \$366 for a two bedroom apartment and \$460 for a two bedroom house in Sweetwater County (Sweetwater County 1998). As of early June 1998, there were 355 housing units for sale (Vanderpool 1998) and 80 units for rent (Rocket Miner 1998).

As of 1998, the price of a new 1,200 square foot home in Sweetwater County was almost \$130,000 (Sweetwater 1998). Existing average homes for sale cost around \$110,000-120,000 (Robertson 1998). Housing starts in the first five months of 1998 numbered 25. By the year 2000, it is estimated that an additional 700 housing units will be required in Sweetwater County should current economic indicators hold true (Sweetwater County 1998). In 1997, Sweetwater County issued 75 building permits (State of Wyoming 1998b).

Fremont County

Housing situation in Fremont County is based upon review of a local newspaper, Lander Wyoming State Journal on June 7 and 24, 1998, and July 5, 1998.

Housing in Fremont County is available. Approximately 12-18 houses, in every price range (\$40,000 to \$400,000+), were for sale in June/July 1998. More moderately priced homes sell faster than higher priced homes (Barlett 1998). Summer or second homes are fairly common in Fremont County. Fremont county issued 54 building permits in 1997 (State of Wyoming 1998b). Rentals are very readily available including apartments, mobile homes, some site-constructed houses, and even rooms. Average rental rate in Riverton was \$347 for

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an apartment in the fourth quarter, 1997; a house rented for \$410 during the same period (State of Wyoming 1998b).

Sublette County

Housing situation in Sublette County is based upon conversations with Gary Caskey of High Mountain Real Estate, Pinedale and Betty Fear with Real Estate of Sublette County, Big Piney on June 18, 1998.

Housing in Sublette County is available. Approximately 80-100 houses come up for sale in a given year and approximately 30-40 houses are sold. Pinedale area has the most housing units (includes cabins, ranches, etc.). Housing prices in Pinedale area have stabilized over the last year and a half. Smaller homes within Town of Pinedale range in price from approximately \$85,000-95,000 on up, depending upon features. Houses outside of town, including new construction and those with acreage, sell for \$140,000 on up. Rentals are very hard to find and relatively expensive. Summer or second homes are fairly common in Sublette County. Sublette County issued 46 building permits in 1997 (State of Wyoming 1998b).

As of June 1998, housing in the Big Piney-Marbleton area is tight. Currently there are four houses for sale, all single family dwellings, and range in price from \$55-90,000. Prices have remained stable over the last few years. Some new housing construction is taking place but only for individuals; no multi-family dwellings. No rentals are currently available.

Employment And Income

For the purpose of discussing local economies, certain industries have been grouped together. To better understand the following tables, the economic sectors are discussed below:

Farm Sector - Animal products including meat products (beef, pork, lamb), dairy products (milk, cheese), poultry and eggs, wool, leather, honey, etc. Crops include wheat, feed crops (hay, barley, oats, corn), oil crops, vegetables (dry beans, potatoes, etc.), sugar beets, and other crops.

Agricultural Services - includes establishments primarily engaged in forest products, commercial fishing, hunting and trapping, and related services.

Mining - includes all establishments primarily engaged in mining. Mining includes the extraction of solid, liquid, and gaseous minerals occurring naturally, as well as other preparation customarily done at the mine site or as a part of the mining activity.

Construction - includes establishments primarily engaged in construction, defined to include new work, additions, alterations, reconstruction, and repairs.

Manufacturing - includes all establishments such as plants, factories, and mills engaged in the mechanical or chemical transformation of materials or substances into new products.

Transportation, Communication, and Public Utilities (TCPU) - includes establishments providing to the general public or to

other business enterprises, passenger and freight transportation, communication services, electricity, gas, steam, water, or sanitary services, and mail services.

Wholesale Trade - includes or places of business primarily engaged in selling merchandise to retailers, or acting as agents or brokers in buying merchandise or for selling merchandise to retailers.

Retail Trade - includes establishments engaged in selling merchandise for personal or household consumption and rendering services incidental to the sale of goods.

Finance, Insurance, and Real Estate (FIRE) - includes establishments operating primarily in the fields of finance, insurance, and the real estate.

Service - includes establishments primarily engaged in providing a wide variety of services (i.e., legal, health, and repair) for individuals, businesses, government establishments, and other organizations.

Government - includes local, state, and federal levels.

Sweetwater County

The county is endowed with tremendous natural resource wealth. The local economy depends on several key commodities: soda ash, coal and coal-fire electric power generation, oil and gas exploration and production, fertilizer production, agriculture, tourism, and construction of industrial, commercial, and residential facilities. In turn, these key industries support secondary employment found in the retail sales, finance, and service industries. All levels of government also play a role in stable employment.

Total number of employed persons was 24,988, employed either in full-time, part-time temporary or permanent positions, in Sweetwater County 1995 (State of Wyoming 1998a). Per capita personal income, total income, and total employment for the years 1991 through 1996 are shown in Table 3-14.

Mining is the largest private employment sector in Sweetwater County, as shown in Table 3-15. It provided over 5,000 jobs in 1995 (State of Wyoming 1998a). A close second is the service sector with 4,539 individuals. Retail industry employed 4,191, followed by transportation at 2,022, construction 1,884, finance (FIRE) with 1,337, wholesale trade at 723, manufacturing with 712 employees. The agriculture service and farm industry employed a total of 128 and 200 individuals respectively. Table 3-15 provides a breakdown of total employment by sector for the years 1991 to 1995.

Employment rates at all levels of government including local, state, and federal in 1995 was 4,120. SWEDA provides additional insight into the health of the employment sector in Sweetwater County. Their latest figures show the private labor force in 1997 totaled 20,599 and in the first half of 1998, the labor force increased by 272 individuals to a total of 20,871 individuals but is still down from 1995 figures (SWEDA 1998a).

Industry earnings are shown in Table 3-16.

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Fremont County

The county is characterized as rural. The local economy is not dependent upon natural resources to the extent that Sweetwater County is. All levels of government also play an important role in stable employment.

Total number of employed persons was 19,426, employed either in full-time, part-time temporary or permanent positions, in Fremont County 1995 (State of Wyoming 1998a). Per capita personal income, total income, and total employment for the years 1991 through 1996 are shown in Table 3-17.

The service sector is the largest private employment sector in Fremont County, as shown in Table 3-18. It provided over 5,000 jobs in 1995 (State of Wyoming 1998a). Second is the retail sector with 3,538 individuals. Construction industry employed 1,475, followed by farm sector at 1,163, manufacturing with 965, finance (FIRE) with 935, transportation at 773, mining with 614, wholesale at 393, and agricultural service with 298 employees. Table 3-18 provides a breakdown of total employment by sector for the years 1991 to 1995.

Employment rates at all levels of government including local, state, and federal in 1995 was 4,159 in 1995. Government is the second highest employer in Fremont County. Industry earnings are shown in Table 3-19.

Economic Situation of the Wind River Indian Reservation on Fremont County

The Wind River Indian Reservation sits within Fremont County and contributes significantly to the economic health of Fremont County. This write-up is based upon the revenue and expenditure flows associated with the following reservation related entities: Northern Arapaho and Eastern Shoshone Tribal Governments; Bureau of Indian Affairs (BIA); the Ethete, Fort Washakie, and Arapaho School Districts; Indian Health Service; and Indian households in Fremont County. These entities bring substantial amounts of revenues into the local economy.

Recent estimates are that the Wind River Indian Reservation brought in \$71.3 million into Fremont County in 1996. This includes \$20.4 million in Tribal Government revenue, local BIA budget of \$4.4 million, State and Federal school district funding in the amount of \$16.6 million, Indian Health Service budget of \$13.7 million, and net Indian household income of \$16.1 million. It should be noted net household income represents income in addition to per capita payments from Tribes, wage and salary payments from Tribes, BIA, school districts, and Indian Health Service (Fremont County 1998).

Approximately 76 percent of the Wind River Indian Reservation revenue was spent directly in Fremont County as wage or salary, purchases from local businesses, and payments to Tribal members. It is estimated that local spending of Wind River Indian Reservation revenue generated \$128.4 million in total economic activity in Fremont County in 1996 (Fremont County 1998).

Total earnings from the revenues associated with Wind River Indian Reservation are estimated to be \$58.6 million in 1996. Total employment is estimated to be 1,647 jobs. Average earnings per job ranged from \$13,190 (Tribal Government employment) to \$37,433 (Indian Health Service employment).

The Wind River Indian Reservation makes up approximately 8 percent of total county economic activity, 8 percent of the total external sales, 10 percent of total county earnings, and 9 percent of employment in Fremont County (Fremont County 1998).

Sublette County

Sublette County can be characterized as rural. All levels of government play an important role in providing stable employment.

Total number of employed persons was 3,537 employed either in full-time, part-time temporary or permanent positions, in Sublette County 1995 (State of Wyoming 1998a). Per capita personal income, total income, and total employment for the years 1991 through 1996 are shown in Table 3-20.

The service sector is the largest private employment sector in Sublette County, as shown in Table 3-21. It provided almost 700 jobs in 1995 (State of Wyoming 1998a). Second is the retail sector with 551 individuals. Farm Sector employed 410 individuals followed by the construction sector with 366. Over 300 individuals made their living in the mining sector, followed by FIRE sector with 211 employees, transportation sector with 131 individuals, manufacturing with 94, agricultural services with 90, and the wholesale trade industry employed 50 individuals. Table 3-21 provides a breakdown of total employment by sector for the years 1991 to 1995.

Employment rates at all levels of government including local, state, and federal in 1995 was 626 in 1995. Government is the second highest employer in Sublette County.

Industry earnings are shown in Table 3-22.

Property Valuation and Taxation

Sweetwater County

Total assessed valuation for Sweetwater County in Fiscal Year (FY) 1997 was just under \$1.1 billion. Total ad valorem taxes levied in FY 1997 was over \$79 million (State of Wyoming 1998a). Table 3-23 provides sales and use tax collections by industrial sector for FY 1997.

Fremont County

Total assessed valuation for Fremont County in Fiscal Year (FY) 1997 was over 261 million. Total ad valorem taxes levied in FY 1997 was just under \$22 million (State of Wyoming 1998a). Table 3-24 provides sales and use tax collections by industrial sector for FY 1997.

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Sublette County

Total assessed valuation for Sublette County in Fiscal Year (FY) 1997 was under 275 million. Total ad valorem taxes levied in FY 1997 was just under \$18.5 million (State of Wyoming 1998a). Table 3-25 provide sales and use tax collections by industrial sector for FY 1997.

In Lieu Tax Payments/Royalty Payments

Sweetwater County

Sweetwater County has over 4.6 million acres held by the federal government not subject to local government land taxes. Therefore, the federal government makes entitlement land payments to local governments in lieu of tax payments. In addition, the federal government shares royalties and bonus payments received from sale of leased minerals on federal lands primarily made up of oil, gas, coal, and trona. There are reimbursements to the county for other uses of federal lands. In 1997, in lieu tax payments to Sweetwater County totaled \$863,835. In FY 1997, production of federally-owned minerals in Sweetwater County generated over \$80 million in royalty value of which over \$40 million was returned to the State of Wyoming for local disbursement (USDI MMS 1997). In 1997, Sweetwater County collected \$11,203 for the harvest of timber products and \$57,496 under the Taylor Grazing Act (State of Wyoming 1998d).

Fremont County

Fremont County has just under 3.2 million acres held by the federal government not subject to local government land taxes. Therefore, the federal government makes entitlement land payments to local governments in lieu of tax payments. In addition, the federal government shares royalties and bonus payments received from sale of leased minerals on federal lands primarily made up of oil and gas production. There are reimbursements to the county for other uses of federal lands. In 1997, in lieu tax payments to Fremont County totaled \$774,223. In FY 1997, production of federally-owned minerals in Fremont County generated just under \$12 million in royalty value of which almost \$6 million was returned to the State of Wyoming for local disbursement (USDI MMS 1997). In 1997, Fremont County collected \$92,869 for the harvest of timber products and \$32,810 under the Taylor Grazing Act (State of Wyoming 1998d).

The Wind River Indian Reservation sits within Fremont County and all royalties and rents that arise from mineral production on these lands are deposited in accounts administered by the Office of Trust Funds Management where they are invested and subsequently distributed to the appropriate Indian Tribe and allottees by the Bureau of Indian Affairs (BIA). BIA collects rents and bonuses from non-producing leases. Royalties collected in behalf of Indian Tribes in 1996 from all mineral sources in the State of Wyoming was almost \$11 million (USDI MMS 1996).

Sublette County

Sublette County has over 2.4 million acres held by the federal government not subject to local government land taxes. Therefore, the federal government makes entitlement land payments to local governments in lieu of tax payments. In addition, the federal government shares royalties and bonus payments received from sale of leased minerals on federal lands primarily made up of oil and gas production. There are reimbursements to the county for other uses of federal lands. In 1997, in lieu tax payments to Sublette County totaled \$233,474. In FY 1997, production of federally-owned minerals in Sublette County generated just under \$33.8 million in royalty value of which almost \$17 million was returned to the State of Wyoming for local disbursement (USDI MMS 1997). In 1997, Sublette County collected \$130,344 for the harvest of timber products and \$16,335 under the Taylor Grazing Act (State of Wyoming 1998d).

Base Year Analysis

Table 3-26 summarizes the estimated physical outputs from the economic activities associated with the planning area in 1998. The planning area supported a wide variety of economic activities including over 4 billion cubic feet of natural gas production, 13,038 AUMs of cattle and sheep grazing, 4,528 days of nonresident and resident hunting, and 48,700 days of nonresident and resident non-consumptive recreation in 1998.

Table 3-27 summarizes the direct economic impact of the planning area on Southwest Wyoming based on the quantities of physical outputs listed in Table 7. Direct economic impact represents the initial amount of dollars flowing into the region's economy as the result of an economic activity. It is estimated that the economic activities in the planning area generate \$11.0 million of direct economic impact in the Southwest Wyoming economy in 1998. Oil and gas activity (development and production) was the largest source of this revenue, representing 78 percent of the total. The second largest source was nonresident non-consumptive recreation expenditures (16 percent). The rest of the revenue was from livestock grazing (4 percent) and nonresident hunter expenditures (2 percent).

Table 3-28 summarizes the estimated total economic impact of the planning area on the Southwest Wyoming economy. The total economic impact represents the direct impact plus any secondary impacts resulting from the "multiplier effect". The multiplier effect considers the re-spending that occurred within the region as a result of economic linkages between the producing sectors and other sectors in the region's economy. The total economic impact of economic activity in the planning area was estimated to have been \$15.3 million. This amount included the direct impact of the \$11.0 million plus \$4.3 million in secondary impacts.

Oil and gas activity (development and production) accounted for 76 percent of the total economic impact from the planning area. Nonresident non-consumptive recreation expenditures accounted for 17 percent of the total economic impact. The rest came from livestock grazing (5 percent) and nonresident hunter expenditures (2 percent).

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A portion of the total economic activity associated with the planning area represented labor earnings (wage and salary payments and self-employment income) in the region. Table 3-29 indicates that total earnings (direct and secondary) in the region from economic activities in the planning area amounted to \$1.7 million in 1998.

Oil and gas activity (development and production) represented 64 percent of the total earnings for the planning area. Nonresident non-consumptive recreation expenditures represented 25 percent of the total earnings. The rest represented earnings from livestock grazing (9 percent) and nonresident hunting expenditures (2 percent). The percentage of earnings from oil and gas activity was somewhat lower than that for the direct and total impacts because oil and gas activity was less labor intensive than other economic activities in the planning area. Similarly, the percentage of earnings from nonresident non-consumptive recreation expenditures was somewhat higher because the sectors associated with this economic activity were more labor intensive. Differences in the relative wage rates between economic activities also affected the percentage of earnings for different economic activities.

The economic activity associated with the planning area also supports employment in the Southwest Wyoming economy. Table 3-30 summarizes the total employment (direct and secondary) supported by the economic activity in the planning area. The employment estimates were expressed on annual job equivalents basis. An annual job equivalent represents 12 months of employment. For example, one annual job equivalent could represent one job for 12 months or two jobs for six months or three jobs for four months. The total employment resulting from the economic activity in the planning area was estimated to have been the equivalent of nearly 80 annual jobs in 1998.

Nonresident non-consumptive recreation expenditures and oil and gas activity represented about 43 percent and 42 percent, respectively, of the total employment associated with the planning area. The rest came from livestock grazing (12 percent) and nonresident hunting expenditures (4 percent). The percentage of employment from oil and gas activity was lower than that for the direct and total impacts because oil and gas activity was less labor intensive than other economic activities in the Jack Morrow Hills. Similarly the percentage of employment from nonresident non-consumptive recreation expenditures was higher because the sectors associated with this economic activity were more labor intensive.

By comparing labor earnings and employment it is possible to get an estimate of the average earnings per job for the economic activities in the planning area. Table 3-31 summarizes the average earnings per job for the various economic activities found in the area. Average earnings per job for all economic activities in the planning area were \$21,391. This was about 80 percent of the average earnings for all jobs in Southwest Wyoming (\$27,122). There was substantial variation in average earning per job between different economic activities in the planning area. They ranged from a low of \$12,521 per job for nonresident non-consumptive recreation expenditures to a high of \$32,369 per job for oil and gas activities. Average earnings per job were over 2.5 times

greater for oil and gas activities than for nonresident non-consumptive recreation expenditures. Average earnings per job for livestock grazing were only about one-half of those for oil and gas activity, but were about 30 percent higher than for nonresident non-consumptive recreation expenditures. Average earnings per job for nonresident hunting expenditures were about 14 percent higher than for nonresident non-consumptive recreation expenditures. The earnings per job estimates represent the average for all jobs directly or indirectly associated with the activity, not just the direct jobs in the producing sectors.

Economic activities on federal land, such as the planning area, are an important source of revenue for local governments in Southwest Wyoming. Table 3-32 summarizes the revenues to local governments in the region that result from the economic activities in the planning area. The estimated total local government revenue in Southwest Wyoming from economic activity in the planning area was about \$512,000 in 1998.

Due to the tax structure in Wyoming, oil and gas activity (development and production) was the largest source of local government revenue from the Jack Morrow Hills representing 86 percent of the total. The second largest source was nonresident non-consumptive recreation expenditures (8 percent). The rest of the revenue came from livestock grazing (5 percent) and nonresident hunter expenditures (1 percent).

Recreation activities in the planning area were important to Southwest Wyoming not only because they attract nonresident visitor expenditures but also because they provide recreation opportunities for regional residents. As such, they are part of the quality of life associated with living in Southwest Wyoming. Table 3-33 summarizes the estimated net economic benefits to resident users from participating in recreation activities in the planning area. The total net economic benefit from resident recreation use in the planning area was estimated to be about \$593,000 in 1998. Resident non-consumptive recreation use represented 75 percent of the total with the other 25 percent from resident hunting.

SOILS

Soils in this area are generally light colored with minimal leaching of soluble salts. Uplands are dominated by soils with fractured sandstone and shale bedrock within 40 inches of the surface. Many of these soils also have flat rock fragments throughout the profile. Rock outcrop is common. The high calcium carbonate content and steeper slopes of these upland soils makes many of them susceptible to water erosion. Drainages and lower slopes have deeper soils with less rock and more vegetation. Red soils, which are often highly erosive, occur in some drainages. Darker soils with greater leaching and development and consequent productivity occur in the northeast corner of the planning area at higher elevations. These darker soils also occur in snow drift areas around Steamboat and Essex Mountains. The Killpecker Dune field, composed of active and stabilized sand dunes, traverses the southern perimeter of this area. The vegetated dunes are susceptible to severe wind erosion when the stabilizing plant cover is removed.

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Moderately and strongly saline soils are common along drainages, as is evident along Jack Morrow Creek and Pacific Creek. Slightly saline soils dominate the upland areas. Major causes of increased non-geologic salinity into local drainages are overgrazing, off-road vehicle use, and energy exploration and extraction. These surface disturbing activities often result in loss of vegetation and compaction of the soil surface, both of which, can cause increased runoff and erosion.

SPECIAL STATUS PLANT SPECIES

Special Status Plants are those which are officially listed as threatened or endangered (T&E), proposed for listing or candidates for listing as T&E by the Secretary of the Interior under the provisions of the Endangered Species Act; those listed or proposed for listing by a state in a category implying potential endangerment or extinction; and those designated by each State Director as sensitive.

The Bureau of Land Management is mandated by law and policy to protect and manage threatened, endangered, candidate, and sensitive plant species and their habitat identified by the U.S. Fish and Wildlife Service. BLM is also required to protect and manage for sensitive species jointly identified and agreed to with the appropriate state agency. Additionally, former Candidate species are provided the same protection as Candidates under the BLM Manual Section 6840 "Special Status Species Management". 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 Jack Morrow Hills areas has been accumulated by the BLM to date (Map 53). General floristic inventories were conducted in the Continental Divide region by botanists from the University of Wyoming Rocky Mountain Herbarium in 1994 and 1995. In addition, a specific survey of plant communities and species of special concern in the planning area was performed for the BLM by the Wyoming Natural Diversity Database in 1994 and 1995 (Jones and Fertig 1996).

The Jones study provided information on 10 species of special concern found within the planning area, including four species not previously known from the ecosystem. Six other species of concern are known from the area based on recent or historical herbarium specimens. In all, sixteen plant species of concern are now confirmed from the planning area (Table 3-34). Two of these species, meadow pussytoes and the large-fruited bladderpod, are managed as Special Status Plant species in the Rock Springs Field Office. The remaining 14 species are state and regionally rare plant species that currently are not similarly managed, pending the release of a BLM state list of sensitive species.

Threatened, Endangered and Candidate Species

Ute ladies'-tresses (*Spiranthes diluvialis*)

The Ute ladies'-tresses is listed as a Threatened species by the U.S. Fish and Wildlife Service under the Endangered Species Act. This species, a member of the orchid family, occurs in three general areas of the interior western United States: near the base of the eastern slope of the Rocky Mountains in southeastern and central Wyoming and north-central and central Colorado and Montana; in the upper Colorado River basin, particularly in the Uinta Basin; and along the Wasatch Front and westward in the eastern Great Basin, in north-central and western Utah and extreme eastern Nevada. The total population is approximately 20,500 individuals. The riparian and wetland habitats required by this species have been heavily impacted by urban development, stream channelization, water diversions and other watershed and stream alterations that reduce the natural dynamics of stream system, recreation, and invasion of habitat by exotic plant species (USFWS 1995).

The Ute ladies'-tresses reaches a height of eight to 14 inches and is marked by an open cluster of several small white flowers arranged in a spiral resembling braids—a characteristic accounting for its name. The plant grows along streams, rivers, ponds, reservoirs, in bogs, or in wetland, riparian or seepage areas. This species has been found associated with cottonwood, willow, and prairie grassland communities. It generally blooms in late July through August and occasionally into September. It has been found in locations between 4,300 and 7,200 feet in elevation.

The Ute ladies'-tresses has not been found in southwest Wyoming yet, although BLM-authorized searches for the species have been performed at several locations along the Green River. The closest known location of the Ute ladies'-tresses to the planning area is on the Green River at Brown's Park, Utah. Potential suitable habitat in the planning area may be found on Jack Morrow Creek and its tributaries (Rock Cabin Creek); Pacific Creek; the meadows at Crookston Ranch (located on Nitchie Creek); the Sweetwater River and tributaries such as Oregon Slough, Harris Slough, Long Slough and Dickie Springs Creek; the sand dune ponds (flockets); and the perennial/intermittent streams in the Red Desert area (Bush Creek, Bear Creek, Red Creek, and Sand Creek). It is likely that this species will be found eventually in southwest Wyoming due to the proximity of the other populations and the similarity of riparian habitat types.

In order to gather as much information about this species as possible and comply with the provisions of the Endangered Species Act and BLM national policy, the Rock Springs BLM requires surveys of all suitable areas that could provide habitat for these species prior to surface disturbing activities. In addition, the BLM and the Rocky Mountain Herbarium are partners in a cooperative project to perform searches for the Ute ladies'-tresses on the Green River from Seedskadee Wildlife Refuge to the Utah-Wyoming border during the summer of 1999.

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Mandatory surveys and avoidance of this species would prevent adverse effects in the planning area. Consultation procedures with the U.S. Fish and Wildlife Service as mandated under Section 7 of the Endangered Species Act would be required for any project that would involve potential or known habitat areas for the Ute ladies'-tresses.

In addition, range condition assessments conducted under the Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management on BLM lands would address this species.

Small Rockcress (*Arabis pusilla*)

Small rockcress was formerly proposed for listing under the Endangered Species Act as either Threatened or Endangered. It has been dropped from consideration due to the protection currently afforded the species but may be proposed again in the future if any threats are identified. The Nature Conservancy ranks this plant as G1S1, extremely vulnerable to extinction globally and extremely vulnerable to extirpation statewide. Small rockcress is known from only one location in the southern Wind River Range in Fremont County, Wyoming. The single known population occurs on about 6 acres of suitable habitat just north of the planning area boundary, on public land managed by the BLM.

Small rockcress is found in crevices and on sparsely vegetated, very coarse soil in granite-pegmatite outcrops surrounded by sagebrush grassland. Most granite-pegmatite outcrops in the South Pass area were surveyed in 1986 by the Nature Conservancy-Wyoming Natural Diversity Database (Mariott 1988). Other suitable habitats along the Lander Cutoff were spot-checked. No other populations were located during that survey. More plants were found in the immediate area during a later survey conducted for the U.S. Fish and Wildlife Service (Dorn 1990). The entire population size is estimated at 600 individuals. Motorized recreational activity and livestock grazing in the area have been identified as threats to the population. The extremely restricted geographic range of this species makes it highly vulnerable to extinction.

A Habitat Management Plan/Environmental Assessment was developed for the protection of the small rockcress and its habitat in 1994. Protective management actions that have been implemented include designation of the species' habitat and surrounding area part of the Special Status Plant Area of Critical Environmental Concern (ACEC); construction of a 500-acre enclosure around the plants and their habitat; closure and rehabilitation of two-track trails through the ACEC, annual monitoring of the plant populations, closure within the ACEC to motorized vehicles, surface disturbing activities and livestock grazing; a No Surface Occupancy designation for mineral leasing; and institution of a permanent mineral withdrawal (signed February 4, 1998). This species is also included in the Special Status Plant Area of Critical Environmental Concern (ACEC) which closes the habitat to surface disturbing activities.

Although it is not likely that this species occurs within the planning area due to limited habitat, granitic outcrops along the Sweetwater River may provide suitable habitat. Searches

for the small rockcress would be required in suitable habitat prior to any surface disturbing activities by authorization of the Green River RMP/Record of Decision (USDI 1997) and the BLM Manual Section 6840.

Blowout penstemon (*Penstemon haydenii*)

Blowout penstemon is listed as an Endangered species by the U.S. Fish and Wildlife Service under the Endangered Species Act. This species, a member of the figwort family, occurs in two general areas of the interior western United States: in the Sand Hills of central Nebraska and a recently discovered location in the sand dune country south of the Ferris Mountains in south-central Wyoming. The total population consists of thirteen populations in Nebraska containing 3,000 - 5,000 individuals (Stubbendick, et al., 1997) and approximately 300 to 500 plants in one location of less than 20 acres in Wyoming. Threats to the species include off-road vehicle traffic, removal of fire, and leveling of the sand dunes.

Blowout penstemon is a perennial herb reaching 1 foot tall with one to many stems. It has milky-blue to pale lavender flowers that are 1 inch long and found in 6 to 10 whorls. It is found in sparsely vegetated, actively shifting sand dunes and blow-out depressions. It is commonly found with thickspike wheatgrass, lemon scurf-pea, and rubber rabbitbrush. It flowers from late June to early July.

Other Special Status Plant Species

General floristic inventories were conducted in the planning area by botanists from the University of Wyoming Rocky Mountain Herbarium and the Wyoming Natural Diversity Database (WNDDDB) between 1994 and 1996. Species specific status surveys were performed for *Lesquerella macrocarpa* (1994) and *Antennaria arcuata* (1994); permanent transects have been established and baseline information gathered for these species. In addition, the 1995 WNDDDB vegetation inventory provided information on 10 species of special concern found within the planning area.

Meadow Pussytoes (*Antennaria arcuata*)

Meadow pussytoes is a former Category 2 Candidate. The Nature Conservancy ranks this plant as G2S2, very vulnerable to extinction globally and very vulnerable to extirpation statewide, due to its restricted range. *Antennaria arcuata* has been found in Idaho (one site in Blaine County near Carey) and Nevada (two sites in Elko County). Twenty sites are known from Wyoming, all in Fremont County. Most known locations are east and southeast of Atlantic City, while two occurrences are in the Granite Mountains northwest of Jeffrey City. Two populations are found on public land southwest of South Pass City. One population is found along Fish Creek approximately 1 mile west of Wyoming Highway 28; the other is located about 1.5 miles east of Wyoming Highway 28 on Pine Creek. Populations of meadow pussytoes at these sites are small compared to those near Atlantic City and in the Granite Mountains. Only one of the twenty Wyoming populations was previously known to extend into the Rock Springs Field Office at Long Slough, near South Pass City. However,

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a status survey of meadow pussytoes, conducted in 1995 for the BLM (Fertig 1996a) discovered a single new population of meadow pussytoes in the Oregon Gulch drainage, approximately four miles west of Continental Peak. These two populations are the only known occurrences in the planning area. Surveys in other areas of potential habitat along Dickie Springs, Alkali Creek and west Pacific Creek at that time were unsuccessful.

Meadow pussytoes occurs in hummocky or level, subirrigated, grassy drainages which remain moist late into the summer. Known populations occur primarily on soils derived from sandy alluvial deposits. These soils may have a whitish, alkaline crust and a well-developed layer of mosses and cryptogams on the surface. On more level sites with bare soil, the plants occasionally form vegetative mats.

Individual Wyoming occurrences range in size from two to over 90 acres and are often divided into numerous smaller subpopulations in areas of suitable habitat. Total actual habitat acreage for meadow pussytoes is estimated at 400-500 acres. Actual habitat for this species within the planning area is approximately 5 acres.

Trend data are available for twelve of the Wyoming occurrences surveyed in 1995. Six of these occurrences show an apparent downward trend since 1982, four show an increase, and one is stable. Overall, the total state population appears to be stable to slightly declining since 1982. Grazing may be compatible with the species, based on studies at other sites, however stocking rates must be appropriate to avoid impacts from trampling.

In 1995 permanent monitoring transects were established at Long Slough and Harris Slough, both near Atlantic City. In addition, a floristic inventory of the Great Divide Basin area during 1994 and 1995 documented the new location of meadow pussytoes at Oregon Gulch. Potential habitat in the area of Atlantic City and South Pass City has been adequately inventoried, and additional survey is not a high priority.

Searches for this species in suitable potential habitat would be required in the planning area prior to surface disturbing activities. Avoidance of the species is the preferred form of mitigation where possible. In addition, mineral withdrawals for the plant and its habitat will be pursued.

Large-Fruited Bladderpod (*Lesquerella macrocarpa*)

The large-fruited bladderpod is a former Category 2 Candidate. The Nature Conservancy ranks this plant as G2S2, very vulnerable to extinction globally and very vulnerable to extirpation statewide. Prior to 1992, the large-fruited bladderpod was thought to be endemic to the northern Great Divide Basin in Sweetwater and Fremont counties, Wyoming. However, during a vegetative survey, it was located near the town of Opal in Lincoln County, Wyoming (Culwell 1992).

Most of the known large-fruited bladderpod populations occur on public land northeast of Steamboat Mountain on Bush Rim, near Continental Peak, and in the Oregon Buttes area. The species has been collected from sparsely vegetated

clay flats, benches, slopes, and hills. It commonly grows in association with Gardner's saltbush between 7,200 and 7,700 feet in elevation.

Sites surveyed in 1981 ranged in size from 80 to over 1,000 acres, with estimates ranging from several hundred to tens of thousands of plants. Large-fruited bladderpod population sizes fluctuate from year to year, apparently in response to moisture availability. During dry years, when populations are small, the species is much more vulnerable to adverse impacts. Its overall limited range and small population sizes in dry years qualify *Lesquerella macrocarpa* as a Candidate species. No threats are known at this time. A monitoring program was established in 1988 by the Wyoming Natural Diversity Database (Marriott 1988), but was not considered a good baseline because of the effect of drought conditions on the population size. A status survey was conducted for this species in cooperation with the Rawlins District (now Field Office) BLM in the summer of 1994.

Species of Special Concern

The remaining 14 species of special concern in Table 3-34 are considered by the Wyoming Natural Diversity Database as state and regionally rare plant species lacking formal federal status or protection, but potentially threatened within the ecosystem. These species include annuals or biennials like *Cryptantha scoparia*, *Eriastum wilcoxii*, *Eriogonum divaricatum*, *Monolepis pusilla*, *Oxytheca dendroidea*, *Phacelia demissa*, and *Phacelia salina* that have fluctuating population sizes in response to favorably moist years. Such species are dependent on the establishment and maintenance of adequate seedbanks for long-term survival. The habitats of these plants may be threatened by impacts from vehicles, mineral development activities, or livestock. Equally threatened are desert riparian species like *Carex parryana* which occur in habitats that are highly sensitive to disturbances. Several rare species of the Jack Morrow Hills 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. These species include *Astragalus nelsonianus*, *Ipomopsis crebrifolia*, *Penstemon paysoniorum*, and *Phacelia scopulina*.

VEGETATION AND WEEDS

Vegetation

The high-elevation, cold desert vegetation of the planning area is composed predominantly of Wyoming big sagebrush/grass and Gardner saltbush vegetation communities, with grass-dominated riparian vegetation along Jack Morrow Creek. Within this complex can be found 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, such as Pacific Butte and Steamboat Mountain.

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The University of Wyoming's Gap Analysis Project (GAP) maps provided the base data for a more intensive vegetation inventory of the Jack Morrow Hills Ecosystem performed in 1995 (Jones and Fertig 1996a) by the Wyoming Natural Diversity Database. Vegetation types of the planning area were classified according to a system developed for Wyoming by the Wyoming Natural Diversity Database (Jones 1992) and the classification developed by The Nature Conservancy for the western United States (Bourgeron and Engelking 1994). In most cases, classification of shrub stands was based on the species contributing the most cover to the shrub and herbaceous layers in the study plots within that stand. Additional vegetation class information documented by BLM was used as needed in this report (Map 54).

The ecologic significance of this area has been frequently documented. Steamboat Mountain and the sand dunes were recommended for nomination as a National Natural Landmark in a report prepared for the National Park Service (Knight 1976). National Natural Landmarks are areas which are designated as being of value in their natural condition. In addition, the Jack Morrow Hills ecosystem has been assigned the highest biodiversity significance rating by the Wyoming Natural Diversity Database (1998) due to the presence of the only known occurrence of the basin big sagebrush/lemon scurfpea association, 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 rare pygmy rabbit and the desert elk herd. 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. These dunal ponds, or flocks, have not been systematically inventoried, and should be surveyed for the presence of amphibians as well as rare plants.

At this time, it is impossible to establish a significance threshold value for the loss of the tall sagebrush/lemon scurfpea vegetation association. This is the only known occurrence of this type of plant community in North America. Removing any of this community type before it is known if it is possible to reestablish the plants after disturbance, and how long it would take, could comprise an irreversible and irretrievable commitment of this unique resource. Under the BLM Manual section 6840, the BLM initiative Fish and Wildlife 2000, Rare Plants and Natural Plant Communities, and the Federal Land Policy and Management Act of 1976, the BLM is responsible for protecting and conserving rare plants and their habitat. Complete surveys of the plant community have not been performed, thus it is impossible to say what other important rare species could occur in association with this unique type. In addition, in designating the Steamboat Mountain area as an ACEC, natural resources that have more than local significance or have qualities that make them rare, irreplaceable, exemplary or vulnerable to adverse change were identified. Conserving this plant community from man-caused impacts such as surface disturbing activities would also mitigate potential impacts from natural disturbances such as wildfire.

Wyoming Big Sagebrush Communities

Wyoming big sagebrush-grassland is the dominant vegetation type in the planning area. Two different associations of

this type, Wyoming big sagebrush/western wheatgrass and Wyoming big sagebrush/bluebunch wheatgrass are described.

Wyoming Big Sagebrush/Western Wheatgrass Association

Stands of this association typically occupy the lower parts of easterly slopes, benches and valley bottoms, and typically cover from several hundred to 1,000 square meters. Wyoming big sagebrush forms a fairly sparse shrub layer about 0.5 meters high. Other shrubs such as green rabbitbrush, Utah snowberry, and rubber rabbitbrush are commonly present, and occasionally Gardner's saltbush, forming a lower shrub layer of about 0.3 meters high. The understory is composed of primarily western or thickspike wheatgrass and in many areas, alkali bluegrass co-dominates the herbaceous layer. In addition, Indian ricegrass, bottlebrush squirreltail, milkvetches, phlox, penstemon, paintbrush and bushy bird's beak are commonly found in these communities.

Wyoming Big Sagebrush/Bluebunch Wheatgrass Association

This association usually occupies exposed sites, on southerly or westerly slopes, or the upper parts of easterly slopes. In these locations, Wyoming big sagebrush, antelope bitterbrush, and green rabbitbrush form a sparse shrub layer 0.2 to 0.3 meters high. Bluebunch wheatgrass dominates the herbaceous layer, and forbs such as turnip spring-parsley, granite pricklygilia, bushy bird's beak, timber milkvetch, rockcress and buckwheat are often present.

Gardner's Saltbush-Winterfat Vegetation Type

The Gardner's saltbush-winterfat community is the second most abundant vegetation type in the planning area, and characteristically occupies the more alkaline soils of benches, flats and gentle slopes. Gardner's saltbush and winterfat are both low-growing species, forming a shrub layer of less than 0.3 meters high. The herbaceous layer typically consists of bottlebrush squirreltail, Indian ricegrass, greenmolly, spring-parsley and phlox. This type generally provides sparse cover and considerable bare ground. The large-fruited bladderpod, *Lesquerella macrocarpa*, occupies habitat within this vegetation type in the Bush Rim/Continental Peak area.

Mountain Shrub Communities

For the purposes of this document, mountain shrub communities are those that support vegetation tall enough to serve as cover for elk and mule deer, or contain species that are especially important as food for elk and deer. Four vegetation associations are considered mountain shrubs—basin big sagebrush, mountain big sagebrush, true mountain mahogany, and Utah juniper. Although the Utah juniper is technically a tree species, it is often found growing with the sagebrush community types. The juniper stands are of considerable importance for wildlife habitat in the planning area. Of the above community types, the basin big sagebrush communities on the aeolian sands occupy the largest area while the other shrub

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stands are several acres or less in size. Mountain shrub associations are restricted to areas of substantial topographic relief within the vicinity of the planning area; the area of Oregon Buttes and Pacific Buttes in the north-central part of the ecosystem, the Bush Rim—Joe Hay Rim area in the center, the Jack Morrow Hills—Steamboat Mountain—Essex Mountain area in the central and south-central parts, and the White Mountain area in the southwestern corner. A detailed vegetation study of the different types of mountain shrub vegetation identified in the planning area is found in the 1996 report by Jones and Fertig.

Basin Big Sagebrush Vegetation Type

Three different associations of the basin big sagebrush type are recorded for the planning area. Although these communities are not as widespread as the Wyoming big sagebrush type, they form the largest stands of sagebrush and are critically important to the ecology of the planning area.

Basin Big Sagebrush/Basin Wildrye Association

Stands of this association grow on southeast-facing escarpments, primarily at the foot of the escarpment, and in valley bottoms on terraces above the floodplain. The big sagebrush shrub layer in this association extends upward to 1.0 meter high, and contributes substantial cover on escarpments. At the upper locations on escarpments, Utah snowberry may contribute significant amounts of cover, and be accompanied by smaller amounts of green rabbitbrush and antelope bitterbrush. Stands of basin big sagebrush growing at lower locations such as the foot of slopes or valley bottoms may contain mountain silver sagebrush. Basin wildrye contributes substantial cover in the lower locations while bluebunch wheatgrass dominates the herbaceous understory on escarpments; often bottlebrush squirreltail is present in this type, but contributes little cover. Less than 100 acres of this association has been mapped in the planning area; along a valley tributary to Jack Morrow Creek north of Essex Mountain, at the foot of the escarpment below Bush Rim, and on slopes in Alkali Draw near Bush Rim.

Basin Big Sagebrush/Lemon Scurfpea Association

Southwest of Steamboat Rim and south of Essex Mountain in the southern part of the planning area, the sand dunes support large stands of basin big sagebrush/lemon scurfpea communities. Many of the same species found in the sagebrush-grassland are also found on the dunes, however the dune habitat has fostered development of a unique community displaying plant species which can survive in the shifting sands. Slopes in the vicinity range from flat to moderate, and aspects are primarily northeast to south. In this association, basin big sagebrush forms a shrub layer up to 2.5 meters high. Rubber rabbitbrush forms a shrub layer up to about 1.0 meter, and may dominate patches covering up to several hundred square meters. Other species present in the understory are green rabbitbrush and Utah snowberry; and on more mesic sites, Utah serviceberry and chokecherry, whisky currant and antelope bitterbrush are commonly found. Graminoids documented growing in this community type are basin wildrye, Indian ricegrass, thickspike wheatgrass and needle-and-thread

grass. The largest stand, south of Steamboat Rim, is on the rolling surface of a field of stabilized sand dunes. This tall sagebrush vegetation is well known as hiding cover and crucial calving habitat for elk. Smaller stands in the upper parts of valleys draining north from Steamboat Rim occur on valley sides and bottoms, where the sand has accumulated. This association is considered unique because it is not reported from anywhere else in Wyoming or the western U.S. Approximately 18,020 acres of this type are mapped in the planning area.

Basin Big Sagebrush/Western Wheatgrass Association

This association has been observed on the mesa east of Alkali Draw on a northwest-facing slope in a shallow draw, and on a sandy colluvium site in a broad valley bottom near Essex Mountain. These stands form a sparse shrub layer from 1 to 1.5 meters high, with lower shrubs such as Utah snowberry and green rabbitbrush providing additional cover. The understory of this type is usually dominated by thickspike wheatgrass with smaller amounts of alkali bluegrass, bottlebrush squirreltail, bushy bird's beak, rockcress, and other grasses and forbs. Approximately 5 acres of this type are mapped for the planning area.

Mountain Big Sagebrush Vegetation Types

Variations of the mountain big sagebrush type described from the area are: mountain big sagebrush-Utah snowberry/basin wildrye and mountain big sagebrush/bluebunch wheatgrass.

Mountain Big Sagebrush—Utah Snowberry/Basin Wildrye Association

Stands of this community are largely restricted to slopes with northerly to south-southeasterly aspects, slopes steeper than 10 percent, and substrates of residual soils or colluvium derived from sandstone, limestone, or siltstone. Stands are especially well developed on escarpments below rims formed by limestone. Stands of this community are absent from, or poorly developed on, slopes underlain by claystone and mudstone. The dominant shrub layer formed by mountain big sagebrush usually grows from 0.6 meter to 1 meter high, with a lower shrub layer of Utah snowberry, but it may also contain significant amounts of antelope bitterbrush and green rabbitbrush. The dominant herbaceous understory species are generally basin wildrye (which often is found growing with alkali bluegrass), Nelson's needlegrass, bottlebrush squirreltail, sulphur buckwheat, bushy bird's beak, and western gromwell. Stands of this type growing on steep escarpments below rims often include patches of chokecherry. Cushion plant communities often grow on the windswept rims above the escarpments. Approximately 2,300 acres of this vegetation type were mapped in the planning area.

Mountain Big Sagebrush/Bluebunch Wheatgrass Association

This association is located on the northeast face of Pacific Butte, where the sagebrush forms a mosaic with aspen and limber pine woodland. Mountain big sagebrush forms a

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sparse, open shrub layer up to 0.5 meter high in this type. Utah snowberry is present in small amounts, as are bluebunch wheatgrass, sedge, needlegrass, lupine, phlox, and other forbs. Aspen sprouts and seedlings grow on the edges of the shrub stand, and display a tendency to form the overstory layer in mountain big sagebrush stands if left undisturbed. Approximately 400 acres of this vegetation type were mapped in the planning area, but there is likely to be more scattered throughout the vicinity.

True Mountain Mahogany/Bluebunch Wheatgrass Vegetation Type

Small stands of mountain mahogany exist in the planning area, many covering up to several acres on relatively steep slopes with all aspects. This type generally occurs on or near sandstone outcrops. The shrub layer may range from less than 0.5 meters to over 1.0 meter high. The stands are generally sparse, but include shorter shrubs, such as Wyoming big sagebrush, Utah snowberry, spineless horsebrush, green rabbitbrush, and rubber rabbitbrush. Commonly found herbaceous species include bluebunch wheatgrass, Indian ricegrass, Wyoming thistle, slender buckwheat, turnip spring-parsley, and bushy bird's beak. Elk and deer droppings and evidence of browsing on mountain mahogany, antelope bitterbrush, and Utah serviceberry have been noted in most of the stands. The true mountain mahogany stands are widely scattered; less than a total of 100 acres is recorded for the planning area.

Utah Juniper/Bluebunch Wheatgrass Vegetation Type

Utah juniper forms scattered stands on sandstone-derived soils, mainly east and south-facing slopes and outcrops in the planning area. Individual trees in the stands may reach a height of 3 to 5 meters. Although there is a rich species diversity in the understory of juniper stands, the vegetation is sparse. Wyoming big sagebrush forms a low shrub layer of under 0.5 meter high and typically includes antelope bitterbrush, green rabbitbrush, and black sagebrush. Bluebunch wheatgrass had the highest average cover values in the studied juniper stands, but thickspike wheatgrass, needle-and-thread grass, and Indian ricegrass are also well represented in the type. Alkali bluegrass, bottlebrush squirreltail, and Sandberg bluegrass are common associates in this type as are the forbs species sulphur buckwheat, goldenweed, bushy bird's beak, aster, milkvetch, and sandwort. Total juniper acreage in the planning area is estimated at 800 acres.

Woodlands

Tree species are a very minor component of the vegetation in the project area. In addition to the previously mentioned juniper stands, 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 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.

Biological Islands

Some of the more botanically interesting areas in the planning area are Continental Peak, Oregon Buttes, and Steamboat Mountain. These sites are major land features in the planning area rising approximately 2,000 feet above the surrounding desert plains to an elevation of about 8,400 feet above sea level. The fine-textured soils of this area are derived from mudstone and sandstone parent material, are poorly developed and provide very little moisture for plant growth. They are also fragile and very highly susceptible to sheer erosion. Dominant vegetation community types found at these sites represent both the basin and montane floras, creating biological islands of diverse plant communities. At the lower elevations, the vegetation is dominated by species representative of the Great Basin flora; Gardner's saltbush, Indian ricegrass, and bottlebrush squirreltail. As elevation increases up the slopes of Oregon Buttes, the desert vegetation gives way to montane community species representative of the Rocky Mountain flora; limber pine, aspen, and Douglas fir.

Steamboat Mountain provides an especially important biological island in the desert on the Continental Divide. Topped by sagebrush-grassland, the mountain supports limber pine and pockets of aspen and moisture-loving forbs where numerous springs and seeps occur. Mountain shrub species such as serviceberry, chokecherry and buffaloberry are found on more mesic sites on the west side of Steamboat where the sand dunes abut its base. The tall stands of basin big sagebrush and other mountain shrubs on the west side of the mountain provide critical cover and calving habitat for the desert elk herd.

Riparian

For wetlands and riparian areas, the minimum standard is Proper Functioning Condition (PFC). Stream (lotic) inventories began in 1995 and were completed in 1999. The ratings for lentic riparian areas (bogs, marshes, ponds, wetlands and wet meadows) have not been completed. Twenty percent (16.5 miles out of 79.95 miles) of the stream (lotic) riparian areas in the Jack Morrow Hills planning area are in PFC. A significant portion (40 percent) is in upward trend and an equally significant portion (40 percent) is in downward or "not apparent" trend. These data were collected in 1995-6 when a significant amount of non-use was occurring. Not all of the poor conditions in riparian areas are due to livestock grazing; however, livestock grazing, roads, and water diversions create the most significant impacts to the riparian areas in the planning area. However, it is known that season long use by livestock, concentrations around riparian areas during the hot season, and that later fall use tends to be adverse to riparian plants.

Weeds

Weed populations are found scattered throughout the planning area: along main dirt roads and two-tracks (especially those that cross meadows and drainage bottoms); areas of livestock concentration such as stock reservoirs, riparian

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areas and sheep camps; and areas of intense recreational use, such as frequently-used dispersed camping areas. Weed species have been introduced through many channels, but motorized vehicles (personal vehicles, all-terrain vehicles, and industrial vehicles) transporting the weed seeds in tire treads are a significant source of new infestations. Other modes of spread include untimely road blading (spreading mature weed seeds along roadbanks); transportation of non-local livestock into the area, or movement from a weedy area to a non-infested site; use of contaminated hay for stock animals; and overutilization and denigration of native plant communities which create openings for weed invasion. Most of the weed species described below are found along County Road 21 (the Tri-Territory Road) and County Road 74 (the Oregon Buttes Road).

Widespread populations of halogeton (*Halogeton glomeratus*), kochia (*Kochia scoparia*), and Russian thistle (*Salsola kali*) are found throughout the planning area. These species were introduced from Europe, but are now found on millions of acres of semi-arid desert rangelands. They tend to be found mainly on roadsides, in borrow ditches and disturbed areas, and will take over any area cleared of vegetation. However, these species will generally decrease if native grasses and shrubs are allowed to recolonize the disturbed sites. They are moderately toxic to livestock.

Extensive infestations of the noxious weed, perennial pepperweed (*Lepidium latifolium*), occur on streambanks in the lower portions of Jack Morrow Creek and Pacific Creek. Once established, perennial pepperweed becomes very difficult to control by herbicides, and can cause loss of native grass communities in riparian areas.

Black henbane (*Hyoscyamus niger*) is expanding into the planning area vicinity, especially in areas along the Tri-Territory Road near Oregon Buttes, North and South Table Mountains, in the sand dunes, along the Bar X Ranch Road, and in disturbed locations of Pacific Creek and Rock Cabin Creek. This species is commonly found along roadsides and in other waste places, and it has been observed invading small open areas within native sagebrush-grass communities. Black henbane contains alkaloids which have caused occasional livestock poisoning, although it is generally not grazed unless other forage is unavailable. This species (especially the seeds) is considered poisonous to humans. It can be treated effectively with herbicides.

Whitetop (*Cardaria spp.*) is a deep-rooted perennial that is commonly found on disturbed, alkaline soils of sagebrush-grass or riparian communities in the planning area. Small populations are evident along Pacific Creek and Bear Creek at the road crossings. It is highly competitive with native plant species once it becomes established, but can be effectively controlled with herbicides.

Scattered populations of musk thistle (*Carduus nutans*) and Canada thistle (*Cirsium arvense*) are found in the meadows around Rock Cabin Creek, Chicken Springs (Bush Rim), and Dickie Springs, as well as in seep areas on the east side of Steamboat Mountain. Musk thistle can be an aggressive invader, forming dense stands which crowd out desirable

species. Chemical herbicides are effective in controlling musk thistle, but they are less successful on Canada thistle.

A population of leafy spurge (*Euphorbia esula*), the first noted in the Rock Springs Field Office area, was found in the Honeycomb Buttes area several years ago. This species is highly undesirable as it has become one of the worst noxious weed problems in the country. Its extensive root system, and an extremely effective seed dispersal mechanism allow this species to significantly out-compete native rangeland species. The population of leafy spurge in the planning area is treated with herbicides annually and monitored. Although the population is not yet eradicated, it is under control. It is imperative that this species be restricted from further spread in the planning area.

An area-wide weed inventory and mapping project began in late 1998. This project, a partnership effort between the BLM and the University of Wyoming, will provide baseline data from which BLM can better manage weed problems in the planning area. In addition, the project will produce a susceptibility model depicting areas of high potential for weed infestation.

VISUAL RESOURCES

Visual resources are best described using the physiographic provinces within the planning area. These physiographic provinces are large scale geographical units of land. Common characteristics (landform, water, color, etc.) unlike those in other provinces exist within each. Each province helps establish a logical frame of reference with which to classify the relative visual quality for each scenery quality rating unit. A detailed description of the 34 scenery quality units of the planning area is located in the Rock Springs Field Office.

The planning area lies mostly within the Wyoming Basin physiographic province. The landscape found within the Wyoming Basin Province is characterized primarily by highly erodible soils and multi-colored, horizontally layered sedimentary bedrock. These conditions have generated the formation of the colorful badlands landscape common throughout most of the province. Between these badland areas, the land form is primarily low rolling or flat-topped hills.

Scenic quality is perhaps best described as the overall impression retained after driving through, walking through, or flying over an area of land. In the VRM process, rating Scenic Quality requires a brief description of the existing scenic values in a landscape. This step identifies (1) areas that must be protected, (2) opportunities for enhancement and rehabilitation, and (3) opportunities for improvement by reducing the contrast of cultural modifications.

From sensitivity level determinations, three visual classes were identified: Class II - retention, changes should not be evident; Class III - deviation, changes may be evident but subordinate; and Class IV - modification, changes are evident and somewhat dominant.

Areas with important scenic and visual values include recreation sites, the Greater Sand Dunes area, Wilderness Study Areas, South Pass Historic Landscape, White Mountain

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Petroglyphs, Steamboat Mountain, rivers, historic trails, and scenic vistas along Wyoming Highway 28. Current VRM classifications are described in Table 2-8.

WATERSHED

The planning area eventually drains into the Colorado River except for the small portion of the planning area that is on the eastern side of the Continental Divide. Most of the planning area is within the Colorado River drainage and subject to the Colorado River Salinity Compact.

Rainfall

The average annual rainfall in the planning area ranges from 8 inches near Farson to 14 inches in the higher elevations. This precipitation comes primarily in the form of winter snow and scattered summer thunder storms. Because of this there is a seasonal runoff with peak flows in the spring and occasional summer runoff that tends to be intense and sporadic.

Channel Condition

Stream channels in the higher elevations are characterized by long meadows bracketed by rock outcrops. In the lower reaches, stream channels tend to form broad floodplains of fine sediment that rely on vegetation for channel stability.

At the end of the 1999 field season, 79.95 miles of streams on public land in the planning area have been surveyed in the planning area using the Proper Functioning Condition survey method as described in BLM Technical Reference 1737-9. The results are shown in Table 3-35.

Because PFC is the minimum physical desired stability rating, this indicates that 20.6 percent of the observed streams are sufficiently stable to withstand moderate flows. Most of this stability can be attributed to rocky substrates. Forty percent of the observed streams have limited stability and are showing some improvement, and 40 percent of the streams have limited stability and are showing signs of becoming more unstable. This high percentage of instability results in a greater than natural loss of soil and elevated levels of sediment, and salinity over what would occur in a stable stream system.

Water Quality

There are no known point sources of water pollution in the planning area. This means that water quality is controlled by Nonpoint sources such as area wide soil erosion and stream channel condition.

Water quality samples have been taken in the planning area in a random pattern over the last 20 years. The lack of point sources in the drainage area allows overall water quality to be assessed using the level of Total Dissolved Solids (TDS) as a general guide. TDS can be thought of as a measurement of how much salt is dissolved in a given volume of water.

The State of Wyoming Department of Environmental Quality (DEQ) has set guidelines for TDS levels and acceptable uses of ground water (Table 3-36). These levels can be applied as general guidelines for surface water use.

Pacific Creek, its tributary Jack Morrow Creek, and Killpecker Creek are tributaries to the Green River and Colorado River systems and are subject to the Colorado River Salinity Compact (Map 55). The Sweetwater River is a tributary to the North Platte River. According to water samples taken over the last 20 years, the water quality in the streams from the Colorado River Drainage tends to be suitable for livestock water and in some but not all places is within the range for agricultural water (Table 3-37).

Given the PFC ratings and the water quality numbers, there is room for improvement in the planning area. The stream system is sensitive to disturbance but has a good chance of recovery and increased stability if it is managed for these attributes (see Table 3-38).

As of 1999 there are no streams within the planning area that are on the Wyoming State 303d list. The closest stream that is currently on the 303d list is the Big Sandy River. The TMDL process for the Big Sandy River is well under way. If streams within the planning area are listed in the future, land use management will be adjusted to comply with the TMDL process.

WILD HORSES

The Great Divide Basin Wild Horse Herd Management Area is located 40 miles east of Rock Springs in the eastern portion of the planning area north of Interstate 80. It encompasses an area from the Rawlins-Rock Springs Field Office boundary west to the Continental Divide. The management level range is 415 to 600 wild horses. The area consists of 778,915 acres of which 73 percent is public, 2 percent is state, and 25 percent is private. The portion of the herd management area that lies within the planning area is predominantly public land. Wild horse management within the Great Divide Basin Wild Horse Herd Management Area is in accordance with the herd area management plan.

Approximately 206,540 acres of the Great Divide Basin Wild Horse Herd Management Area lie within the planning area. This area encompasses roughly the eastern one-third of the planning area with the western boundary of the herd management area formed by the western branch of the Continental Divide. This boundary is unfenced and does not provide an effective barrier to the movement of wild horses. Wild horses are often found outside the herd management area yet within the planning area. These horses are by definition "excess" and are subject to annual removal. These horses are largely confined to the Steamboat Mountain ACEC and the Rock Cabin Creek/Oregon Buttes areas.

Dispersed outdoor recreation activities related to the viewing and enjoyment of free-roaming wild horses in the planning area is becoming more prevalent. Opportunities exist and may be improved to assist the public in viewing wild horses in their natural habitat.

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WILDERNESS

There are seven wilderness study areas (WSAs) within the planning area: Buffalo Hump, Sand Dunes, Alkali Draw, South Pinnacles, White Horse Creek, Oregon Buttes, and the Honeycomb Buttes.

The WSAs in the planning area were evaluated in a previous wilderness environmental impact statement (USDI 1990). As a result of these analyses, the BLM recommended all of the Oregon Buttes (5,700 acres) WSA as suitable for designation. In addition, 6,080 acres of the 10,300-acre Buffalo Hump WSA; 21,304 acres of the 27,109-acre Sand Dunes WSA; and 37,287 acres of the 41,404-acre Honeycomb Buttes WSA have been identified as suitable for designation (BLM 1991).

The following WSAs were not recommended as suitable for designation: Alkali Draw (16,990 acres), South Pinnacles (10,800 acres), Whitehorse Creek (4,002 acres), part of the Buffalo Hump WSA (4,220 acres), part of the Sand Dunes WSA (5,805 acres), and part of the Honeycomb Buttes WSA (4,117 acres). All recommendations are pending Congressional decision.

Until Congress acts, these WSAs will be managed under the "Interim Management Policy and Guidelines for Lands Under Wilderness Review" (USDI 1987). Congress has also closed WSAs to oil and gas leasing (non-discretionary closure). The WSAs are closed to motorized vehicle use.

WILDLIFE

Over 350 species of wildlife are found on a variety of habitats on the public lands in the planning area. Other resource activities, such as realty, mining, recreation, and grazing, affect wildlife habitat beneficially or adversely. The Bureau of Land Management maintains habitat management responsibilities on public lands while the Wyoming Game and Fish Department (WGFD) manages wildlife populations.

The WGFD manages big game on a "herd unit" concept. Herd unit boundaries do not generally match BLM field office boundaries, making analysis and correlation of resource data and big game population data difficult. The WGFD revises its strategic population numbers for each big game species based on new habitat information, population trends, and recreation demand.

Maintaining connectivity between important habitats (crucial winter ranges, severe winter relief areas, calving/fawning habitats, migration corridors, topographic relief areas (Map 56), mountain shrub communities, forest type habitats, etc.) within the planning area is paramount to sustaining viable big game herds and other wildlife. Fragmentation of these crucial habitats will not sustain big game population objectives agreed to by the public and the Wyoming Game and Fish Department and will not meet objectives set forth in the Green River RMP. This is due to the desert environment, flat terrain, lack of escape and hiding habitats, and lack of suitable habitat for thermal protection and secure calving/fawning habitat.

Mule Deer

Mule deer are distributed over most of the planning area and are part of the Steamboat (519,000 public land acres) and Hall Creek (55,800 public land acres) herd units. Currently, the population objective for the Steamboat herd unit is 4,000; however, the actual population is well below this objective level with no apparent increases in population numbers. Approximately 100,990 public land acres are classified crucial mule deer winter range and 23,100 public land acres are classified as mule deer fawning habitat within the planning area (Map 57). During late fall, some herds move south into Jack Morrow Creek and the area between Essex Mountain and Tule Butte within the planning area.

Shrubs furnish nearly 75 percent of the winter diet of deer. The primary winter food species for mule deer in the planning area are sagebrush, mountain mahogany, rabbitbrush, and bitterbrush. Shrubs taller than the average winter snow depth are important for deer survival. Winter range is a limiting factor for deer populations over much of their habitat, as shrubs are covered by snow in many areas. Competition with elk for preferred parturition habitats may also be affecting mule deer fawning success.

Most deer activity within the planning area is dependent on the availability of water. Studies have shown that in arid regions, in the driest months, deer seldom move more than 1 to 1.5 miles from water. Deer require 1.0 to 1.5 quarts of water per hundred pounds of body weight per day in the winter and 2 to 3 quarts in the summer.

Some flowing streams and standing waters dry up during long, hot summers. This concentrates deer activity around those available waters that remain. In an attempt to relieve the pressure on overused water resources and to more evenly distribute deer in unused areas, the BLM and the Wyoming Game and Fish Department have installed 4 wildlife guzzlers in the planning area. Five others exist in the Cedar and Pine Canyon areas adjacent to the planning area.

Pronghorn Antelope

The planning area is made up of the Red Desert (76,230 public land acres) and Sublette (498,570 public land acres) herd units for antelope. The current population objective for the Sublette herd unit is 40,000, with an actual population of approximately 27,000. Approximately 74,970 public land acres within the planning area are considered crucial antelope winter range (Map 58).

Preferred pronghorn habitat is usually characterized by the presence of summer water and sagebrush in combination with rabbitbrush and antelope bitterbrush. Antelope generally do not inhabit areas where sagebrush exceeds 2 to 3 feet in height.

Wyoming big sagebrush dominates the antelope winter ranges in southwest Wyoming. Black sagebrush is found on many ridges and sideslopes, and is a highly desirable forage species for both pronghorn and sage grouse. Saltbush communities are critically important as winter habitat, although pronghorn use them yearlong. Many saltbush communities

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are in association with greasewood, spiny hopsage, or shadscale. These plants apparently provide basic carbohydrates, protein, and other nutrients for growth and body maintenance of pronghorn.

Probably the single most important factor affecting antelope populations is weather. Severe winters with deep, crusted snow and below zero temperatures cause high antelope mortalities. An example of weather-induced population dynamics is the drastic reduction of antelope numbers in the planning area due to severe winter storms in the early 1970s. Mortality loss in the Red Desert herd unit in 1971-72 was estimated at 55 percent.

The water requirements of antelope are met through foraging on plants, consumption of snow, and natural surface water. The availability and distribution of water is probably the most important limiting factor affecting summer antelope distribution.

Lack of surface water in some areas influences migration of pronghorn and their season of use on particular ranges. In many areas, pronghorn rely on plant moisture, rains, some perennial seeps, and human-made water developments to make summer use of otherwise unsuitable habitat. Mild winters during 1987, 1988, 1989, and 1990 reduced winter mortality; however, drought conditions have caused significant losses of fawns in some areas. Water developments have helped improve antelope distribution in some local situations, but timely rainfall and availability of natural water are more significant in maintaining a sustained yield of wildlife. Disease and predation have not been documented as significantly affecting local big game populations.

Fences affect pronghorn movement in the planning area. Right-of-way fences along Wyoming Highway 28 have especially affected movement of antelope into the planning area. Woven wire fences form a barrier to antelope movement. Fence modifications such as antelope passes and lay-down panels, when well maintained, have helped pronghorn cope with some fences.

In 1975, the Wyoming Highway Department began a fencing program on southwest Wyoming highways which continues today. Dimensions, design, and placement of these and other new fences are causing some migration problems and some direct and indirect mortality on big game animals, especially the young. The placement of either wooden or wire stays between posts creates a very tight fence and prevents wildlife from migrating through fences they cannot jump.

Rocky Mountain Elk

The entire planning area is part of the Steamboat herd unit for elk. The herd unit is over 2,600,000 acres with approximately 574,800 acres of public land occurring within the planning area (Map 59). The population objective for this herd is 500 with the actual population being approximately 600 animals (WGFD 2000). Approximately 172,740 acres of public lands are classified as crucial winter range and 58,890

acres of public land are classified as elk calving areas. These acres amount to 67 percent of all classified winter range and 86 percent of parturition habitats for the entire herd unit occurring within the planning area. This demonstrates the importance of the planning area to elk as well as other big game species.

Elk historically migrated to the planning area from Jackson and Yellowstone. Records indicate that this movement was so large that portions of the area were proposed as a winter elk refuge. The last major movement occurred in 1913. Agricultural developments and hunter shooting lines either blocked this movement or the elk decided to stay on newly developed hay fields. Historic information shows a remnant population of elk lived within the planning area until around 1940. Transplants to re-establish elk began in 1944 and continued until around 1967. Some 438 elk were released at various locations within the planning and herd area. Elk numbers continued to increase and reached between 1,200 and 1,400 animals by 1977. By 1981, elk numbers had decreased to approximately 290 animals. Some of the Steamboat elk migrate south to North and South Table Mountain and winter from Hatcher Mesa to Long Canyon and Pine Canyon. This migration has not been observed since about 1985, primarily due to the large amount of human disturbance and activities associated with oil and gas development and year-round access into much of the area for recreationists and other public land users (Map 60).

Elk forage on a wide variety of trees and shrubs, grasses, and herbaceous plants. Fecal studies conducted from 1974 through 1978 show that 74 percent of the diet was grass, 3.5 percent of the diet was forbs, and 22.5 percent consisted of shrubs. More than half of the browse was antelope bitterbrush.

Elk historically were a plains animal; this is one of the few desert elk herds left in the United States. Elk are very intolerant of human presence and are known to travel large distances (up to 3 miles) when disturbed within the planning area (Bock and Lindzey 1999). Lack of hiding cover in this desert environment requires elk to use topographic barriers to escape intrusion. Increased activity within the planning area will displace elk to areas that offer these type barriers.

Moose

Moose found in the planning area are part of the Lander herd unit. Habitat is very limited and these animals are generally migrants although moose are not rare in the planning area. Approximately 55,660 acres of the Lander herd unit occur in the planning area.

Bighorn Sheep

No bighorn sheep are known to inhabit the planning area. Petroglyphs found in the vicinity of the planning area show bighorns which means they were probably historically found in the planning area. Also, many written accounts of bighorn sheep were recorded in the years 1805 to 1878 (Dorn 1986).

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Mountain Lion

The distribution and abundance of mountain lions in the planning area is largely unknown. Information is based upon sketchy reports by the public, BLM biologists, and WGFD information. Indications are that distribution is widespread and the population is very limited. Mountain lions have been observed in the Steamboat Mountain area.

The main habitat components restricting mountain lion populations in the planning area include the absence of large, undisturbed, remote areas; a lack of trees and other habitat used to stalk prey; and low mule deer populations throughout the planning area.

Black Bear

Urbanization of mountain foothills, off-road vehicle use, and animal damage control activities have nearly eliminated this large predator from public lands in the planning area. Black bear have been observed in the planning area; however, they are rare and involve migrating or displaced animals.

Coyote

The coyote is cosmopolitan throughout the west and Wyoming. Populations fluctuate annually, depending on hunting pressure, fur prices, and available prey. This is an almost entirely carnivorous animal, relying on jackrabbits, cottontail rabbits, ground squirrels, mice, other rodents, insects, and other small animals for 98 percent of its diet. The coyote is an opportunist hunter. The coyote will also take sheep if available. Coyote litters increase as coyote mortality increases, or rodent and rabbit populations increase.

Other

Other small mammals that may be present in the planning area include white-tailed jackrabbit, cottontail rabbit, pygmy rabbit, porcupine, raccoon, red fox, swift fox, beaver, skunk, white-tailed prairie dogs, various rodents, bats, and weasel.

Waterfowl

Most of the planning area lies within the Pacific Flyway with a very small portion occurring within the Central Flyway. The period of occupancy by waterfowl is comparatively short, and most of the waterfowl found here are migratory, short-term occupants. Most waterfowl nesting in the Pacific Flyway occurs below 8,500 feet.

Throughout the planning area, the availability of forage, food, and cover are the most significant factors affecting resident waterfowl populations. Nesting habitat is dependent upon cover in riparian areas. These areas are often dependent on beaver pond-building activities.

Every form of available open water in the planning area, from flowing wells and stock ponds to playa lakes and potholes, are used by waterfowl. Shovelers, gadwalls, mallards, pintails, and teal 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, are resident for only part of the year, wintering in western Wyoming. All waterfowl are dependent on ponds, marshes, streams, lakes, and rivers.

Waterfowl nesting in freshwater ponds of the sand dunes has become nearly nonexistent within the past 10 years; however, these areas still offer excellent habitat for certain species. The Red Desert region has historically had fair to good duck production as a result of human-made reservoirs and flowing wells. However, available water and adjacent cover necessary for nesting and escape have been reduced.

Avian and mammalian predators take some waterfowl and their young but their impact on the population is not significant. Probably the greatest limiting factor presently facing resident and migrant waterfowl is direct loss of birds in open industrial wastewater ponds, and the loss of riparian vegetation and habitats along streams and wetlands.

Sage Grouse

Long-term trends from sage grouse harvest questionnaires and lek surveys show a gradual population decline. Local populations increased as a result of better habitat and forage conditions created by heavier than normal precipitation from 1980 through 1986. The drought conditions from 1987 through 1994 probably resulted in an increase in chick mortality. This pattern of gradual population increases and sometimes drastic decreases (as indicated by chick survival and young per hen, production trend counts) is typical of sage grouse and other upland birds. Sage grouse are found throughout the planning area wherever suitable habitat exists (Map 61).

The reproductive characteristics and habits of sage grouse significantly limit their adaptability to human disturbance and habitat alteration. A cycle begins with birds returning to historic "strutting grounds" or breeding complexes in March. 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. The grounds are usually small, open areas from 1/10 acre to 10 acres in size, but 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 strutting ground is an area supporting low, sparse sagebrush or an area denuded of vegetation.

Strutting ground counts have been conducted by the WGFD for many years. There are 19 leks currently identified in the planning area. Approximately 114,660 acres of the planning area are within the 2-mile radius for nesting and 8,170 acres within the quarter-mile strutting area.

Peak breeding season is early to mid-April when up to 200 birds may congregate on a single strutting ground. Birds are active in courtship displays during early morning darkness until sunrise. On overcast or foggy days, strutting grounds may remain active until mid-morning. Strutting can take

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place all night during full moon periods. An estimated 15 to 20 percent of the actual strutting grounds have been identified.

Historic and long-term information on sage grouse nesting indicates that 80 to 85 percent of nesting occurs within a 2-mile radius of strutting grounds. Recent radiotelemetry data gathered by Rocky Mountain Energy biologists show that some grouse move up to 11 miles to nest, while most range one to four miles. University of Wyoming Co-op studies have consistently shown the most successful nests are located beyond 2 miles (Anderson 1999).

Raptors

There are 83 raptor nests identified in the planning area and approximately 43,150 acres of nesting habitat (Map 62). There are 27 different species of hawks, eagles, and owls either nesting, thought to nest, or having the potential of nesting in the planning area. Other species are either wintering populations, migrants, or possible migrants. The bald eagle is federally listed as a Threatened species and requires a biological assessment for activities which may jeopardize or destroy it or its critical habitats. The BLM has identified the bald eagle, peregrine falcon, ferruginous hawk, prairie falcon, osprey, and golden eagle, as raptors of high priority and has effected conservation and habitat criteria for management. The burrowing owl is listed by the state as a species in the "rare" abundance category with a biological status designation of "I," indicating declining populations and/or habitat conditions or indicators of such throughout all or a part of their range.

Approximately 70 percent of the planning area has been surveyed for nesting raptors. About 40 percent of the planning area was surveyed for "special habitat features" in 1979 with most potential cliff-nesting habitat identified. A 1980-1981 raptor inventory was conducted within the Rock Springs Known Recoverable Coal Resource Area by BLM biologists and survey crews to satisfy coal leasing suitability criterion. Raptor inventories have not been completed on all potential habitats in the planning area. Raptor studies are currently driven by specific development projects and data are collected to determine raptor management conflicts.

Many of the known raptor nests occur on hilltops, low cliffs, and rock escarpments found within the sagebrush steppe community. Conservation and management of this habitat component is of primary importance.

Raptor species that are commonly seen in the planning area include prairie falcon, American kestrel, ferruginous hawk, red-tailed hawk, Swainson's hawk, northern harrier, raven, golden eagle, and great-horned owl.

Prairie falcons nest on cliffs, ranging from low rock outcroppings to tall vertical cliffs (e.g., Rock Springs Uplift, Steamboat Mountain). Prairie falcon feed on cottontail rabbits, prairie dogs, horned larks, snakes, and ground squirrels.

American kestrels nest in varied environments such as dead snags, clay streambanks, and rimrock. Their diet includes insects, small birds, and small mammals.

Swainson's hawks nest on dry plains, open foothills, open forest, sparse trees, and riverbottoms (e.g., the Green River, Little Sandy River, and wood lots). Their diet includes rabbits, other small mammals, grasshoppers, and birds.

The ferruginous hawks nest on low cliffs, buttes, trees, on the ground, and artificial nesting platforms. Their diet consists primarily of rodents. These hawks have also been known to nest on sheepherder monuments found throughout the planning area. Current population estimates show these hawks are declining in numbers within the planning area.

The red-tailed hawk prefers riparian zones and timbered areas for nesting. Their diet includes cottontails, jackrabbits, rodents, reptiles, and birds.

The northern harrier (or marsh hawk) commonly nests on the ground, often in dense vegetation. Their diet consists primarily of rodents, amphibians, reptiles, and other birds.

Golden eagles nest on cliffs, ledges, and pinnacles that provide a view of the area. Their diet includes rabbits, rodents, and carrion.

Great-horned owls nest in cliff holes, rock crevices, and trees. Their diet includes a wide variety of small mammals.

Aquatic

Aquatic wildlife in the planning area is primarily found in the streams which cross through the area. The most important ponds or lentic habitats are found in the sand dunes region (locally called the "flockets").

The streams containing fish life are the Sweetwater River, Harris Slough, Oregon Slough, Pacific Creek, and Jack Morrow Creek (Table 3-39). Cold water game fish exist in some portions of all of these except Jack Morrow Creek which only contains non-game minnow species.

The Sweetwater River has the highest WGFD rating of all the streams within the Jack Morrow planning area with a classification of 3 (Important trout waters - fisheries of regional importance). Pacific Creek, Harris Slough, and Oregon Slough all have classifications of 4 (Low production trout waters - fisheries frequently of local importance, but generally incapable of sustaining substantial fishing pressure). All the rest of the streams in the area (perennial and intermittent) are classified as 5 (very low production waters).

The Sweetwater River represents the highest value cold water fishery in the planning area with an estimated 630 to 2,350 trout per mile. Pacific Creek trout populations range from 0 to 1,500 trout per mile (page 2-101, Sandy Grazing EA). Water quality within this area is generally suitable for most other aquatic organisms (see hydrology section). No threatened or endangered aquatic species have been identified in this area. However, 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. Any withdrawals of water from these tributaries are considered to adversely affect these species and require Section 7 consultation (Endangered Species Act) with the U.S. Fish and

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Wildlife Service. See the Biological Assessment for further information on those species. Overall quality tends to decline as conductivity, temperature, and turbidity levels progressively increase after streams leave the montane and foothill areas and traverse the more sedimentary bottoms of the cold desert plains. Lack of full bank development and an adequate riparian shade canopy also result in a progressive deterioration of fish habitat downstream.

Pacific Creek flows along the northern edge of the planning area. The lower half to this creek has little to fair resident habitat with poor spawning potential for salmonids. Sixty to 100 percent of the bottom is silted, making this reach most suited to cyprinids which populate the lower half of the creek. Summer water temperature maximums in excess of 20°C limit salmonid habitat in the lower reaches of Pacific Creek. Lack of bank protection by vegetation, cutting, mass wasting and livestock damage in specific areas along the creek contribute to bank instability and poor habitat conditions in the lower reach. Pacific Creek above State lands has brook trout and fair pool habitat. Spawning potential is still limited but bank protection and cover is better.

Jack Morrow Creek heads at spring sources on Steamboat Mountain and flows northwest to its confluence with Pacific Creek. This stream is not suitable for salmonids due to low flows which only maintain pool habitat in the lower 10 miles. Its primary values lie in habitat for nongame fish, mostly minnow species, and as a riparian habitat for wildlife. This also holds true for all of the tributaries to Jack Morrow Creek.

The streams in the Red Desert Basin and the tributaries flowing into the Green River drainage are mostly intermittent streams and have valuable riparian and water source assets for terrestrial wildlife in such a water-short area.

Riparian inventory using Proper Functioning Condition methodology has been completed (see Watershed section).

There are numerous small reservoirs and some natural ponds (dune area) scattered throughout the planning area which function primarily as stock water reservoirs. These standing waters and their aquatic communities create an important early season resource base for the production of food organisms (invertebrates) and nesting sites for waterfowl and other birds common to the aquatic environment. A lentic PFC inventory of these sites (specifically the flocks - dune ponds) will be completed in Summer 2000.

Since the aquatic and riparian habitat is a reflection of the watershed's health any activities that affect the quality and health of watershed and its vegetative cover will directly affect the aquatic environment. Conflicts to the aquatic environment are not limited to livestock grazing. Also included are things such as road development, oil and gas development activities, off-road use, fire, ecological seral stage of the plant communities, mining, recreation, irrigation and diversions, etc. Proper management of all activities and resources is essential for high quality riparian and aquatic conditions.

Threatened, Endangered, and Special Status Species

Special Status species are those plant and animal species which are proposed for listing, officially listed (threatened and endangered), or candidates for listing as threatened or endangered by the Secretary of the Interior under the provisions of the Endangered Species Act; those listed or proposed for listing by a state in a category implying potential endangerment or extinction; and those designated by each BLM State Director as sensitive.

The management actions for special status species apply only to BLM-administered public lands. Emphasizing management of these species on public lands and preventing these species from being listed as threatened or endangered would benefit all parties within the planning area. When species are listed as threatened and endangered, by law they become more universally protected on private and state-owned lands, in addition to federal lands.

In October 1999, the U.S. Fish and Wildlife Service supplied species lists to be considered in preparing the Jack Morrow Hills Coordinated Activity Plan. The following plant and animal species occur or may occur within the planning area.

Listed Species

Black-footed ferret (*Mustela nigripes*)
Bald eagle (*Haliaeetus leucocephalus*)
Whooping crane (*Grus americana*)
Colorado River fish species:
 Bonytail chub (*Gila robusta elegans*)
 Colorado pikeminnow (*Ptychocheilus lucius*)
 Humpback chub (*Gila cypha*)
 Razorback sucker (*Xyrauchin texanus*)
Blowout penstemon (*Penstemon haydenii*)
Ute ladies'-tresses (*Spiranthes diluvialis*)

Proposed Species

Canada lynx (*Lynx canadensis*)
Mountain plover (*Chadrius montanus*)

Candidate Species

Swift fox (*Vulpes velox*)

Special Status Species

Small rockcress (*Arabis pusilla*)
Wolverine (*Gulo gulo*)
Pygmy rabbit (*Brachylagus idahoensis*)
Peregrine falcon (*Falco peregrinus*) (recently downlisted)
Ferruginous hawk (*Buteo regalis*)
Swainson's hawk (*Buteo swainsoni*)
Long-billed curlew (*Numenius americanus*)
White-faced ibis (*Plegadis chihi*)
Flannelmouth sucker (*Catostomus latipinnis*)
Meadow pussytoes (*Antennaria arcuata*)
Large-fruited bladderpod (*Lesquerella macrocarpa*)

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Current Status and Habitat Use by Threatened and Endangered Species

Four federally listed endangered species may have inhabited the planning area. Listed species include black-footed ferret, bald eagle, whooping crane, Colorado River fish species, blowout penstemon, and Ute ladies'-tresses.

Black-Footed Ferret (*Mustela nigripes*)

There is historical documentation of presence of ferrets near the planning area as late as 1984. Other areas where ferrets are presumed to have occurred near the planning area are Sublette Flats, Seedskadee National Wildlife Refuge, and the Red Desert. Potential areas of ferret habitat can be delineated due to their association with prairie dogs and prairie dog colonies. Researchers have concluded that the

black-footed ferret has never been very abundant based upon archaeological and historical evidence.

Primarily nocturnal, ferrets spend much of their time below ground and are rarely seen during daylight hours. This behavior is probably the reason for so few sightings recorded here and elsewhere.

Few formal surveys and inventories of prairie dogs have been conducted in the planning area. Numerous scattered white-tailed prairie dog colonies occur south of Tule Butte near Fifteen Mile flowing well, north of Essex Mountain, in the Oregon Buttes-Continental peak area and in the Red Desert. Known colonies have been plotted on map mylar for placement in the BLM GIS database.

The following black-footed ferret sightings were near the planning area boundary.

Date	Location	Animal(s)	Comments
Spring 1969	Sweetwater County, 2 miles west of Eden	1 adult, 4 kits	Confirmed
Summer 1979	Sweetwater Co., Superior Exit on I-80	1 adult(?)	Probable
May 1983	T. 23 N., R. 98 W., Sweetwater Co.	1 adult	Confirmed
July 1983	Sweetwater Co., Bar-X Road near I-80	1 adult(?)	Probable
June 1984	T. 26 N., R. 105 W., Sec 36 on S. side of Hwy 28.	1 adult(?)	Probable

Management Conflicts Animal damage control programs probably have had the greatest impact on ferret mortality. From the 1920s until the mid-1970s, predator control through trapping and poisoning resulted in some black-footed ferret mortality. Secondary poisoning of ferrets is also known to have occurred from highly toxic rodenticides used in prairie dog eradication programs.

Coyote trapping and sport prairie dog hunting activities have resulted in some ferret mortality in the past. These activities need some measure of control and agencies need to initiate efforts to educate hunters and trappers about ferret identification and their habits.

Land use activities such as rights-of-ways, energy developments, Special Land Use and Free Use permits, urban expansion, mineral extraction, and grazing programs can effect the quality and quantity of ferret habitat and therefore require inventory and clearances. Habitat losses can be minimized through analysis, planning, and coordination.

Bald Eagle (*Haliaeetus leucocephalus*)

The main food item for this species is fish. Bald eagles nest in association with water, and most often winter where fish are available. Additional food items may include ducks, coots, rabbits, carrion, and small rodents.

The accelerated decline in numbers of the species since World War II has been attributed to several factors. The bald eagle and other raptors have suffered reproductive problems

due to organochloride pesticide poisoning. Raptors are especially susceptible to accidental poisoning through animal damage control programs, primarily when administered by untrained or unauthorized individuals.

Shooting is another significant factor, causing fledgling mortality estimated as high as 75 percent in some areas. Electrocution, while still a problem, has been reduced through alteration and redesign of many power transmission systems both nationally and locally.

Habitat Requirements 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. Currently, the only known active bald eagle nesting site near the planning area is on the Green River on Seedskadee National Wildlife Refuge.

In the planning area, the bald eagle is classed as a casual migrant. They have been observed feeding on carrion near Pacific Butte and perched on signposts along the AT&T pipeline during winter. The bald eagle is fully protected by the Endangered Species Act of 1973 (Federal Register 1978), the Bald and Golden Eagle Act, the Migratory Bird Treaties, and Wyoming Game and Fish Department laws.

Management Conflicts The primary factor influencing the bald eagle's habitation of the area is available undisturbed habitat and the absence of significant river systems with large woody vegetation.

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Whooping Crane (*Grus americana*)

As of March 21, 1990, only 13 whooping cranes were known to be alive and free-roaming in the Gray's Lake flock. Several of these found their way into the Rock Springs Field Office area over the past eight or nine years. In 1986, two Colorado State University summer wildlife volunteers working for BLM in the Farson area observed a lone whooping crane on several occasions. The USFWS was notified and the bird was captured and taken to Grays Lake in an attempt to have it mated to another crane. During 1987 and 1988 a pair did spend part of the summers in Farson grainfields and wetlands. Two observations of whooping cranes were made along Pacific Creek wetlands in 1991 and 1992.

Whooping cranes select muskeg, prairie potholes, and marshes for nesting. Their nest is a flat mound in the marsh usually containing two buff, blotched eggs. Food habits are similar to the resident sandhill crane (*Grus canadensis*). Though largely vegetarian, they eat some animal food. Insects, snails, frogs, mice, lizards, snakes and fish have been recorded in their diet. Besides eating seeds of wild plants and grains, they also consume herbaceous foliage, underground stems, tubers, and roots.

Conflicts The greatest mortality among whooping cranes is collision with powerlines, cables, and fences along streams, wetlands, and marshes. New rights-of-way should also consider the impacts to large migrating birds and mitigate accordingly. Agricultural grain depredation in the Farson Project area by both sandhill cranes and whooping cranes pose management conflicts which have been resolved by the WGFD paying depredation claims to landowners.

Major facilities and activities which conflict with whooping crane habitat include: powerlines/river cable crossings, riparian fences; recreation (off-road vehicles, camping, etc.), shooting (sport hunting and poaching), wetlands conversion, riparian habitat losses, agriculture and irrigation, water diversions, hazardous wastes, and chemical spills.

Colorado River Fish Species

The bonytail chub (*Gila robusta elegans*), Colorado pikeminnow (*Ptychocheilus lucius*), humpback chub (*Gila cypha*), and razorback sucker (*Xyrauchin texanus*) no longer occur in Wyoming. These fishes are only affected by water depletions to the Colorado River System. Consultations with the U.S. Fish and Wildlife Service are required for any water depletions within the Colorado River and Platte River systems.

Blowout penstemon (*Penstemon hayendii*)

See the discussion at Special Status Plant Species in this chapter.

Ute Ladies'-tresses (*Spiranthes diluvialis*)

See the discussion at Special Status Plant Species in this chapter.

Proposed Species

Canada Lynx (*Lynx canadensis*)

The last known lynx in the Field Office area was taken by a hunter in the 1960s just north of Big Sandy Reservoir. This area is out of its "typical" habitat, although the cat probably came from the Wind River Mountains or foothills. Cat tracks are often seen in the Prospect Mountains and along the Wind River Mountains but these have always identified as cougar or bobcat. Commercial timber removal could remove some valuable cover, but size of sale blocks and select cutting practices should reduce impacts to this species. The planning area has no commercial timber areas, only small, isolated woodlands. Modest restrictions in the way animal damage control is conducted will help reduce incidental take of this species.

Population Distribution There is little population information on the lynx in the Rock Springs Field Office. Lynx were historically distributed throughout the Wyoming Range, Wind River Range, and Uinta Mountains. Lynx, like other species, wander out of the preferred or typical range and are seen in badland and desert habitats where they compete with other similar predators. However, outside forested habitats, they are more susceptible to predation due to a lack of escape cover.

Habitat Requirements Lynx are generally found in association with snowshoe hare populations. The planning area has no known snowshoe populations. Highways and roadways can lead to vehicle/lynx collisions and impede movement. Primary habitat for lynx is Engelmann spruce, subalpine fir, and lodgepole pine at the higher elevations, generally 6,500 to 9,800 feet. This habitat occurs in only limited amounts in the planning area.

Conflicts Removal of old growth timber, clearcutting in large blocks, juniper chaining, and burning are all detrimental to perpetuating the species. Road intrusion into forested habitats results in displacement and often collision with individuals. Forest road reclamation and obliteration benefits lynx habitat. Wilderness also benefits lynx habitat. In some areas, timber management and fire suppression have affected lynx habitat. Conversion or alteration of native vegetation communities in and adjacent to lynx habitat would decrease prey populations. Pre-commercial thinning likely has a direct negative effect on snowshoe hare habitat, at least in the short term.

Grazing use levels, by livestock or wild ungulates, may increase competition for forage resources with lynx prey. By changing native plant communities, such as aspen and high elevation riparian willow, grazing can degrade snowshoe hare habitat.

Road and trail access and recreational use that results in snow compaction allows ingress of coyotes into lynx habitat, and increased competition for prey.

Poison baits, traps, snares, and any type of animal damage control which is not specific to a species pose a threat to the lynx. Lynx may be incidentally trapped during the trapping seasons for other carnivores, particularly bobcat and wolverine (Squires and Lorean 1999).

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Mountain Plover (*Charadrius montanus*)

Population Distribution The mountain plover is a candidate species (proposed threatened) inhabiting the high dry short-grass plains/prairies east of the Rocky Mountains, as well as the sagebrush grasslands throughout Wyoming. It is also known from northern Utah and northwestern Colorado. The focus of breeding activity appears to be northeastern Colorado.

Taxonomic changes recently placed this bird with other plovers and killdeer. The bird is of bland coloration about the size of a killdeer without the striking white marking on the head and breast rings. The bird summers and nests in areas of naturally occurring low vegetation within the planning area.

Habitat Requirements Parrish, et al. (1993) noted that mountain plover nests in northeastern Wyoming were found in areas of short (< 4 inches) vegetation on slopes of less than 3 percent. Any short grass, short shrub, or cushion plant communities could be considered as nesting habitat. In Colorado, the mountain plover diet is composed of 99.7 percent arthropods, with beetles, grasshoppers, crickets, and ants the most important food items (Baldwin 1971). Breeding bird surveys between 1966 and 1987 show an overall decline in the continental population of mountain plovers (U.S. Department of Agriculture, Forest Service, 1994a). Surveys completed in 1991 indicate that only 4,360 to 5,610 mountain plovers remain on the North American continent.

Conflicts Probably the most important reasons for the decline of the mountain plover are human impacts and habitat alteration on breeding grounds and the degradation in the quality of wintering habitats. Loss of breeding habitat due to cultivation and prey base declines resulting from pesticide use are also threats to mountain plover survival. Cattle often maintain the open blue grama/buffalo grass preferred by mountain plovers so livestock grazing may benefit the species to some extent. However livestock grazing can also result in a reduction in prey species for mountain plovers due to the reduction in vegetation. Surveys would help determine breeding and nesting areas. Activities would avoid nesting and breeding areas during these periods.

Candidate Species

Swift Fox (*Vulpes velox*)

Population Distribution The swift fox, a federal candidate species, is a resident of the Great Plains from the northern Rocky Mountain foothills in southern Canada to western Texas. In Wyoming, this species primarily inhabits the eastern Great Plains grasslands of the state. A few sightings have been reported in the Rock Springs Field Office area.

Habitat Requirements Living up to its name, the swift fox can reach speeds of over 50 km/hr. This speed allows it to catch its prey and also to escape predators such as coyotes, golden eagles, bobcats, and wolves. Swift fox dens are burrows located in sandy soil on open, bald prairie, along fence rows or in plowed fields and often in association with prairie dog towns. The diet of swift fox varies seasonally. Hunting primarily at night, they feed on a variety of food including: small mammals, birds, reptiles, amphibians, and insects.

Conflicts Historically, the major threat to the swift fox has been extermination by humans. Trapping, shooting, and poisoning as part of predator control programs for coyotes and red fox caused the extinction of the Canadian population of this species. While it is now illegal to kill swift foxes, some are still confused with coyotes and red fox and are killed by mistake.

Current threats to the swift fox include habitat loss, automobile traffic, accidental killings, and conversion of grasslands to agricultural lands.

Special Status Species

Small Rockcress (*Arabis pusilla*)

See the discussion at Special Status Plant Species in this chapter.

Wolverine (*Gulo gulo*)

No sightings of wolverine or their scat or tracks have been made in or adjacent to the planning area in over 20 years. They are not expected to inhabit the planning area in the long term. The Oregon Buttes provide the only habitat suitable for this species in the planning area.

Management Conflicts Animal damage control activities and encroachment on undisturbed forested lands are the primary conflicts with this species.

Pygmy rabbit (*Brachylagus idahoensis*)

The Wyoming population of this small rabbit was first described by Tom Campbell of Biota Research in a paper of 1980. It was thought to occur primarily within sandy hummock habitats south and west of Little America. The Nature Conservancy has continued inventory of this species in the Field Office area during recent years and conclude the population is interspersed within desert cottontail (*S. auduboni*) populations. Pygmy rabbits are found over a broader area than first thought, now extending into the Red Desert and south into South Baxter Basin. With dramatic cyclic trends in rabbit species, the long-term effect of mineral development, road development, and other factors of habitat loss cannot be realistically assessed. Hunting is not considered to be a factor in long-term population alteration. Some discussion of management direction toward commodity development discussed in the Preferred Alternative may adversely impact habitat for this species.

Peregrine Falcon (*Falco peregrinus*)

The peregrine falcon was removed from the endangered species list in August 1999. The BLM will continue its current management practices until the U.S. Fish and Wildlife Service releases its management plan for the peregrine falcon.

The apparent reason for the precipitous decline of the species in the United States, beginning in 1947, was the loss in reproduction due to sublethal chronic poisoning from organic chlorine pesticides. This poisoning is manifested in the thinning of egg shells which results in accidental breakage.

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Principal food items of peregrines are perching birds, shorebirds, and waterfowl. The presence of a nesting cliff is a preferred habitat component, with falcons at times nesting on slopes, river cut-banks, tall buildings, and occasionally on sand dunes. Potential peregrine falcon nesting habitat exists in some Jack Morrow habitats such as along the Sweetwater River, Steamboat Mountain, and on Oregon Buttes. Sightings of peregrines in the planning area are rare and no active nests are currently known to exist here. In 1976 a peregrine was observed by a BLM contract survey crew on Oregon Buttes. Sightings in 1979 and 1986 on the Sweetwater River gave hope of finding an aerie on uninventoried cliffs. That inventory has not yet been performed.

Management Considerations Management efforts to improve the number of peregrines and reduce mortality should include: (1) Education of public land users and school groups concerning the biological role of peregrines and other raptors in our natural ecosystem, (2) Identified peregrine aeries and associated habitat should be given total protection and potentially suitable habitat should be given status preventing its alteration or disposal, and (3) Suitable hawk sites should be identified and BLM should cooperate in establishing peregrines in these areas.

Management Conflicts Considerable time, effort, and money have gone into peregrine recovery programs. They are successfully inhabiting metropolitan areas with high-rise buildings. In the west, peregrine hacking into the Greater Yellowstone Ecosystem have led to somewhat unknown success. Many birds are showing up outside the Greater Yellowstone Ecosystem and are probably the result of the extensive planting efforts. Mortality and poor nest establishment are attributed to one or more of the following conflicts: habitat encroachment, wetlands loss, riparian habitat degradation and loss, agriculture, pesticides and toxic wastes, recreation (off-road vehicle, float boating, etc.), shooting, drought, and illegal take by falconers.

Ferruginous Hawk (*Buteo regalis*)

The ferruginous hawk is the second most abundant of the Buteo hawks to be found nesting in the Rock Springs Field Office area. This hawk is a desert raptor commonly found in remote habitats of the planning area which provide ledges or pinnacles for nesting. Ferruginous hawks are opportunistic nesters having built upon shepherd "monuments" in the Red Desert, on cliffs, atop clay pinnacles, in nests of other raptors, in juniper trees, on the ground, and on artificial nesting platforms.

Nest construction consists of sagebrush sticks, lath, twine, cow dung, and whatever they may find. Nesting is a highly sensitive time in the Ferruginous life cycle and they frequently abandon eggs when disturbed. Rabbits and ground squirrels are the most common prey species. Nests commonly contain three to four young.

Both light and dark color phases exist in the planning area with the dark phases (almost universally males) most colorful but uncommon. Resurveys of historic nesting habitat (1984-1994) show a general decline in the nesting success of these birds. This may, in part, be due to the prolonged drought and

poor populations of rodents and other small prey. An effort should be made to determine what specific factors are responsible for the decline in ferruginous hawk nesting activity and the management efforts required to reverse this trend.

Management Conflicts Increased human activity in areas with nesting populations of ferruginous hawks create adverse impacts if activity occurs before hatching. A thorough inventory of the planning area in all habitats will be necessary to identify and afford protection to ferruginous hawk nests. They are particularly vulnerable as most of their nests are easily accessible from the ground.

The ferruginous hawk is protected by the Migratory Bird Treaty Act of 1913, and an additional treaty signed with Mexico in March 1972. The bird is also protected by Wyoming state law. Falconry permits have been issued for ferruginous hawks, with capture quotas established in 1973.

Some of the conflicts identified with ferruginous hawks include power lines, fences, livestock grazing, mineral exploration/development, off-road vehicles, and predator control activities.

Swainson's Hawk (*Buteo swainsoni*)

The Swainson's hawk winters in Mexico and Central America, migrating north in April. They are commonly found on dry plains, open foothills, open forest, sparse trees, and river bottoms. Nesting occurs on the Little Sandy and Big Sandy Rivers and in woodlots near Eden and Farson.

Swainson's build a small, shallow nest of twigs lined with bark, grass, or other greenery. They may also occupy nests previously used by Red-tailed hawks. Two or three eggs are laid in late April or early May. Rabbits usually comprise more than 90 percent of their diet with grasshoppers, small mammals and birds making up the remainder.

Management Conflicts Nesting habitat for this species has declined over the past 20 years as mature trees have died and are not being replaced. Woodlots in the Farson farmlands are becoming overmature and decadent. Very few shelter belts are being planted to replace dead and dying trees. Overbank flooding of the Big Sandy River has not occurred since 1980, resulting in little or no recruitment of tree seedlings. Grazing of stream bottoms has had detrimental effects on tree and shrub recruitment and plant vigor. The Sweetwater River has not been inventoried for raptors and additional Swainson's hawk nests may be found in this habitat. Livestock grazing, recreation activities, excessive beaver activities, agriculture, and mineral exploration conflict with habitat management for the Swainson's hawk.

Long-billed Curlew (*Numenius americanus*)

This large bird is known to have occurred in the Rock Springs Field Office area, although the last recorded observations were in the mid-1980s. They were common residents at Circle Springs and Maggie Springs until heavy livestock grazing and the drought impacted their historic habitat. Little is known of their activities in suitable habitats in the planning area. Long-billed curlews are known to occupy arid habitats on prairie dog colonies in the tall grass prairie (Nebraska). In

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Sweetwater County, they are most commonly seen during spring migration and casual during late summer.

Management Conflicts Wetland and riparian habitat loss and degradation may be associated with the decline of long-billed curlew in the planning area. Destruction or alteration of prairie dog towns may also be associated with the decline of the long-billed curlew.

White-faced ibis (*Plegadis chihi*)

These birds are commonly seen in the planning area spring through fall. A large nesting colony had used the Old Eden Reservoir slough annually until drought in 1986. Loss of this water source and loss of suitable habitat at Old Eden Reservoir slough since then, has resulted in no known nesting by the species at this location. The prolonged drought may result in losing birds aware of this nesting site and will require recolonization by pioneering birds. Sightings of white-faced ibis were common in wetland habitats of the Sand Dunes and along perennial streams in the planning area prior to this long-term drought. Sightings of white-faced ibis are still common in the Farson/Eden area during the migration.

Management Conflicts Wetland and riparian activities causing degradation or habitat loss are in direct conflict with management of this species. Maintaining some residual cover along streams and standing waters is necessary for nesting. Fox and raccoons are somewhat predatory on nesting ibis. Management should be directed at improving residual nesting and escape cover, maintaining healthy riparian habitats and helping maintain flooded areas for nesting.

Flannelmouth sucker (*Catostomus latipinnis*)

The species selects river runs, shorelines, eddies, and pools of main river systems. During the 1970s and early 1980s, they migrated up the Green River from Flaming Gorge Reservoir in large numbers to spawn in the Big Sandy River, Slate Creek, and even into Alkali Creek. Spawning fish were usually 12 to 16 inches in length and averaged about one pound in weight. They provided a good forage base for great-blue herons which nested on Seedskadee and the Green River along with mink and other fish predators. The last known spawning run of significance was 1985, with few fish spawning up the Big Sandy River in 1992 and 1993.

Meadow Pussytoes (*Antennaria arcuata*)

See the discussion at Special Status Plant Species in this chapter.

Large-Fruited Bladderpod (*Lesquerella macrocarpa*)

See the discussion at Special Status Plant Species in this chapter.

SPECIAL MANAGEMENT AREAS

Greater Sand Dunes ACEC (38,650 acres in the planning area)

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. In 1982, the Greater Sand Dunes (including Boars Tusk) was designated an ACEC to protect geologic, cultural, and wildlife values with management objective to preserve and protect the integrity of the unique values in the area for future public use and enjoyment. The ACEC comprises about 38,650 acres (approximately 38 percent of the Killpecker dune field).

The ACEC is unique to the Wyoming Basin and contains values that are “geologically, aesthetically and biologically interesting” (McGrew, et al. 1974). In addition, the ACEC includes prehistoric and historic values, high scenic values, diverse wildlife and habitats, high recreation use, and high oil and gas values.

The Greater Sand Dunes ACEC encompasses portions of the Sand Dunes and Buffalo Hump Wilderness Study Areas (WSA). These WSAs are located in the western portion of the ACEC and are closed by policy to oil and gas leasing. This portion of the ACEC is closed to off-road vehicle use.

Crookston Ranch is closed to ORV use, and the road around Boars Tusk is closed. The unstabilized sand dunes in the eastern portion of the ACEC are open to ORV use. The remainder of the eastern portion is limited to existing roads and trails.

Recreation use, particularly with all-terrain vehicles (ATVs), is high in parts of the ACEC. An ORV open area is located on the unstabilized dunes in the eastern portion of the ACEC. A parking lot was developed to provide access to the dunes.

ATV user days in the ACEC are estimated at 3,200 a year and appear to be increasing. Other recreation user days such as sightseeing, hunting, horseback riding, and environmental education field trips in the ACEC are estimated at 10,000 per year.

The historic Crookston Ranch site (40 acres) is located in the ACEC south of the ORV parking lot. The site is potentially eligible for the national Register of Historic Places as a representative example of vernacular architecture within the Wyoming Basin homesteading era. The site is closed to surface disturbing activities. Some damage is occurring to the riparian area on the ranch site from ATV users and campers.

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The dunes within the Greater Sand Dunes ACEC help to support the desert elk herd known to occupy this unique desert habitat. Large numbers of elk occupy the area during the spring, summer, 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. Waterfowl species use these ponds for nesting in the spring, raising young in the summer, and staging in the fall. Amphibians, such as the tiger salamander, can be found in many dunal ponds reproducing and rearing young.

Livestock grazing in the Greater Sand Dunes ACEC includes both cattle and sheep use. Cattle use the area mostly in the spring and summer months, while sheep use the area mostly in the late fall and early winter. Cattle use on the dunal ponds can be heavy while sheep use is generally light.

Heavy use of the dunal ponds in portions of the Greater Sand Dunes ACEC by cattle may cause ecological damage to the ponds and surrounding riparian vegetation by trampling the riparian vegetation and stirring up the bottom of the ponds by wading in the water. This wading in the water causes sediments to become suspended. Pollution also occurs from cattle defecating in the ponds making them more eutrophic which reduces the oxygen available in the water for amphibians, making successful reproduction difficult. Spring and summer use of the ponds by cattle is also disruptive to nesting waterfowl.

In 1983, there were 10 producing gas wells in the eastern portion of the ACEC, 2 of which were in the Sand Dunes WSA. This level of development was considered acceptable in 1983 and it met the ACEC objectives.

Portions of the ACEC are leased for oil and gas; other portions are unleased. Presently, there are 17 producing gas wells within the eastern portion of the ACEC, one of which is inside the Sand Dunes WSA. Industry is interested in developing this area further; including development of up to 10 coalbed methane wells in the eastern part of the ACEC. To remain consistent with the purpose and intent of the ACEC, clear and specific management direction is needed on whether further oil and gas development will be allowed within the ACEC, and if so, where and at what level.

Oil and gas activity has caused some conflicts with ATV use. Oil and gas facilities, particularly linear facilities such as pipelines, may be buried but after a period of time, as the sand moves and shifts, portions of these pipelines become exposed creating a hazard for ATV users driving across the sand. Some pipelines were placed aboveground when constructed and have since been buried in the sand. Different portions of the pipelines could be exposed at different times and change often, making it difficult to identify and mark these hazards for the ATV user. As more oil and gas development occurs, more hazards would be created.

Approximately 9,840 acres of federal coal lands in the ACEC are closed to coal leasing and development by surface mining methods and related surface facilities and activities. This area is open to consideration for coal leasing (i.e., new

competitive leasing, emergency leasing, lease modifications, and exchange proposals, under the Federal Coal Management Program) by subsurface mining methods, with placement of surface facilities extremely limited and with appropriate and necessary conditions and requirements for protection of other land and resource values and uses. Any activities or ancillary facilities related to subsurface mining would be prohibited on about 1,400 acres of BLM-administered public lands surrounding and including the Boars Tusk (see Appendix 3).

The ACEC is managed as a VRM class II area. As more oil and gas development occurs, more effects to the visual quality of the area will occur.

Oregon Buttes ACEC (3,450 acres in the planning area)

The Oregon Buttes ACEC was designated in April 1982 to protect the scenic integrity as a historic landmark. The Oregon Buttes ACEC lies on a structural platform which 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.

Because the Buttes are a dominating landform, they 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 Oregon Buttes provide 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 occurs in the area.

Bird watching, wildlife photography, backpacking, hunting, horseback riding, and sightseeing are uses which now exist in the area. These uses are compatible with the goals for the ACEC.

Three wilderness study areas overlap the ACEC; thus, the ACEC is closed to oil and gas leasing and is also closed to surface disturbing activities and motorized vehicle use.

Red Desert Watershed Area (169,010 acres in the planning area)

About two thirds of the Oregon Buttes ACEC occurs in the Red Desert Watershed Area. A portion of the Steamboat Mountain ACEC (about 990 acres) also occurs in the area. The Watershed Area was identified as a watershed management area in the Green River RMP (USDI 1997). The management objective established for the Watershed Area in the Green River RMP is to manage for all resource values in the Red Desert area with emphasis on protection of visual resources, watershed values, and wildlife resources and to provide large areas of unobstructed views for enjoyment of scenic qualities. The Watershed Area is managed to ensure developments and activities conform with the concepts of

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open space. Management prescriptions are summarized in Appendix 3).

There has been less formal inventory for cultural resources in the Red Desert area than anywhere else in the planning area. The limited inventory indicates the same density and diversity of sites in the Red Desert area as elsewhere in the planning area. Several stone circle sites are located below Steamboat Mountain. A very old rock art site exists west of Black Rock.

Historic resources in the area include the Point of Rocks to South Pass freight road and a station at Freighters Gap. This historic linear corridor is significant on a regional level. The exact location of the Freightier Gap station is not known.

There are some sites related to early ranching in the Red Desert area, but most of these are on private land. A historical context for the area has not been written, and the significance of particular sites should not be evaluated without some kind of areal context.

The Red Desert area does not seem to have any particular unifying settlement pattern reflected in the prehistoric or historic record; however, there is a very limited data base to analyze. There are undoubtedly important sites in the sand dunes within the area. Otherwise, the Red Desert area probably does not differ remarkably from the remainder of the planning area.

The entire Red Desert Watershed Area is open to grazing.

The BLM-administered public lands within the watershed area are open to leasing, except those areas currently managed under the Interim Wilderness Management Policy and Guidelines for Lands under Wilderness Review (about 73,080 acres). Once final wilderness determinations are made, those areas not selected will be opened to leasing, although some areas may require special stipulations to protect unique resources.

Most of the watershed area is underlain with deep deposits of coal; however, the entire watershed does not have coal at depths economically feasible to mine. No coal mining activities are occurring in the watershed area at this time. The Great Divide Basin is encumbered by the coal withdrawal, which precludes disposal of the coal resource. About 1,710 acres of federal coal lands within that portion of the Coal Occurrence and Development Potential area would be open to further consideration for coal leasing and development (i.e., new competitive leasing, emergency leasing, lease modifications, and exchange proposals, under the Federal Coal Management Program) with appropriate and necessary conditions and requirements for protection of other land and resource values and uses (see Appendix 3).

Coal gas is present only where coal is found; thus, the potential exists for development in the southern half of the watershed area. Limited exploration and no development for coalbed methane has occurred.

Potential exists for development of mineral materials (sand, gravel, and volcanic rock).

A number of current mining claims affect the northeastern portion of the planning area, specifically areas north of the

Honeycomb Buttes and Oregon Buttes (Map 48). No Notices or Plans have been received for any of these claims.

The entire watershed area is open to seismic activity, except in wilderness study areas (although seismic activity can occur within WSAs depending upon the method used).

The Red Desert Watershed Area lies within the western portion of the Great Divide Basin, a 3,500-square mile internally drained basin. It is dominated by dry, shallow depressions that are the remnants of Pleistocene era lakes. Other geologic features found include badlands, flat-topped mesas, isolated buttes, and active sand dunes. Over 6 miles of faults lie in the northeastern part of the area. Landslides can occur around areas of steep terrain. Windblown sand is a common occurrence. Vertebrate fossils of scientific significance have been found in other parts of the planning area in formations like those in the Red Desert Watershed Area.

The watershed area provides many recreational opportunities. Sight-seeing and hunting are two of the most popular forms of recreation, while rock hunters can find a variety of interesting rocks, including petrified wood and agates around the Oregon Buttes area. Outstanding opportunities exist for solitude. Several types of tours are available to individuals or groups, including wagon train, horse, and mountain bike tours. The Red Desert backcountry byway was identified in the Green River RMP.

The management objectives are to develop, maintain, preserve, or enhance the various recreational activities such as camping, picnicking, winter sports, and collecting that occur in the Red Desert Watershed Area, provide for an optimum and satisfying visitor experience, and enhance hunting and fishing opportunities to maximize the visitors recreation experience. Camping restrictions limit camping to 14 days. ORV use has been limited to existing roads or trails.

Many roads and trails provide access into the area including a county road network and private and BLM roads.

The Red Desert Watershed Area is dominated by well to excessively drained soils from 10 to 40 inches deep over bedrock. The dominant soil types have a sandy loam, fine sandy loam, or loam surface and substrata. These soils formed on upland plains dissected by rocky ravines, short escarpments, and draws. Slopes range from 5 to 30 percent. Scattered throughout the basin are very deep, moderately well drained soils dominated by silty clays. These soils formed in level basins and on fans derived from alkaline and saline lacustrine deposits. Included are areas of playa lakes which seasonally retain water. Slopes range from 0 to 3 percent. The Killpecker Dune field, composed of active and dormant sand dunes, traverses the area. Slopes range from 5 to 30 percent.

Vegetation in the Red Desert Watershed Area primarily consists of big and low sagebrush communities found under the low density sagebrush classification (less than 35 percent ground cover). The big sagebrush community generally occupies areas where precipitation averages 7 to 9 inches per year and soils are sandy or loamy, well drained, and non-alkaline. The major shrub component of the big sagebrush community is Wyoming big sagebrush; other species com-

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monly found in this ecosystem are: rabbitbrush, winterfat, sandberg bluegrass, wheatgrasses, ricegrass, sandwort, and buckwheat.

Lesquerella macrocarpa is a candidate plant species under review for listing as threatened or endangered under the Federal Endangered Species Act, and can be found on Bush Rim, Oregon Buttes, and Continental Peak. *Lesquerella macrocarpa*, large-fruited bladderpod, occurs on sparsely-vegetated clay flats, benches, slopes, and hills. It is found in association with Gardner's saltbush.

Visual management classifications of II and III occur in the watershed area. The westernmost portion of the area has been identified as Class III, encompassing over 63,720 acres, although isolated flat-topped mesas and buttes are qualified as Class II (105,290 acres).

The Red Desert Watershed Area falls within the Great Divide Basin, hydrologically a closed basin. Most streams are intermittent and flow toward the center of the basin into playa lakes where they either recharge the aquifers or, more likely, evaporate. Artesian groundwater, as well as unconfined groundwater, is found throughout the watershed area. Generally, sedimentary rocks associated with the flanks of the surrounding uplifts create favorable conditions for extensive artesian groundwater systems. Although unconfined groundwater is found, water movement is generally toward the central part of the Great Divide Basin. Few studies on groundwater occurrence within the Red Desert have been conducted to date. Five formations known to contain groundwater within the watershed area include the Bridger, Laney Shale, Wilkins Peak, Tipton Shale, and Wasatch formations. Water quality ranges from poor to good depending on the formation. Generally, the quality of groundwater decreases with depth. Most existing wells range from 500 to 1,200 feet in depth. The Almond Formation, a good potential source of domestic drinking water, is found in the western rim of the area.

All or portions of four Wilderness Study Areas (WSAs), encompassing about 73,080 acres, are found within the portion of the Red Desert in the planning area. These are the Alkali Basin, South Pinnacles, Oregon Buttes, and Honeycomb Buttes Wilderness Study Areas. WSAs are managed under the "Interim Management Policy and Guidelines for Lands Under Wilderness Review" (USDI 1995).

The Red Desert Watershed Area contains a portion of the Great Divide Basin Wild Horse Management Area. The wild horse area is managed by objectives outlined in the Divide Basin Wild Horse Herd Management Plan implemented in 1982. This plan provides for the protection and management of 415 to 600 wild horses. Management objectives of diverse age, color, sex, and general good health have been achieved and are presently being maintained.

The Great Divide Basin is a cold, high elevation, desert environment that provides habitats for a variety of wildlife species. Low precipitation, short growing season, and cool average ambient temperature result in limited plant growth and forage production. Saline soils also limit forage production and species occurrence of both plants and animals. Along

Bush Rim, Freightner Gap, and other rims surrounding the basin, vegetation is highly variable and provides the most cover and forage. Small pockets of aspen, willow, and serviceberry are found where snow accumulates. Unique plant species occur on clay outcrops of Honeycomb Buttes and Continental Peak. Wildlife using the rim habitats include elk, deer, porcupine, golden eagles, red-tailed hawks, ferruginous hawks, prairie falcons, bobcat, sage grouse, and a variety of songbirds.

Aspen provide cover for deer and elk fawn to escape from predators and people. The aspen also affords nesting areas for hawks and songbirds. Limber pine occurs on the southeast slope of Steamboat Mountain and Oregon Buttes where flickers, porcupine, Clark's nutcracker, and Wortman's golden-mantled squirrel are found. South-facing slopes containing serviceberry, mountain mahogany, and currants are favored as deer and elk winter range. Deer, elk, and antelope winter in various parts of the basin.

Clay, siltstone, and sandstone outcrops across the basin are used by nesting raptors. Golden eagle, great-horned owl, and prairie falcon prefer the side slopes and cavities, while ferruginous and red-tailed hawks nest atop pinnacles and rocks. Raptors can be found throughout the watershed area, although most are concentrated in the Oregon Buttes ACEC and the Honeycomb Buttes WSA. Active raptor nests are closed to surface disturbing activities and seasonal restrictions apply to any construction activity during the period from February 1 through July 31 within 1/2 mile (or line of sight depending upon the topography) of an active nest.

Below the talus slopes, vegetation is predominately sagebrush, greasewood, saltbush, or forb community. These habitats are favored by antelope, prairie dog, jackrabbit, swift fox, badger, and short-horned lizard. Snowy plover, northern shrike, horned lark, and burrowing owl are common residents. Occupied white-tailed prairie dog habitat exists here. Reports of black-footed ferret sightings have been recorded near Buffalo Hump. A variety of game and non-game species inhabit the watershed area. Big game species such as elk, mule deer, and antelope can be found.

Crucial winter range is located mostly along the southern and western perimeters. Seasonal restrictions apply to crucial winter range or calving areas from November 15 through April 30.

Two sage grouse leks are located on federal lands within the watershed area. Seasonal restrictions apply to strutting grounds and nesting areas between March 15 and July 31.

South Pass Historic Landscape ACEC (45,830 acres in the planning area)

The South Pass Historic Landscape ACEC was designated in August 1997. Management priority and emphasis was given to maintaining and enhancing the visual and historical integrity of historic trails and their surrounding viewscape. The portion of the ACEC containing the Lander Cutoff of the Oregon/Mormon Pioneer/Pony Express/California National Historic Trails is not within the planning area.

AFFECTED ENVIRONMENT

Management of the ACEC is described in detail in the Green River RMP (USDI 1997) and summarized in Appendix 3). The ACEC is open to consideration of oil and gas leasing with appropriate mitigation (Appendix 3). Vibroseis activity will not occur within 300 feet of the historic trails. Shothole activity would not be allowed along the trails. Other geophysical operations would be allowed within the historic trails corridors if site specific analysis determines that no effects adverse to the visual integrity of the trails would occur.

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. The pass was the site where emigrant travelers traversed the Continental Divide. South Pass thus marks roughly the halfway point in the epic westward journey. The topographic setting of South Pass facilitated American settlement of the Pacific Northwest, thus solidifying United States sovereignty over that region. South Pass is located on the northwest edge of the Wyoming Basin — a desert-like geographical feature which extends south for 150 miles and forms a complete break in the Rocky Mountain chain.

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

The area having the most historic value is the viewscape created by the Continental Divide, including 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 ACEC also contains wildlife habitat values. In particular, elk use the area and two elk calving areas occur within the ACEC.

Special Status Plant Species ACEC (0 acres in the planning area)

The Special Status Plant Species ACEC was designated in August 1997. Management priority and emphasis was given to maintaining or enhancing these species and their habitats. Although no species associated with the ACEC occur within the planning area, there is potential for other sensitive species (*Lesquerella macrocarpa*) to be added to the ACEC (see the special status plant species section of the affected environment). The management actions provided in the Green River RMP allow for consideration of other species to be added to this ACEC.

Special Status Plant species are those which are proposed for listing, officially listed (T&E), or candidates for listing as threatened or endangered by the Secretary of the Interior under the provisions of the Endangered Species Act; those listed or proposed for listing by a state in a category implying potential endangerment or extinction; and those designated by State Directors as sensitive.

Steamboat Mountain ACEC (43,310 acres in the planning area)

The Steamboat Mountain ACEC was designated in August 1997 and a notice published in the Federal Register on July 10, 1998. The Federal Register notice indicated that the ACEC was 43,270 acres of BLM-administered public land. Updated information shows that there are 43,310 acres in the ACEC. The boundary did not change.

The Steamboat Mountain ACEC area contains approximately 43,310 acres of public lands. Forming the south end of the general location area are the talus slopes off the base of Steamboat Rim and Steamboat Mountain. Easterly, the area follows the road at the head of Split Rock Canyon northerly along the Continental Divide to the top of the dugway on Bush Rim. Here it follows a two-track trail northwesterly and north to Parnell Creek. The north area follows Parnell Creek downstream to Jack Morrow Creek, and then follows the road all the way to Indian Gap. From Indian Gap, it follows a two track southerly along the base of Steamboat Rim until it meets the existing Sand Dunes ACEC. From here it follows the Sand Dunes ACEC boundary until it reaches the talus slopes at the southern boundary.

The area has highly varied topographic features and ranges in elevation from 7,063 to 8,683 feet. Unique habitats of stabilized sand dunes occur here that are found nowhere else in the Field Office area. Tall sagebrush communities (up to 8-12 feet tall) provide escape cover, shelter, thermal protection, and parturition areas. An understory of bitterbrush and a variety of other shrubs and grasses provide forage. Some of these sagebrush have been estimated to be over 300 years old.

Livestock grazing occurs in the ACEC and consists mainly of summer use by cattle. Livestock grazing did not occur from 1991 to 1996. Currently, the vegetation in the ACEC is in good condition, partially due to a lack of livestock grazing, good yearly precipitation, and good growing seasons.

Limber pine and aspen communities provide habitat to a wide variety of wildlife but are limited in size and localities making them extremely important. Browsing by elk is definitely limiting aspen in many locations. Other mountain shrub communities such as serviceberry and mountain mahogany provide browse in deep snow conditions. Grass-covered ridgetops offer additional forage for elk during crucial winter periods.

Because of the terrain (steep slopes with dense sagebrush used for elk calving and high ridge tops utilized during the winter), elk use the area year round. Elk are the least tolerant to human disturbance of any of the big game species that inhabit the planning area. Activities tend to displace the elk great distances (to 3 miles) due to the extended sight distances in this desert terrain. Elk tend to abandon the Steamboat area rather than seek shelter in adjacent canyons because of the narrowness of benches and canyons and lack of hiding cover. Loss of crucial elk winter ranges in the Pine and Cedar Canyon areas due to intensive oil and gas development and human intrusion make the Steamboat area critical to the survival of this elk herd. Intensive development of any kind in the

AFFECTED ENVIRONMENT

Steamboat area will displacement of elk from this area for the term of the activity.

Water is abundant and found in good distribution through springs, ephemeral and perennial streams, seeps, and reservoirs. Snow pack commonly lies along steep slopes in lee areas late into spring. Two supplemental wildlife waters (guzzlers) are found in the ACEC. Flockets associated with the Greater Sand Dunes ACEC are also extremely important to a wide variety of wildlife that inhabit the area.

The Sands-Steamboat elk herd has fluctuated widely from a high population of about 1,100 in the late 1970s to about 245 in 1979-1980. The Steamboat Herd Unit objective is 500. This herd ranges from just north of Green River to Red Hill (east of Point of Rocks) and north to Wyoming Highway 28 and the Sweetwater River. Roughly one-third of the elk are found in the special management area yearlong.

The Sands-Steamboat elk herd is very important to local Wyoming residents, and is one of the only true desert elk herds in Wyoming. These elk are highly visible and are seen frequently by people driving through the sand dunes, Steamboat Mountain, and the Red Desert areas. Past public meetings held for coalbed methane development in the Steamboat Mountain area brought up concern over this elk herd being displaced from the region.

Historically, from 400 to 700 deer from the Wind River Mountains wintered here. Construction of the Wyoming Highway 28 fence in about 1979 apparently interrupted winter migration. Less than 250 deer presently winter in this area, although it serves as excellent spring-summer-fall deer range. Most suitable habitats are occupied by deer during these seasons.

Currently the Steamboat Mountain ACEC has a seasonal closure to protect big game birthing areas from May 1 to June 30. This closure applies to Steamboat proper and associated basin big sagebrush areas that provide cover and fawn/calf rearing habitat.

The Steamboat Mountain ACEC, along with the Sand Dunes ACEC and overlapping crucial winter ranges is part of what is called the "Core Area" within the planning area. The "Core Area" is approximately 80,410 acres in size and is considered the most crucial habitat for many of the species (especially elk and deer) that inhabit the planning area. The "Core Area" and much of the entire planning area is relatively undisturbed from December through June. Roads in the area

are limited and are not maintained (no snow removal) during this time.

The Steamboat Mountain ACEC has a high potential for oil and gas development.

About 9,870 acres of federal coal lands within that portion of the Coal Occurrence and Development Potential area that is within the ACEC, would be open to further consideration for coal leasing and development (i.e., new competitive leasing, emergency leasing, lease modifications, and exchange proposals, under the Federal Coal Management Program) with appropriate and necessary conditions and requirements for protection of other land and resource values and uses (see Appendix 3). Leasing and development of federal coal in the area (approximately 9,870 acres) will be considered for subsurface mining methods only. Development plans (e.g., mine plans) would be required to ensure adequate measures are taken to protect and maintain the elk herd and habitat. The location of surface facilities relating to subsurface mining would be considered on a case-by-case basis.

White Mountain Petroglyphs ACEC (20 acres in the planning area)

The White Mountain Petroglyphs ACEC was designated to protect Indian drawings associated with the early ancestors of the present Shoshone tribe and perhaps other tribes. Common drawings include human figures, elk, buffalo, feather head dresses, and human stick figures. The ACEC was officially designated on April 16, 1982.

Management actions are identified in the Green River RMP and summarized in Appendix 3). The ACEC is closed to surface disturbing activities and is currently unleased.

The petroglyphs and immediate area are intensively used by local schools for environmental education field trips. The area below the petroglyph panel, adjacent to the access road, has been degraded by uncontrolled off-road vehicle use. These impacts will begin to reverse themselves if off-road vehicle and foot traffic are channeled by establishing a parking area and access footpath. The surrounding area is also an important deer fawning area and an important raptor nesting area. Scenic viewing of Boars Tusk and the surrounding area is also a popular use. The White Mountain Petroglyphs have received a moderate amount of vandalism over the years, including bullet holes, modern graffiti, and chalk marks within the carvings.

**TABLE 3-1
UNDERGROUND WATER CLASS**

Use Suitability Constituent or Parameter	I Domestic Concentration¹	II Agriculture Concentration¹	III Livestock Concentration¹
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
Chromium (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	---	---
Fluoride (F)	1.4-2.4	---	---
Hydrogen Sulfide (H ₂ S)	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 (in- cluding 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.

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 a water would contain after subtracting an amount equivalent to the calcium plus the magnesium, and is a measure of potential hazard which 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 a water is defined by the U.S. Department of Agriculture Laboratory (1954) as:

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

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 upon known potential hazards and information needed for ongoing studies and monitoring.

**TABLE 3-2
ALLOTMENT ACRES LOCATED WITHIN
THE JACK MORROW HILLS PLANNING AREA**

Allotment Number	Allotment	Category	Public Lands in Entire Allotment	Public Lands in Jack Morrow Hills	% of Public Lands in Allotment That Are in JMHCAP Area
301600	4th of July	I	9,760	3,260	3
320700	Pacific Springs	C	320	320	100
321400	Johnson Place	C	60	60	100
321500	Crookston Ranch	C	10	10	100
330700	Hay Meadow	C	380	380	100
1300700	Pacific Creek ¹	M	182,220	182,220	100
1300800	Bar X	M	4,060	4,010	99
1301100	Continental Peak	M	81,970	81,970	100
1301200	Red Desert	M	243,200	73,090	30
1301300	Bush Rim	M	92,710	92,710	100
1301400	Steamboat Mountain	I	33,650	32,610	97
1301500	Sands	I	105,210	100,440	95
1301800	Rock Springs	M	1,009,790	2,230	0.28
1310700	Middle Hay	C	298	298	100
1311400	Chiltons Place	C	140	140	100
1311500	Houghton Ranch	C	270	270	100

¹ An additional 1,170 acres of Bureau of Recreation Lands occur within the Pacific Creek Allotment (183,390 total federal acres).

**TABLE 3-3
ALLOTMENT/OPERATOR DATA FOR JMH PLANNING AREA**

Allotment	Operator	Livestock Number	Class of Livestock	Use Period	AUMs	Permitted Use			Cattle AUMs	Sheep AUMs
						Active	Suspended	Total		
4th of July (numbers adjusted by 0.03)	D. Mines	13	C	05/16-07/20	12	25	16	41	25	
		13	C	10/01-12/06	13					
Pacific Springs	Blair & Hay	63	C	06/01-06/30	29	29		29	29	
Johnson Place	D. Mines	2	C	05/01-09/30	10	10		10	10	
Crookston Ranch	DeLambert	2	C	06/01-07/31	4	4		4	4	
Hay Meadow	Blair & Hay	157	C	10/01-11/03	91	91		91	91	
Pacific Creek	DeLambert	75	C	05/01-05/02	5	5	4,526	5	5	22
	Magagna Brothers	220	S	10/01-10/15	22	22		22	5	
	Blair & Hay	949	C	05/01-12/31	7,032	7,030		11,556	7,030	
	Erramouspe Brothers	750	S	07/15-07/16	10	10		10	10	
	G&E Livestock	2,835	S	12/01-12/02	37	38		38	38	
	Bar X Sheep	1,119	S	05/25-05/26	15	15		15	15	
	White Acorn	90	C	05/01-05/31	92	90		90	90	
Bar X (numbers adjusted by 0.99)	Bar X Sheep	210	C	06/01-10/15	463	463		463	463	
Continental Peak	Magagna Brothers	572	S	05/01-10/31	630	630	41	671	1,635	630
	Robert Hellyer	293	C	05/01-10/31	1,631	1,635	613	2,248		
	Erramouspe Brothers	531	C	05/11-10/31	2,923	3,463	347	3,810	2,923	
		1,555	S	05/19-07/15	540					
	Bar X Sheep	3,060	S	05/25-05/26	40					40
	White Acorn	17	C	05/01-05/31	17	17	17	17	40	

**TABLE 3-3
ALLOTMENT/OPERATOR DATA FOR JMH PLANNING AREA**

Allotment	Operator	Livestock Number	Class of Livestock	Use Period	AUMs	Permitted Use			Cattle AUMs	Sheep AUMs
						Active	Suspended	Total		
Red Desert (numbers adjusted by 0.30)	Magagna Brothers	847	S	05/01-10/31	953	946	19	965	1,251	946
	Blair & Hay	175	C	05/01-12/15	1,251	1,251	1,962	3,213		
	Erramouspe Brothers	1,095	S	05/01-05/06	43	43		43		
	Bar X Sheep	204	C	05/15-10/14	935	935	266	1,201		
	White Acorn					8	13	21		
Bush Rim (numbers adjusted by 0.99)	Magagna Brothers	640	S	10/01-10/15	63	64		64	3,814	64
	Blair & Hay	815	S	05/02-06/01	166	166		166		
	Erramouspe Brothers	3,300	S	04/30-05/01	43	22		22		
	Bar X Sheep	967	C	05/25-09/15	3,814	3,814	2,456	6,270		
	White Acorn					71	75	146		
Steamboat Mountain (numbers adjusted by 0.97)	Blair & Hay	378	S	05/02-06/01	78	79		79	822	79
	Bar X Sheep					19		19		
	D. Mines	413	C	07/21-09/30	821	822	1,174	1,996		
Sands (numbers adjusted by 0.95)	Midland Dunton	1,647	S	11/27-11/30	44	44		44	1,194	44
		269	S	10/01-12/31	162	206	19	225		
	DeLambert	199	C	05/06-11/05	1,206	1,194	336	1,530		
	G&E Livestock	7,790	S	04/25-04/25	51	51		51		
	GZ Livestock	202	C	05/15-12/15	1,696	1,699	823	2,522		
		91	C	05/10-11/11	558	552	337	889		
	White Acorn					51		51		
	Roberts Livestock	1,105	S	11/01-12/14	320	324	39	363		
Rock Springs* (numbers adjusted by 0.0028)	Blair & Hay	4	S	03/01-04/30	2	2		2	1	2
		1	C	05/01-12/15	1	1		1		
		4	S	12/16-02/28	2	4	1	5		
	D. Mines	1	C	05/15-12/15	4	4	1	5		
Middle Hay	Blair & Hay	15	C	06/01-07/31	16	16		16	16	
Chiltons Place	D. Mines	3	C	05/01-09/30	15	15		15	15	

**TABLE 3-3
ALLOTMENT/OPERATOR DATA FOR JMH PLANNING AREA**

Allotment	Operator	Livestock Number	Class of Livestock	Use Period	AUMs	Permitted Use			Cattle AUMs	Sheep AUMs
						Active	Suspended	Total		
Houghton Ranch	Chilton Land and Livestock	11	C	05/02-06/01	11	12		12	12	
Total AUMs in Jack Morrow Hills									22,767	3,265

**TABLE 3-4
PREVIOUS 5-YEAR LIVESTOCK GRAZING USE IN JMH PLANNING AREA**

Allotment	Operator	1998	1997	1996	1995	1994	Average Use Total (5 Years)	Average Non-use Total (5 Years)	Average Use Total for Cattle over 5 Years	Average Use Total for Sheep over 5 Years
4th of July	D. Mines	12					2		2	
	Ken Routh		25*	25*				25		
Pacific Springs	Blair & Hay	29	29	29	29	29	29			29
Johnson Place	D. Mines	10					2		2	
	Chilton Land & Livestock		10	10	10	10	8		8	
Crookston Ranch	DeLambert	4	4	4	4	4	4		4	
Hay Meadow	Blair & Hay	91 *	91 *	91 *	91 *	91 *		91		
Pacific Creek	DeLambert	5 *	5 *	5 *	5 *	5 *		5		
	Magagna Brothers	39	54	49	100	81	64.6			65
	Blair & Hay	5,496	4,522	2,187	4,450	3,294	3,990		3,990	
	Erramouspe Brothers	10 *	10 *	10 *	10 *	10 *		10		
	G&E Livestock	38 *	38 *	38 *	38 *	38 *		38		
	Bar X Sheep	15 *	15 *	15 *	15 *	15 *		15		
	White Acorn	90 *	90 *	90 *	90 *	90 *		90		
Bar X	Bar X Sheep	323	414	439	248	257	336.2		336	

**TABLE 3-4
PREVIOUS 5-YEAR LIVESTOCK GRAZING USE IN JMH PLANNING AREA**

Allotment	Operator	1998	1997	1996	1995	1994	Average Use Total (5 Years)	Average Non-use Total (5 Years)	Average Use Total for Cattle over 5 Years	Average Use Total for Sheep over 5 Years
Continental Peak	Magagna Brothers	198	135	104	177	238	170.4			170
	Robert Hellyer	1,629	1,637	1,485	1,202	1,043	1399.2		1,399	
	Erramouspe Brothers	3,463 *	3,463 *	3,463 *	3,463 *	3,463 *		3463		
	Bar X Sheep	41 *	41 *	41 *	41 *	41 *		32.8		
	White Acorn	17 *	17 *	17 *	17 *	17 *		13.6		
Red Desert	Magagna Brothers	223	136	160	211	289	203.8			204
	Blair & Hay	117	375*	375*	375 *	375 *	23.4	300	23	
	Erramouspe Brothers	13*	13*	13*	13*	13*		13		
	Bar X Sheep	71	37	279 *	55	21	36.8	55.8	37	
	White Acorn	2*	2*	2*	2*	2*		2		
Bush Rim	Magagna Brothers	33	38	33	58	86	49.6			50
	Blair & Hay	166 *	166 *	166 *	166 *	166 *		132.8		
	Erramouspe Brothers	22 *	22 *	22 *	22 *	22 *		17.6		
	Bar X Sheep	926	1,152	3,814 *	572	1,063	742.6	762.8	743	
	White Acorn	71 *	71 *	71 *	71 *	71 *		56.8		
Steamboat Mountain	Blair & Hay	78	78 *	78 *	78 *	78 *	15.6	62.4	16	
	Bar X Sheep	19 *	19 *	19 *	19 *	19 *		19		
	D. Mines	386					77.2		77	

**TABLE 3-4
PREVIOUS 5-YEAR LIVESTOCK GRAZING USE IN JMH PLANNING AREA**

Allotment	Operator	1998	1997	1996	1995	1994	Average Use Total (5 Years)	Average Non-use Total (5 Years)	Average Use Total for Cattle over 5 Years	Average Use Total for Sheep over 5 Years
	Steamboat Not Leased		822 *	822 *				328.8		
Sands	Midland Dunton	184	90	217	76	85	130.4			130
	DeLambert	1,194	1,194	1,194	1,194	1,194	1194		1,194	
	G&E Livestock	21	19	36	19	17	22.4			22
	GZ Livestock	1,699	1,552	1,693			988.80		989	
	White Acorn	51 *	51 *	51 *	51 *	51 *		51		
	Roberts Livestock	320	320	320	320	320	320			320
Rock Springs* figures	Blair & Hay	5*	5*	5*	5*	5*		4		
	D. Mines	4	4	3			2.20		2	
Middle Hay	Blair & Hay	16	16 *	16	16	16	12.8	3.2	13	
Chiltons Place	D. Mines	15					3		3	
	Chilton Land and Livestock		15	15	15	15	12		12	
Houghton Ranch	Chilton Land and Livestock	11	11	11	11	11	11		11	
Allotment Total							9851	5,661	8861	990
Total Active Use		13,038	11,373	8,005	8,767	8,073				
Total Not Scheduled		4,119	5,435	9,512	4,572	4,572				

* non-use/not scheduled

- Chilton Land and Livestock was suspended until 05/15/1996 Steamboat, 4th of July, Rock Springs, Sands Allotments

- Don Mines Rock Springs Allotment 1996-1998
- Leased 4th of July, Steamboat, Johnson Place Chilton Place, 1998-2000
- GZ Livestock 1996-1998 Sands

**TABLE 3-5
RANGELAND STANDARDS
NOT MET (N) OR UNKNOWN (U)
FY 99**

Allotment	Rangeland Standards Not Met or Unknown					
	1	2	3	4	5	6
Bar-X					U	
Bush Rim					U	
Continental Peak					U	
4 th of July					U	
Pacific Springs					U	
Pacific Creek	N	N			U	
Red Desert					U	
Sands					U	
Steamboat Mountain		N			U	

TABLE 3-6
WELLS DRILLED IN THE JMH

SEC.	TWN.	DIR.	RNG.	DIR.	QTR/QTR	FOOTAGE	DIR.	FOOTAGE	DIR.	OPERATOR	UNIT/FIELD NAME	WELL NO.	SURF. ELEV.	ELEV. TYPE	FIELD	DEEPEST FORMATION	SPUD DATE	TOTAL DEPTH	DEEPEST FORMATION	COMPL. DATE	COMP. STATUS
30	27	N	98	W	se se	660	fsl	660	fel	CHORNEY OIL CO	CIRCLE BAR UNIT	1	7163	KB	WILDCAT	Mesaverde	19710714	10970	Mesaverde	19710914	P&A
3	27	N	99	W	sw nw	1900	fml	510	fwl	EUROPEAN SOUTHWEST CO	CONTINENTAL PEAK UNIT	1-3	7389	KB	WILDCAT		19820626	5005	Tertiary	19820810	P&A
25	27	N	99	W	nw se	1980	fsl	1780	fel	DAVIS OIL CO	HONEYCOMB BUTTES UNIT	1	7238	KB	WILDCAT	Lance	19790722	13984	Rock Springs	19791008	P&A
26	27	N	99	W	sw sw	660	fsl	660	fwl	ENERGETICS INC	HARRIS SLOUGH UNIT	1-A	7241	KB	WILDCAT	Lance	19810118	13620	Ericson	19810430	P&A
17	27	N	100	W	sw nw	1461	fml	1177	fwl	AMOCO PRODUCTION CO	SOUTH PASS UNIT	1	7428	KB	WILDCAT	Morrison	19810306	22947	Morrison	19830413	P&A
30	27	N	100	W	c sw	1320	fsl	1320	fwl	BRITISH AMER OIL PROD CO		1	7742	KB	WILDCAT		19591022	11012	Lewis	19600102	D&A
9	27	N	101	W	nw sw	1980	fsl	460	fwl	SKINNER ROBERT E		1-9	7390	GR	WILDCAT		0	3004	Tertiary	1978	D&A
9	27	N	101	W	ne sw	1990	fsl	1980	fwl	WEST COAST OIL CO INC		1	7438	KB	WILDCAT	Precambrian	19770804	9691		19770831	P&A
24	27	N	101	W	ne nw	990	S	990	W	SINCLAIR OIL & GAS CO	OREGON TRAIL UNIT	1	8085	GR	WILDCAT		19470623	1858	Tertiary	19470821	P&A
24	27	N	101	W	sw nw	1980	fml	660	fwl	MOUNTAIN FUEL SUPPLY CO	DICKIE SPRINGS UNIT	1	8035	KB	DICKIE	Lance	19700614	12272	Mesaverde	19701003	P&A
29	27	N	102	W	se nw	1650	fml	1650	fwl	SUPERIOR OIL CO		1	7034	GR	WILDCAT	Wasatch	19430727	3458	Wasatch	19430825	
32	28	N	101	W	se nw	1980	fml	1980	fwl	AMERICAN QUASAR PETR CO		1	7581	KB	WILDCAT	Hilliard	19740927	15040	Mesaverde	19751106	P&A
36	28	N	102	W	nw se	1961	fsl	2166	fel	AMERICAN QUASAR PETR CO	MONUMENT DRAW UNIT	36-33	7372	KB	WILDCAT	Eocene	19810922	3260	Tertiary	19811029	P&A
5	22	N	104	W	se sw	660	fsl	1980	fwl	BRITISH AMER OIL PROD CO		1	6694	KB	WILDCAT	Ericson	19620107	3712	Ericson	19620120	D&A
1	22	N	105	W	sw sw	660	fsl	660	fwl	BRITISH AMER OIL PROD CO		1	7044	KB	WILDCAT	Ericson	19611106	5001	Ericson	19611119	D&A
5	22	N	105	W	lot 11	2051	fml	1980	fel	HUSKY OIL CO	EDEN UNIT	7-5	7233	KB	WILDCAT	Ericson	19721031	11036	Baxter	19730117	D&A
6	22	N	105	W	sw ne	3301	fml	1818	fel	HUSKY OIL CO	EDEN UNIT	7-6	6984	KB	WILDCAT	Mesaverde	19740822	9383	Ericson	19741013	P&A
11	22	N	105	W	sw nw	2334	fml	306	fwl	HUSKY OIL CO	EDEN UNIT	5-11	7693	KB	WILDCAT	Dakota	0	18150	Morrison	19751030	D&A
1	23	N	101	W	ne ne	607	fml	662	fel	SUN RAY MID-CONT OIL CO	BIG DUNE UNIT	3	6996	KB	WILDCAT	Almond	19610919	5720	Almond	19610929	D&A
4	23	N	101	W	se ne	1593	fml	720	fel	DAVIS OIL CO	TREASURE UNIT	3	7204	KB	TREASURE	Morrison	19810311	13966	Morrison	19810508	P&A
4	23	N	101	W	nw sw	1525	fsl	1065	fwl	CONOCO INC	BIG DUNE UNIT	4-1	7202	KB	WILDCAT	Ericson	19590114	5456	Ericson	19590211	D&A
3	23	N	102	W	se nw	1764	fml	1938	fwl	WOODS PETROLEUM CORP	STEAMBOAT MOUNTAIN UNIT/FIELD	1	7632	KB	WILDCAT	Muddy/upr Dakota	19780630	13044	Morrison	19781030	GAS
4	23	N	102	W	sw ne	2240	fml	2413	fel	WOODS PETROLEUM CORP	STEAMBOAT MOUNTAIN UNIT/FIELD	2	7855	KB	WILDCAT	Morrison	19790710	12850	Morrison	19790824	P&A
10	23	N	102	W	ne ne	660	fml	660	fwl	WOODS PETROLEUM CORP		1	7996	KB	WILDCAT	Almond	19690802	4517	Almond	19690809	D&A
11	23	N	102	W	se nw	2600	fml	2581	fwl	WOODS PETROLEUM CORP	STEAMBOAT MOUNTAIN UNIT/FIELD	4	7862	KB	WILDCAT	Frontier	19810901	13025	Morrison	19811018	P&A
33	23	N	102	W	nw nw	1231	fml	1308	fwl	TRITON OIL & GAS CORP	UNNAMED FIELD	3	7109	KB	WILDCAT	Blair	19900216	4600	Blair	19900801	METH
33	23	N	102	W	ne ne	1145	fml	1319	fel	UNION PACIFIC RESOURCES	UNNAMED FIELD	2-33	7061	KB	WILDCAT	Fox Hills	19950506	4750	Blair	19950912	METH
1	23	N	103	W	se nw	3300	fsl	1980	fwl	MESA PETROLEUM CO		1	7980	DF	WILDCAT	Morrison	19730807	12091	Morrison	19731014	P&A
3	23	N	103	W	c sw	1320	fsl	1320	fwl	AQUITAINE OIL CORP	NITCHIE GULCH FIELD	13-3	7211	KB	NITCHIE GULCH	stray	19771007	10090	Lakota	19771118	GAS
4	23	N	103	W	ne sw	2550	fsl	2370	fwl	AQUITAINE OIL CORP	NITCHIE GULCH FIELD	1-4	7236	KB	NITCHIE GULCH	Dakota	19770418	10030	Dakota	19780325	GAS
5	23	N	103	W	nw nw	1028	fml	750	fwl	K W B PROPERTY MGMT INC	NITCHIE GULCH FIELD	2-5	7130	KB	NITCHIE GULCH	Morrison	19871103	9520	Morrison	19871229	GAS
5	23	N	103	W	sw ne	1980	fml	2175	fel	OKLAHOMA SILURIAN PTRS	NITCHIE GULCH FIELD	3-5	7205	KB	NITCHIE GULCH	Morrison	19900304	9693	Morrison	19900723	GAS
5	23	N	103	W	se sw	1000	fsl	2020	fwl	MCBRIDE W C INC	NITCHIE GULCH FIELD	1-5	7104	KB	NITCHIE GULCH	3rd Dakota	19660929	9236	Dakota	19661119	GAS
6	23	N	103	W	se nw	2047	fml	2017	fwl	TERRA RESOURCES INC	NITCHIE GULCH FIELD	2-6	6978	KB	NITCHIE GULCH	Morrison	19861219	9150	Morrison	19870222	GAS
6	23	N	103	W	ne ne	1100	fml	750	fel	TERRA RESOURCES INC	NITCHIE GULCH FIELD	20-6	7087	KB	NITCHIE GULCH	Morrison	19890305	9361	Morrison	19890407	GAS
6	23	N	103	W	nw sw	1470	fsl	1125	fwl	PACIFIC ENT OIL CO USA	NITCHIE GULCH FIELD	30-6	6925	KB	NITCHIE GULCH	Morrison	19890710	9012	Morrison	19890918	O&G
6	23	N	103	W	c se	1320	fsl	1320	fel	MCBRIDE W C INC	NITCHIE GULCH FIELD	1	7039	KB	NITCHIE GULCH	Dakota	19650519	9112	Dakota	19651107	GAS
7	23	N	103	W	se nw	1489	fml	1393	fwl	TERRA RESOURCES INC	NITCHIE GULCH UNIT/FIELD	14-7	6999	KB	NITCHIE GULCH	2nd stray	19841115	8400	Mowry	19841231	GAS
7	23	N	103	W	se nw	1900	fml	2300	fwl	TERRA RESOURCES INC	NITCHIE GULCH UNIT/FIELD	19-7	7037	KB	NITCHIE GULCH	Morrison	19890125	9010	Morrison	19890315	GAS
7	23	N	103	W	ne se	2357	fsl	911	fel	PACIFIC ENT OIL CO USA	NITCHIE GULCH UNIT/FIELD	22-8	6954	KB	NITCHIE GULCH	Morrison	19900203	9086	Morrison	19900411	GAS
7	23	N	103	W	ne se	1990	fsl	660	fel	AMAX PETROLEUM CORP	NITCHIE GULCH UNIT/FIELD	6-7	6968	KB	NITCHIE GULCH	stray ss	19641128	8950	Morrison	19650202	GAS
8	23	N	103	W	nw nw	1271	fml	1293	fwl	TERRA RESOURCES INC	NITCHIE GULCH UNIT/FIELD	15-8	7002	KB	NITCHIE GULCH		19841208	5840	Baxter	19850110	J&A
8	23	N	103	W	nw nw	1176	fml	1293	fwl	TERRA RESOURCES INC	NITCHIE GULCH UNIT/FIELD	15-8X	7002	KB	NITCHIE GULCH	Mowry	19850114	8446	Mowry	19850606	GAS
8	23	N	103	W	nw se	1980	fsl	2280	fel	AMAX PETROLEUM CORP	NITCHIE GULCH UNIT/FIELD	7-8	7031	KB	NITCHIE GULCH	1st Dakota	19651113	8930	Dakota	19651222	GAS
9	23	N	103	W	se nw	1980	fml	1980	fwl	C R A INC	NITCHIE GULCH UNIT/FIELD	11-9	7064	KB	NITCHIE GULCH	Dakota	19680405	9150	Dakota	19680712	GAS
11	23	N	103	W	c nw	1320	fml	1320	fwl	ELF AQUITAINE PETR INC		11-11	7322	KB	NITCHIE GULCH	Morrison	0	10254	Morrison	19780511	P&A
16	23	N	103	W	nw nw	330	fml	330	fwl	TERRA RESOURCES INC	NITCHIE GULCH UNIT/FIELD	17-16	7063	KB	NITCHIE GULCH	Morrison	19870119	8870	Morrison	19870608	GAS
16	23	N	103	W	nw se	1650	fsl	2310	fel	TRIGOOD OIL CO	NITCHIE GULCH FIELD	1	7096	GR	NITCHIE GULCH		19620314	235	Tertiary	19620501	SUSP
16	23	N	103	W	se ne	1880	fml	760	fel	C R A INC	NITCHIE GULCH FIELD	9-16	7184	KB	NITCHIE GULCH	Morrison	19671026	8966	Morrison	19671208	D&A
17	23	N	103	W	se se	660	fml	660	fel	TRIGOOD OIL CO	NITCHIE GULCH UNIT/FIELD	1	7134	KB	WILDCAT	Morrison	19610918	8713	Morrison	19611115	GAS
17	23	N	103	W	nw sw	1980	fsl	660	fwl	AMAX PETROLEUM CORP	NITCHIE GULCH UNIT/FIELD	4-17	6949	KB	NITCHIE GULCH	Morrison	19630831	8750	Morrison	19631003	GAS
18	23	N	103	W	ne ne	818	fml	527	fel	TERRA RESOURCES INC	NITCHIE GULCH UNIT/FIELD	12-18	7031	KB	NITCHIE GULCH	3rd Frontier	19831029	8200	Frontier	19831209	GAS
18	23	N	103	W	se nw	1550	fml	1566	fwl	AMAX PETROLEUM CORP	NITCHIE GULCH UNIT/FIELD	8-18	6923	KB	NITCHIE GULCH	Morrison	19651212	8923	Morrison	19660124	GAS
19	23	N	103	W	se ne	2500	fml	80	fel	PACIFIC ENT OIL CO USA	NITCHIE GULCH UNIT/FIELD	20-19	6925	KB	NITCHIE GULCH	Morrison	19890503	8660	Morrison	19890614	GAS
19	23	N	103	W	se nw	1980	fml	1980	fwl	AMAX PETROLEUM CORP	NITCHIE GULCH UNIT/FIELD	5-19	6849	GR	NITCHIE GULCH	Morrison	19631031	8850	Morrison	19631231	GAS

TABLE 3-6
WELLS DRILLED IN THE JMHW

SEC.	TWN.	DIR.	RNG.	DIR.	QTR/QTR	FOOTAGE	DIR.	FOOTAGE	DIR.	OPERATOR	UNIT/FIELD NAME	WELL NO.	SURF. ELEV.	ELEV. TYPE	FIELD	DEEPEST FORMATION	SPUD DATE	TOTAL DEPTH	DEEPEST FORMATION	COMPL. DATE	COMP. STATUS	
20	23	N	103	W	nw nw	465	fnl	703	fwl	PACIFIC ENT OIL CO USA	NITCHIE GULCH UNIT/FIELD	13-20	7017	KB	NITCHIE GULCH	3rd Frontier	19831027	8106	Mowry	19831206	GAS	
20	23	N	103	W	nw se	1980	fsl	1981	fel	TRIGOOD OIL CO	NITCHIE GULCH UNIT/FIELD	2-20	7084	KB	NITCHIE GULCH	Dakota	19620430	8596	Dakota	19620531	GAS	
21	23	N	103	W	nw sw	2400	fsl	990	fwl	PACIFIC ENT OIL CO USA	NITCHIE GULCH UNIT/FIELD	21-21	7145	KB	NITCHIE GULCH	Morrison	19891028	8620	Morrison	19900104	GAS	
21	23	N	103	W	se nw	1860	fnl	1980	fwl	TRIGOOD OIL CO	NITCHIE GULCH UNIT/FIELD	3-21	7036	KB	NITCHIE GULCH	Morrison	19620831	8480	Dakota	19621201	GAS	
22	23	N	103	W	sw nw	1640	fnl	1298	fwl	LUFF EXPL CO	PINE CANYON FIELD	3-22	7152	KB	PINE CANYON	Dakota	19820119	8770	Morrison	19820215	P&A	
22	23	N	103	W	se se	1120	fsl	1308	fel	LUFF KENNETH INC	PINE CANYON FIELD	2-22	7265	KB	WILDCAT	Morrison	19770908	8849	Morrison	19771004	GAS	
26	23	N	103	W	nw nw	1120	fnl	1319	fwl	LUFF KENNETH INC	PINE CANYON FIELD	4-26	7183	GR	WILDCAT	Morrison	19771206	8929	Morrison	19780510	GAS	
27	23	N	103	W	ne nw	1092	fnl	1381	fwl	UNION PACIFIC RESOURCES	PINE CANYON FIELD	1	7420	KB	NITCHIE GULCH	Morrison	19870608	8830	Morrison	19870801	GAS	
28	23	N	103	W	sw nw	1434	fnl	1125	fwl	TERRA RESOURCES INC	NITCHIE GULCH UNIT/FIELD	16-28	7290	KB	NITCHIE GULCH	Morrison	19860418	8731	Morrison	19860630	GAS	
28	23	N	103	W	ne ne	1000	fnl	1050	fel	B P EXPL INC	PINE CANYON FIELD	1-28	7427	KB	PINE CANYON	Morrison	19890623	8875	Morrison	19890921	GAS	
1	23	N	104	W	n/2 se	1470	fsl	1320	fel	TEXAS OIL & GAS CORP	NITCHIE GULCH FIELD	1	6911	KB	NITCHIE GULCH	Morrison	19781028	9308	Morrison	19790303	GAS	
1	23	N	104	W	ne ne	1010	fnl	658	fel	GULF OIL CORP	INDIAN GAP UNIT/NITCHIE GULCH FIELD	1	6936	DF	WILDCAT	Nugget	19550928	10066	Nugget	19551201	D&A	
2	23	N	104	W	se se	660	fsl	660	fel	TEXAS OIL & GAS CORP	NITCHIE GULCH FIELD	1	6442	GR	NITCHIE GULCH	Morrison	19790429	9770	Morrison	19790831	GAS	
3	23	N	104	W	ne se	1503	fsl	1243	fel	TEXAS OIL & GAS CORP	NITCHIE GULCH FIELD	1	6810	KB	NITCHIE GULCH	Morrison	19800809	9550	Morrison	19801107	J&A	
3	23	N	104	W	ne se	1403	fsl	1243	fel	C & K PETROLEUM INC	NITCHIE GULCH FIELD	9-3	6830	KB	NITCHIE GULCH	Morrison	19810406	10765	Morrison	19810625	GAS	
11	23	N	104	W	se ne	1455	fnl	1085	fel	TEXAS OIL & GAS CORP	BOARS TUSK UNIT/NITCHIE GULCH FIELD	1	6891	KB	NITCHIE GULCH	Morrison	19800430	9554	Morrison	19810120	GAS	
11	23	N	104	W	nw se	2160	fsl	1905	fel	SUNSET INTL PETR CORP	NITCHIE GULCH FIELD	11-10	6829	KB	NITCHIE GULCH	stray ss	19661031	9585	Morrison	19670401	GAS	
12	23	N	104	W	c ne	1320	fnl	1320	fwl	GRYNBERG JACK J	NITCHIE GULCH FIELD	20-12	6895	KB	NITCHIE GULCH	Aspen	19890220	8997	Morrison	19890516	GAS	
12	23	N	104	W	se se	1150	fsl	1210	fel	AMAX PETROLEUM CORP	NITCHIE GULCH FIELD	1-12	6904	KB	NITCHIE GULCH	Morrison	19650629	8997	Morrison	19650911	GAS	
13	23	N	104	W	sw ne	1406	fnl	1515	fel	TERRA RESOURCES INC	NITCHIE GULCH FIELD	7-13	6876	KB	NITCHIE GULCH	3rd Frontier	19730618	8400	Frontier	19730809	O&G	
15	23	N	104	W	c se	1320	fsl	1320	fel	F M C WYOMING CORP	BOARS TUSK UNIT/NITCHIE GULCH FIELD	1-15	6734	KB	NITCHIE GULCH	Morrison	19791225	10400	Morrison	19800313	D&A	
16	23	N	104	W	sw sw	2205	fsl	2115	fel	BOARS TUSK OIL CO	NITCHIE GULCH FIELD	1	0		WILDCAT			0	1529	Mesaverde	19271107	D&A
17	23	N	104	W	sw sw	460	fsl	660	fwl	HUSKY OIL CO	NITCHIE GULCH FIELD	13-17	6717	KB	WILDCAT	Lance	19790518	3300	Lance	19790604	P&A	
23	23	N	104	W	w/2 se	1320	fsl	1370	fel	F M C WYOMING CORP	NITCHIE GULCH FIELD	1-23	6763	BB	WILDCAT	Mowry	19790427	9681	Morrison	19790601	P&A	
26	23	N	104	W	w/2 sw	1320	fsl	1316	fwl	SOUTHLAND ROYALTY CO	NITCHIE GULCH FIELD	1-26	6713	KB	WILDCAT	Morrison	19770201	9914	Morrison	19770713	O&G	
29	23	N	104	W	sw sw	662	fsl	660	fwl	HUSKY OIL CO	NITCHIE GULCH FIELD	13-29	6732	GR	WILDCAT		19790503	3117		19790514	P&A	
31	23	N	104	W	se nw	1980	fnl	1490	fwl	HUSKY OIL CO	NITCHIE GULCH FIELD	31-1	6849	KB	WILDCAT	Lance	19781110	3382	Lance	19781129	P&A	
2	24	N	100	W	lot 6	537	fnl	660	fwl	ROWAN DRLG CO INC	NITCHIE GULCH FIELD	1	7077	KB	WILDCAT	Almond	19620711	8970	Ericson	19620807	D&A	
3	24	N	100	W	ne se	1980	fsl	660	fel	SOHIO PET CO	NITCHIE GULCH FIELD	1	6946	KB	WILDCAT	Lance	19700604	8660	Ericson	19700626	P&A	
10	24	N	100	W	ne ne	660	fnl	660	fel	CHEROKEE OIL & GAS CORP	NITCHIE GULCH FIELD	1	6946	DF	WILDCAT		19610606	218		19610809	D&A	
12	24	N	100	W	sw sw	660	fsl	660	fwl	WOLF EXPL CO	PINNACLES UNIT	1	6999	KB	WILDCAT		19670321	9000	Ericson	19670417	D&A	
22	24	N	100	W	ne sw	2588	fsl	2592	fwl	WOODS PETROLEUM CORP	SADDLE BAG UNIT/FIELD	1	7058	KB	WILDCAT	Morrison	19810531	16542	Morrison	19821110	P&A	
22	24	N	100	W	nw se	2588	fsl	2595	fel	MONCRIEF W A JR	OASIS UNIT	1	7057	KB	WILDCAT	Mowry	19831114	16660	Morrison	19840515	P&A	
28	24	N	101	W	se ne	2627	fnl	326	fel	H P C INC	TREASURE UNIT/FIELD	4	7544	KB	TREASURE	Morrison	19811214	14930	Morrison	19820818	GAS	
31	24	N	101	W	se nw	2055	fnl	1970	fwl	MOUNTAIN FUEL SUPPLY	NITCHIE GULCH FIELD	1	7486	KB	WILDCAT	Almond	19640910	5100	Almond	19640920	D&A	
32	24	N	101	W	sw ne	1981	fnl	1991	fel	HPC INC	TREASURE UNIT	2	7402	KB	TREASURE	Mowry	19800724	14036	Morrison	19810909	P&A	
33	24	N	101	W	ne sw	1905	fsl	1986	fwl	DAVIS OIL CO	TREASURE UNIT/FIELD	1	7673	KB	TREASURE	Morrison	19790831	14426	Morrison	19800630	GAS	
7	24	N	102	W	nw sw	2025	fsl	412	fwl	GRYNBERG JACK & ASSOC	NITCHIE GULCH FIELD	1-7	7406	KB	WILDCAT	Morrison		0	13676	Morrison	19730510	D&A
11	24	N	102	W	sw sw	585	fsl	660	fwl	SOUTHLAND ROYALTY CO	NITCHIE GULCH FIELD	1	7267	KB	WILDCAT	Rock Springs	19730601	7000	Rock Springs	19730617	D&A	
13	24	N	102	W	sw ne	2590	fnl	2583	fel	WOODS PETROLEUM CORP	FREIGHTER GAP UNIT/FIELD	1	7610	KB	FREIGHTER GAP	Morrison	19810301	14623	Morrison	19810615	O&G	
14	24	N	102	W	sw ne	2691	fsl	2540	fel	WOODS PETROLEUM CORP	FREIGHTER GAP UNIT/FIELD	2	7340	KB	WILDCAT	Morrison	19810725	14130	Morrison	19840929	P&A	
27	24	N	102	W	se ne	2130	fnl	660	fel	SAN JACINTO PETR CORP	MONUMENT RIDGE UNIT	1	7465	KB	WILDCAT	Baxter	19630613	7507	Blair	19630708	D&A	
34	24	N	102	W	ne sw	1674	fsl	2136	fwl	WOODS PETROLEUM CORP	STEAMBOAT MOUNTAIN UNIT/FIELD	3	?	KB	WILDCAT	Morrison	19790803	13004	Morrison	19791129	P&A	
2	24	N	103	W	ne nw	626	fsl	1979	fwl	SHELL OIL CO	PLUNGE UNIT	21-2	7036	KB	WILDCAT	Ericson	19600301	5021	Ericson	19600316	D&A	
4	24	N	103	W	se nw	1169	fnl	1318	fwl	WOLD JOHN S	INDIAN GAP UNIT	1	7081	DF	WILDCAT	Mesaverde	19570625	4011	Mesaverde	19570711	D&A	
8	24	N	103	W	se nw	1325	fsl	1564	fwl	ENRON OIL & GAS CO	ESSEX MOUNTAIN FIELD	1-8	7298	KB	WILDCAT	Morrison	19910829	12281	Morrison	19920107	GAS	
10	24	N	103	W	se nw	2310	fsl	2100	fwl	WOODS PETROLEUM CORP	RIM ROCK UNIT/FIELD	1	7171	KB	RIM ROCK	Morrison	19800227	12657	Morrison	19801009	GAS	
16	24	N	103	W	sw ne	2695	fsl	2589	fel	MONCRIEF W A JR	RIM ROCK UNIT/FIELD	2	7278	KB	WILDCAT	Morrison	19870817	12230	Morrison	19871103	O&G	
20	24	N	103	W	se nw	1880	fnl	1973	fwl	MCBRIDE W C INC	NITCHIE GULCH FIELD	1	7227	KB	WILDCAT	Morrison	19670608	11421	Morrison	19670814	D&A	
21	24	N	103	W	se nw	2042	fsl	2514	fwl	WOODS PETROLEUM CORP	NITCHIE GULCH FIELD	21-1	7443	KB	NITCHIE GULCH	Morrison	19811019	12042	Morrison	19820127	GAS	
31	24	N	103	W	ne sw	2310	fsl	2310	fwl	TERRA RESOURCES INC	NITCHIE GULCH FIELD	30-31	6985	KB	NITCHIE GULCH	Morrison	19870517	9518	Morrison	19870803	GAS	
31	24	N	103	W	nw nw	475	fsl	709	fwl	TERRA RESOURCES INC	NITCHIE GULCH FIELD	10-31	7056	KB	NITCHIE GULCH	Morrison	19871229	9872	Morrison	19880302	GAS	
31	24	N	103	W	se se	750	fsl	1030	fel	TERRA RESOURCES INC	NITCHIE GULCH FIELD	40-31	7019	KB	NITCHIE GULCH	Morrison	19880410	9430	Morrison	19880505	P&A	
31	24	N	103	W	ne sw	1980	fsl	1420	fwl	PACIFIC ENT OIL CO USA	NITCHIE GULCH FIELD	30-31F	6968	KB	NITCHIE GULCH	Frontier	19890712	8435	Frontier	19900504	GAS	
32	24	N	103	W	ne nw	1296	fsl	1508	fwl	TERRA RESOURCES INC	NITCHIE GULCH FIELD	10-32	7065	KB	NITCHIE GULCH	Morrison	19880203	10038	Morrison	19880412	GAS	
32	24	N	103	W	c se	1320	fsl	1320	fel	ELF AQUITAINE PETR INC	NITCHIE GULCH FIELD	33-32	7098	KB	NITCHIE GULCH	Morrison	19780527	10051	Morrison	19810917	P&A	

**TABLE 3-6
WELLS DRILLED IN THE JMH**

SEC.	TWN.	DIR.	RNG.	DIR.	QTR/QTR	FOOTAGE	DIR.	FOOTAGE	DIR.	OPERATOR	UNIT/FIELD NAME	WELL NO.	SURF. ELEV.	ELEV. TYPE	FIELD	DEEPEST FORMATION	SPUD DATE	TOTAL DEPTH	DEEPEST FORMATION	COMPL. DATE	COMP. STATUS
32	24	N	103	W	se sw	520	fsl	2035	fwl	MCBRIDE W C INC	NITCHIE GULCH FIELD	1-32	7141	KB	NITCHIE GULCH	3rd Dakota	19680520	9732	Dakota	19680623	D&A
33	24	N	103	W	c sw	1320	fsl	1320	fwl	AQUITAINE OIL CORP	NITCHIE GULCH FIELD	13-33	7215	KB	NITCHIE GULCH	lwr Dakota	19771201	10465	Dakota	19780323	GAS
34	24	N	103	W	c sw	1320	fsl	1320	fwl	ELF AQUITAINE PETR INC	NITCHIE GULCH FIELD	13-34	7367	KB	NITCHIE GULCH	stray ss	19780125	11075	Dakota	19781007	GAS
1	24	N	104	W	se ne	1495	fml	1270	fel	BROWN H L JR		1-1	7605	KB	WILDCAT	Lewis sh	19831028	8104		19840701	P&A
24	24	N	104	W	se se	848	fsl	848	fel	HOUSTON OIL & MIN CORP	ESSEX MOUNTAIN UNIT/FIELD	44-24	7056	GR	ESSEX MOUNTAIN	Morrison	19800628	10700	Morrison	19801210	GAS
24	24	N	104	W	sw se	490	fsl	1520	fel	KIRBY ROYALTIES INC		1	7043	KB	WILDCAT	Baxter	19631030	5500	Baxter	19631114	D&A
25	24	N	104	W	se se	1229	fsl	1180	fel	TERRA RESOURCES INC	NITCHIE GULCH FIELD	40-25	7046	KB	NITCHIE GULCH	Morrison	19880611	10049	Morrison	19880926	GAS
35	24	N	104	W	nw se	2180	fsl	2020	fel	FLORIDA EXPL CO	NITCHIE GULCH FIELD	1-35	7019	KB	NITCHIE GULCH	Mowry	19801031	10100	Dakota	19810325	O&G
36	24	N	104	W	sw ne	1979	fml	2170	fel	PERTO PACIFIC RESOURCES INC.	NITCHIE GULCH FIELD	1	7035	KB	WILDCAT	Almond	19821019	752	Almond	19821025	P&A
36	24	N	104	W	c se	1320	fsl	1320	fel	TERRA RESOURCES INC	NITCHIE GULCH FIELD	40-36	7056	KB	NITCHIE GULCH	Morrison	19870612	9500	Morrison	19870727	GAS
36	24	N	104	W	se ne	1478	fml	1156	fel	TERRA RESOURCES INC	NITCHIE GULCH FIELD	20-36	6985	KB	NITCHIE GULCH	Morrison	19870821	9650	Morrison	19871106	GAS
36	24	N	104	W	se sw	1319	fsl	1475	fwl	TERRA RESOURCES INC	NITCHIE GULCH FIELD	30-36	7085	KB	NITCHIE GULCH	Morrison	19880309	9700	Morrison	19880425	GAS
36	24	N	104	W	sw ne	1980	fml	1980	fel	ROCK HILL INDUSTRIES INC	NITCHIE GULCH FIELD	36-1	7026	KB	WILDCAT	Almond	19690318	878	Almond	19690327	P&A
22	24	N	105	W	se nw	3300	fsl	3300	fel	DAVIS OIL CO		1-2	6880	KB	WILDCAT		19701229	7997	Ericson	19710111	D&A
20	25	N	99	W	ne sw	2761	fml	2352	fwl	WOODS PETROLEUM CORP	LOST VALLEY UNIT	3	6944	KB	WILDCAT	Baxter	19791022	13738	Baxter	19791209	P&A
20	25	N	99	W	ne sw	2761	fml	2352	fwl	MONCRIEF W A JR	LOST VALLEY UNIT	3	6944	KB	LOST VALLEY	Muddy	19821119	18723	Muddy	19830424	P&A
10	25	N	100	W	se ne	1370	fml	50	fel	WOODS PETROLEUM CORP	CITATION UNIT	1	7013	KB	WILDCAT	Lewis	19820225	11000		19820413	P&A
19	25	N	100	W	sw sw	1257	fsl	1230	fwl	WOODS PETROLEUM CORP	CENTURION UNIT	1	7488	KB	WILDCAT	Almond	19810430	8613	Almond	19810603	P&A
26	25	N	100	W	nw ne	660	fml	1980	fel	SOHIO OIL CO		2	7037	KB	WILDCAT	Ericson	19710105	9250	Ericson	19710202	P&A
27	25	N	101	W	se nw	1980	fml	660	fel	HUMBLE OIL & REFG CO	PARNELL CREEK UNIT	1	7531	GR	WILDCAT	Ericson	19611013	8500	Ericson	19611126	D&A
30	25	N	101	W	sw ne	3563	fsl	1497	fel	DAVIS OIL CO	PIRATE UNIT	1	7339	KB	WILDCAT	Morrison	19801126	15590	Morrison	19810226	P&A
3	25	N	102	W	sw nw	1780	fml	660	fwl	PAN AMERICAN PETR CORP		1	7451	KB	WILDCAT	Lance	19630927	5220	Lance	19640817	D&A
7	25	N	102	W	ne sw	1328	fsl	1786	fwl	SAXON EXPL CO	UNNAMED FIELD	7-11	7628	KB	WILDCAT	Mesaverde	19900917	6955	Mesaverde	19901111	METH
7	25	N	102	W	ne sw	1990	fsl	1984	fwl	H S RESOURCES INC	BIG BEAR UNIT/UNNAMED FIELD	11-7	7643	GR	WILDCAT	Morrison	19950606	15990	Morrison	19960107	OIL
9	25	N	102	W	sw nw	1980	fml	660	fwl	PAN AMERICAN PETR CORP		1	7372	KB	WILDCAT	Lance	19640724	4901	Lance	19640801	D&A
17	25	N	102	W	sw nw	1980	fml	660	fwl	ATLANTIC REFG CO	PLUNGE UNIT	2	7501	KB	WILDCAT	Mesaverde	19610615	9803	Blair	19610823	D&A
26	25	N	102	W	se nw	1593	fml	1604	fwl	SKELLY OIL CO		1	7229	DF	WILDCAT	Mesaverde	19581015	6998	Ericson	19581103	D&A
9	25	N	103	W	sw se	1307	fsl	1323	fel	KERR MCGEE OIL IND INC	MORROW CREEK UNIT	1	7485	KB	WILDCAT	Lewis	19590915	7050	Lewis	19591019	P&A
13	25	N	103	W	ne ne	750	fml	660	fel	FREEPORT MINERALS CO		1-13	7506	GL	WILDCAT	Lance	19760629	9868	Blair	19760828	P&A
23	25	N	103	W	sw se	532	fsl	1323	fel	SAXON EXPL CO		23-15	7606	GR	WILDCAT	Mesaverde	19901011	5955	Almond	19910724	P&A
24	25	N	103	W	nw se	2000	fsl	2840	fwl	WOODS PETROLEUM CORP	PACKSADDLE UNIT	1	7662	KB	WILDCAT	Morrison	19790421	14850		19790705	P&A
29	25	N	103	W	nw ne	660	fml	1980	fel	EL PASO NATURAL GAS CO	MORROW CREEK UNIT	1	7153	KB	WILDCAT	Baxter	19540830	9598	Baxter	19541228	D&A
9	26	N	98	W	se nw	1980	fml	1980	fwl	DAVIS OIL CO	SCOTTY LAKE UNIT	1	7086	KB	WILDCAT	Lance	19790619	13150	Rock Springs	19790828	P&A
10	26	N	100	W	sw sw	400	fsl	400	fwl	WOODS PETROLEUM CORP	HOURGLASS UNIT	10-1	7247	KB	WILDCAT	Baxter	19800722	15300	Baxter	19801027	P&A
16	26	N	100	W	nw ne	1285	fml	1356	fel	MONCRIEF W A JR	SANDS OF TIME UNIT	1	7202	KB	WILDCAT	Rock Springs	19830303	11978	Rock Springs	19830518	P&A
25	26	N	100	W	n/2 ne	1320	fml	3933	fwl	DAVIS OIL CO		1	7067	KB	WILDCAT	Rock Springs	19770220	11564	Rock Springs	19770408	P&A
8	26	N	101	W	sw sw	807	fsl	763	fwl	DAVIS OIL CO	MUSKETEER UNIT	1	7543	KB	WILDCAT	Morrison	19810627	19569	Morrison	19820321	P&A
23	26	N	102	W	sw se	810	fsl	1980	fel	DAVIS OIL CO	BUCCANEER UNIT/FIELD	1	7346	KB	BUCCANEER	Dakota	19801231	17844	Dakota	19811114	GAS
30	26	N	102	W	sw sw	660	fsl	660	fwl	GULF OIL CORP	MORROW CREEK UNIT	1	7214	GR	WILDCAT	Lance/Lewis	19661109	8212	Ericson	19670116	D&A
34	26	N	102	W	se se	660	fsl	786	fwl	GULF OIL CORP	MORROW CREEK UNIT	2	7301	GR	WILDCAT	Ericson	19670603	8500	Ericson	19670715	D&A
3	26	N	103	W	n/2 n/2	1000	fml	2640	fwl	RAINBOW RESOURCES INC	GREATER PACIFIC CREEK UNIT	1-3	6970	GR	PACIFIC CREEK	Ericson	19791022	15000		19800623	P&A
25	26	N	103	W	sw ne	1980	fml	1880	fel	WOODS PETROLEUM CORP	ROCK CABIN UNIT	1	7258	KB	WILDCAT	Morrison	19800815	18777	Morrison	19810926	P&A

**TABLE 3-7
AREAS WITH COAL DEVELOPMENT RESTRICTIONS**

Area	Open/Closed To Exploration	Mining Activity Restriction
Crookston Ranch	Closed	Closed to surface mining of coal and to placement of related surface facilities.
Boars Tusk	Closed	Open to subsurface mining methods only-any activities or ancillary facilities related to subsurface mining are prohibited. Closed to surface mining of coal and to placement of related surface facilities.
Eastern Greater Sand Dunes	Open	Open to subsurface mining methods with placement of surface facilities extremely limited. Closed to surface mining methods and related surface facilities and activities.
Native American Burials and other Sacred Sites	Closed	Open to subsurface mining methods only-surface activities and ancillary facilities related to subsurface mining will avoid burial sites.
Oregon Buttes ACEC	Closed	Closed to surface disturbing activities that could adversely affect the resource values in the area. (ACEC is outside the Coal Occurrence and Development Potential area.)
Raptor Nesting	Closed	Avoid nesting sites. If not possible, implement intensive mitigation.
Grouse Leks	Closed	Avoid nesting sites. If not possible, implement intensive mitigation.
Steamboat Mountain	Deferred until completion of the JMHCAP	Open to subsurface mining methods only-location of surface facilities relating to subsurface mining will be considered on a case-by-case basis.
Special Status Pant Species Sites	Closed	Sites are outside the Coal Occurrence and Development Potential area.
South Pass Historic Landscape	Closed	ACEC is outside the Coal Occurrence and Development Potential area.

Area	Open/Closed To Exploration	Mining Activity Restriction
Tri-Territory Marker	Closed	Open to subsurface mining methods only-location of surface facilities relating to subsurface mining will be considered on a case-by-case basis.
Floodplains	Closed	Unsuitable

**TABLE 3-8
AREAS CLOSED TO COAL EXPLORATION AND SODIUM PROSPECTING¹**

Areas Closed	Estimated Acres
Boars Tusk	90
Crookston Ranch	40
Floodplains ²	41,170
Oregon Buttes ACEC	3,450
Petroglyphs: White Mountain (1/2 mile vista)	480
Raptor Nesting	83
Sage Grouse Leks (1/4 mile buffer)	8,170
South Pass Historic Landscape	23,640
Special Status Plant Species Sites	2,680
Steamboat Mountain Area (outside area w/coal recommendation)	33,530
Tri-Territory Marker	10
Wilderness Study Areas	117,060
Estimated Total³	218,420

¹ Established in the Green River RMP (USDI 1997).

² Floodplains, wetlands, and riparian areas (within 500 feet of 100-year floodplains and waters).

³ Acres do not add due to overlap of Oregon Buttes ACEC, floodplains, special status plant species, and WSAs. There are about 11,983 acres of overlap.

**TABLE 3-9
ORV DESIGNATIONS**

Area	Designation	Approximate Acres	Season/Dates of Restriction and Reason for Restriction
Big Game Winter Ranges	Limited through seasonal closures (11/15 - 4/30 as needed)	245,900	To reduce stress to wintering animals. Closure to over-the-snow vehicles would be evaluated on a case-by-case basis in conjunction with the Wyoming Game & Fish Department.
Crookston Ranch	Closed	40	To protect historic site.
Deer Parturition Areas	Limited through seasonal closures (May 1 to June 30 as needed)	23,100	To reduce stress to deer.
Elk Calving Areas	Limited through seasonal closures (to be decided by biologist - May 1 to June 30 as needed)	58,890	To reduce stress to elk.
General JMH Area	Limited to existing roads and trails	287,180	To reduce resource damage.
Greater Sand Dunes ACEC (Eastern Portion)	Open	10,500	Area designated open on active sand dunes to allow the recreating public a place to play in the sand dunes.
	Limited to existing roads and trails	5,810	Limited to protect resource values.
	Closed	90	Closed around Boars Tusk to protect geologic values.
Oregon Buttes ACEC	Closed	3,450	All of the ACEC is closed to vehicle traffic to protect adjacent WSA values.
Raptor Nesting Areas	Limited through seasonal closures (2/1 through 7/31)	83	To protect nesting raptors.
Red Desert	Limited to designated roads and trails	169,010	Limited to protect scenic resource values.

Area	Designation	Approximate Acres	Season/Dates of Restriction and Reason for Restriction
Riparian Areas	Limited to existing roads and trails	41,170	To protect riparian and watershed values. During muddy conditions vehicle travel will be limited to existing roads and trails to protect soil and watershed values.
South Pass (Vista)	Limited to designated roads and trails	23,640	Limited to protect cultural resource values.
Special Status Plant Species	Closed	2,680	Closed yearlong to protect plant populations. (Does not apply to over-the-snow vehicles.)
Steamboat Mountain ACEC	Limited to designated roads and trails. Seasonal closures to be determined.	43,310	To protect wildlife values.
White Mountain Petroglyphs ACEC	Closed	20	Closed to maintain integrity of setting and protect cultural values. Vehicle travel limited to parking area. All other acreage is closed to vehicle travel.
	Limited to designated roads and trails	480	Limited within ½ mile radius.
Wilderness Study Areas	Closed	117,060	To protect naturalness, solitude, and opportunities for unconfined recreation.

NOTE: WSAs are closed to non-motorized mechanical transport, as well as motorized transport.

**TABLE 3-10
RECREATION OPPORTUNITY SPECTRUM CLASS DESCRIPTIONS**

Opportunity Class	Experience Opportunity	Setting Opportunity	Activity Opportunity
Primitive	Opportunity for isolation from the sights and sounds of humans, to feel a part of the natural environment, to have a high degree of challenge and risk, and to use outdoor skills.	Area is characterized by essentially unmodified natural environment of fairly large size. Concentration of 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. Only facilities essential for resource protection are used. No facilities for comfort or convenience of the user are provided. Spacing of groups is informal and dispersed to minimize contacts between groups. Motorized use within the area is not permitted.	Camping, hiking, climbing, enjoying scenery or natural features, nature study, photography, spelunking, hunting (big game, small game, upland birds, waterfowl), ski touring and snowshoeing, swimming, diving (skin and scuba), fishing, canoeing, sailing, and river running (non-motorized craft).
Semi-Primitive Nonmotorized	Some opportunity for isolation from the sights and sounds of humans, but not as important as for primitive opportunities. Opportunity to have high degree of interaction with the natural environment, to have moderate challenge and risk, and to use outdoor skills.	Area is characterized by a predominantly unmodified natural environment of moderate to large size. Concentration of users is low, but there is often evidence of other area users. On-site controls and restrictions may be present, but are subtle. Facilities are provided for the protection of resource values and the safety of users only. Spacing of groups may be formalized to disperse use and limit contacts between groups. Motorized use is not permitted.	Camping, hiking, climbing, enjoying scenery or natural features, nature study, photography, spelunking, hunting (big game, small game, upland birds, waterfowl), ski touring and snowshoeing, swimming, diving (skin and scuba), fishing, canoeing, sailing, and river running (non-motorized craft).

Opportunity Class	Experience Opportunity	Setting Opportunity	Activity Opportunity
Semi-Primitive Motorized	Same opportunity for isolation from the sights and sounds of humans, but not as important as for primitive opportunities. Opportunity to have high degree of interaction with the natural environment, to have moderate challenge and risk, and to use outdoor skills. Explicit opportunity to use motorized equipment while in the area.	Area is characterized by a predominantly unmodified natural environment of moderate to large size. Concentration of users is low, but there is often evidence of other area users. On-site controls and restrictions may be present, but are subtle. Facilities are provided for the protection of resource values and safety of users only. Spacing of groups may be formalized to disperse use and limit contacts between groups. Motorized use is permitted.	Same as the above, plus the following: ORV use (4-WD, dune buggy, dirt bike, snowmobile, power boating).
Roaded Natural	About equal opportunities for affiliation with other user groups and for isolation from sights and sounds of humans. Opportunity to have a high degree of interaction with the natural environment. Challenge and risk opportunity are not very important except in specific challenging activities. Practice of outdoor skills may be important. Opportunities for both motorized and nonmotorized recreation are present.	Area is characterized by a generally natural environment with moderate evidence of the sights and sounds of humans. Resource modification and utilization practices are evident, but harmonize with the natural environment. Concentration of users is low to moderate with facilities sometimes provided for group activity. On-site controls and restrictions offer a sense of security. Rustic facilities are provided for user convenience as well as for safety and resource protection. Conventional motorized use is provided for in construction standards and design of facilities.	All activities listed previously plus the following: picnicking, rock collecting, wood gathering, auto touring, downhill skiing, snowplay, ice skating, waterskiing and other water sports, hang gliding, interpretive use, rustic resorts, and organized camps.

Opportunity Class	Experience Opportunity	Setting Opportunity	Activity Opportunity
Rural	<p>Opportunities to experience affiliation with individuals and groups are prevalent as is the convenience of sites and opportunities. These factors are generally more important than the natural setting. Opportunities for wildland challenges, risk taking, and testing of outdoor skills are unimportant, except in those activities involving challenge and risk.</p>	<p>Area is characterized by substantially modified natural environment. Resource modification and utilization practices are obvious. Sights and sounds of humans are readily evident, and the concentration of 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 specific activities. Developed sites, roads and trails, are designed for moderate to high use. Moderate densities are provided far away from developed sites. Facilities for intensive motorized use are available.</p>	<p>All activities listed previously plus the following competitive games, spectator sports, bicycling, jogging, outdoor concerts, and modern resorts.</p>
Modern Urban	<p>Opportunities to experience affiliation with individuals and groups are prevalent as is the convenience of sites and opportunities. Experiencing the natural environment, and the use of outdoor skills are largely unimportant.</p>	<p>Area is characterized by a highly modified environment, although the background may have natural elements. Vegetation is often exotic and manicured. Soil may be protected by surfacing. Sights and sounds of humans, on-site, predominate. Large numbers of users can be expected. Modern facilities are provided for the use and convenience of large numbers of people. Controls and restrictions are obvious and numerous. Facilities for high intensity motor use and parking are present with forms of mass transit often available.</p>	<p>All activities listed previously.</p>

**TABLE 3-11
POPULATION OF SWEETWATER COUNTY**

Past		Future	
Year	Population	Year	Population
1987	42,118	1997	39,738-41,790
1988	40,080	1998	39,689-40,450
1989	39,246	1999	40,550-41,435
1990	38,823	2000	40,660-41,721
1991	39,778	2001	40,760-41,721
1992	39,796	2002	40,860-42,260
1993	40,387	2003	40,950
1994	40,611	2004	41,040
1995	40,687-40,976	2005	41,130
1996	40,738-41,570	2006	41,300

Sources: Equality State Almanac, U.S. Bureau of Census, Wyoming Department of Administration and Information, Division of Economic Analysis, and Sweetwater Economic Development Association.

**TABLE 3-12
POPULATION OF FREMONT COUNTY**

Past		Future	
Year	Population	Year	Population
1987	34,844	1997	36,200
1988	34,388	1998	36,500
1989	34,192	1999	36,820
1990	33,662	2000	37,140
1991	34,114	2001	37,460
1992	34,283	2002	37,780
1993	34,753	2003	38,100
1994	35,129	2004	38,420
1995	35,680	2005	38,750
1996	35,940	2006	39,150

Source: Equality State Almanac, U.S. Bureau of Census, Wyoming Department of Administration and Information, Division of Economic Analysis.

**TABLE 3-13
POPULATION OF SUBLETTE COUNTY**

Past		Future	
Year	Population	Year	Population
1987	5,358	1997	5,640
1988	4,859	1998	5,710
1989	4,714	1999	5,780
1990	4,843	2000	5,850
1991	4,960	2001	5,930
1992	5,018	2002	6,000
1993	5,179	2003	6,080
1994	5,402	2004	6,150
1995	5,510	2005	6,230
1996	5,577	2006	6,320

Sources: Equality State Almanac, U.S. Bureau of Census, Wyoming Department of Administration and Information, Division of Economic Analysis.

**TABLE 3-14
SWEETWATER COUNTY TOTAL EMPLOYMENT and INCOME**

	1991	1992	1993	1994	1995
Total Employed	23,802	24,295	24,310	25,338	24,988
Total Personal Income (\$000s)	\$729,398	\$766,512	\$797,549	\$848,721	\$871,472
Per Capita Income	\$ 18,328	\$ 18,979	\$ 19,693	\$ 20,860	\$ 21,392

Sources: Equality State Almanac, U.S. Bureau of Census, Wyoming Department of Administration and Information, Division of Economic Analysis. Residence Adjusted.

**TABLE 3-15
TOTAL EMPLOYMENT BY SECTOR, SWEETWATER COUNTY**

Employment Sector*	1991	1992	1993	1994	1995
Mining Sector	5,341	5,419	5,241	5,383	5,121
Service Sector	3,977	4,240	4,264	4,496	4,539
Retail Sector	3,905	3,941	3,980	4,137	4,191
Transportation (TCP) Sector	1,964	1,937	1,973	1,994	2,033
Construction Sector	1,460	1,712	1,851	2,128	1,884
FIRE Sector	1,282	1,101	1,232	1,340	1,337

Employment Sector*	1991	1992	1993	1994	1995
Wholesale Sector	650	674	610	663	723
Manufacturing Sector	733	772	737	746	712
Agricultural Service Sector	92	81	102	127	128
Farm Sector	207	199	199	196	200
Private Sector Total	19,611	20,076	20,189	21,210	20,868
Government (all levels)	4,191	4,219	4,121	4,128	4,120
Total Employment	23,802	24,295	24,310	25,338	24,988

Source: Equality State Almanac, U.S. Bureau of Census, Wyoming Department of Administration and Information, Division of Economic Analysis.

* Total employment, includes covered and non-covered by employment insurance. TCPU Sector includes Transportation, Communication, and Public Utilities. Fire includes Finance, Insurance, and Real Estate.

TABLE 3-16
TOTAL INDUSTRY EARNINGS, SWEETWATER COUNTY
(\$000s)

Industry	1991	1992	1993	1994	1995
Mining Sector	\$274,400	\$286,837	\$294,982	\$302,539	\$311,947
Service Sector	61,649	66,198	66,698	72,869	77,018
Retail Sector	47,274	50,848	53,558	56,408	57,989
Transportation (TCPU) Sector	78,396	82,657	86,599	88,439	89,816
Construction Sector	40,973	50,378	57,602	71,715	60,727
FIRE Sector	10,072	11,497	13,426	14,346	15,405
Wholesale Sector	17,381	18,342	17,402	18,921	20,197
Manufacturing Sector	27,964	29,644	30,646	31,835	30,383
Agricultural Service Sector	697	852	960	1,169	1,224
Farm Sector	2,111	2,846	4,122	1,153	577
Government Sector	94,670	97,695	101,059	103,951	105,879
Total	\$655,587	\$697,794	\$726,872	\$763,345	\$771,162

Sources: Equality State Almanac, U.S. Bureau of Census, Wyoming Department of Administration and Information, Division of Economic Analysis.

TABLE 3-17
FREMONT COUNTY TOTAL EMPLOYMENT AND INCOME
PER CAPITA INCOME

	1991	1992	1993	1994	1995
Total Employed	17,432	17,955	18,222	18,993	19,426
Total Personal Income (\$000s)	\$488,986	\$507,704	\$536,141	\$564,200	\$597,623
Per capita Income	14,334	14,809	15,427	16,061	16,750

Sources: Equality State Almanac, U.S. Bureau of Census, Wyoming Department of Administration and Information, Division of Economic Analysis.

**TABLE 3-18
TOTAL EMPLOYMENT BY SECTOR, FREMONT COUNTY**

Total Employment*	1991	1992	1993	1994	1995
Service Sector	4,399	4,572	4,732	5,000	5,113
Retail	3,148	3,275	3,203	3,387	3,538
Construction	942	992	1,176	1,337	1,475
Farm	1,130	1,149	1,152	1,132	1,163
Manufacturing	814	880	886	935	965
FIRE	862	875	898	950	935
Transportation	762	760	809	803	773
Mining	594	514	579	587	614
Wholesale	356	346	341	381	393
Agricultural Service	230	264	297	277	298
Private Sector Total	13,237	13,670	14,073	14,789	15,267
Government (all levels)	4,195	4,328	4,149	4,204	4,159
Total Employment	17,432	17,955	18,222	18,993	19,426

Sources: Equality State Almanac, U.S. Bureau of Census, Wyoming Department of Administration and Information, Division of Economic Analysis. * total employment, include covered and non-covered by employment insurance.

**TABLE 3-19
TOTAL INDUSTRY EARNINGS, FREMONT COUNTY
(\$000s)**

Industry Earnings	1991	1992	1993	1994	1995
Service Sector	\$64,515	\$69,845	\$74,537	\$81,749	\$85,482
Retail Sector	35,693	38,244	39,096	42,671	45,148
Construction Sector	19,778	21,819	25,831	30,418	33,355
Farm Sector	18,214	16,663	19,211	5,844	7,939
Manufacturing Sector	12,403	14,443	13,950	15,046	16,078
FIRE Sector	6,044	6,992	8,152	8,744	9,249
Transportation (TCPU) Sector	22,808	23,689	25,044	25,431	25,018
Mining Sector	22,297	18,026	19,819	21,423	22,587
Wholesale Sector	8,102	7,646	7,937	9,417	10,482
Agricultural Service Sector	1,730	2,285	2,778	2,696	2,872
Government (all levels)	90,316	93,861	93,965	96,556	100,088
Total	\$301,900	\$313,513	\$330,320	\$339,995	\$358,298

Sources: Equality State Almanac, U.S. Bureau of Census, Wyoming Department of Administration and Information, Division of Economic Analysis.

**TABLE 3-20
SUBLETTE COUNTY TOTAL EMPLOYMENT AND INCOME
PER CAPITA INCOME**

	1991	1992	1993	1994	1995
Total Employed	3,276	3,295	3,385	3,547	3,537
Total Personal Income (\$000s)	\$94,378	\$94,955	\$107,969	\$108,821	\$111,417
Per capita Income	\$19,028	\$18,923	\$20,847	\$20,145	\$20,221

Sources: Equality State Almanac, U.S. Bureau of Census, Wyoming Department of Administration and Information, Division of Economic Analysis.

**TABLE 3-21
TOTAL EMPLOYMENT BY SECTOR, SUBLETTE COUNTY**

Total Employment	1991	1992	1993	1994	1995
Service Sector	630	669	664	669	691
Retail Trade Sector	467	480	517	534	551
Farm Sector	389	394	398	390	410
Construction Sector	301	324	314	361	366
Mining Sector	340	286	326	387	317
FIRE Sector	218	205	204	210	211
Transportation (TCPU) Sector	134	110	132	134	131
Manufacturing Sector	NA	75	77	87	94
Agricultural Services Sector	89	82	92	89	90
Wholesale Trade Sector	NA	71	57	59	50
Total Private Sector	2,718	2,696	2,781	2,920	2,911
Government (all levels)	558	599	604	627	626
Total Employment	3,276	3,295	3,385	3,547	3,537

Sources: Equality State Almanac, U.S. Bureau of Census, Wyoming Department of Administration and Information, Division of Economic Analysis. * total employment, include covered and non-covered by employment insurance.

**TABLE 3-22
TOTAL INDUSTRY EARNINGS, SUBLETTE COUNTY
(\$000s)**

Industry Earnings	1991	1992	1993	1994	1995
Service Sector	\$8,194	\$8,530	\$9,060	\$9,538	\$10,625
Retail Trade Sector	4,618	4,997	5,729	6,111	6,601
Farm Sector	7,917	5,461	13,084	6,062	4,820
Construction Sector	6,183	6,625	6,149	7,554	7,620
Mining Sector	11,601	10,354	11,780	14,605	12,632
FIRE Sector	1,061	1,214	1,490	1,727	2,036
Transportation (TCPU) Sector	3,492	3,083	3,859	3,938	3,763
Manufacturing Sector	NA	724	601	915	644
Agricultural Services Sector	665	744	863	848	884
Wholesale Trade Sector	NA	950	921	982	711
Government (all levels)	11,298	12,971	13,640	14,286	14868
Total	\$57,025	\$55,473	\$66,996	\$66,566	\$65,204

Sources: Equality State Almanac, U.S. Bureau of Census, Wyoming Department of Administration and Information, Division of Economic Analysis.

**TABLE 3-23
SALES AND USE TAX COLLECTIONS, SWEETWATER COUNTY**

Economic Sector	Sales Tax Collections	Use Tax Collection
Agriculture Sectors*	\$29,598	\$2,628
Mining	4,494,113	4,258,872
Construction	738,823	500,258
Manufacturing	1,470,678	662,336
Transportation (TCPU)	2,604,424	507,304
Wholesale Trade	3,023,324	**141,891
Retail Trade	12,407,080	
FIRE	30,947	8,340
Service	3,893,058	37,100
Government (county)	2,821,530	763,373
Total	\$31,513,530	\$6,882,102

*includes farm and agricultural Service Sectors.

** Use taxes for wholesale trade and retail trade combined.

Source: The Equality State Almanac, 1997

**TABLE 3-24
SALES AND USE TAX COLLECTIONS, FREMONT COUNTY**

Economic Sector	Sales Tax Collections	Use Tax Collection
Agriculture Sectors*	\$51,126	\$12,900
Mining	318,712	63,923
Construction	274,501	331,573
Manufacturing	512,052	69,333
Transportation (TCPU)	1,506,310	55,247
Wholesale Trade	829,635	**117,782
Retail Trade	8,634,942	
FIRE	46,922	1,900
Service	1,349,060	52,264
Government (county)	2,165,477	332,410
Total	\$15,688,739	\$982,085

* includes farm and agricultural Service Sectors.

** Use taxes for wholesale trade and retail trade combined.

Source: The Equality State Almanac, 1997

**TABLE 3-25
SALES AND USE TAX COLLECTIONS, SUBLETTE COUNTY**

Economic Sector	Sales Tax Collections	Use Tax Collection
Agriculture Sectors*	\$9,991	\$9,382
Mining	577,186	79,763
Construction	70,587	14,369
Manufacturing	75,705	770
Transportation (TCPU)	307,127	20,079
Wholesale Trade	206,160	**13,070
Retail Trade	1,280,720	
FIRE	3,000	42
Service	395,842	1,230
Government (county ??)	359,070	118,393
Total	\$3,285,389	\$257,098

* includes farm and agricultural Service Sectors.
 ** Use taxes for wholesale trade and retail trade combined.
 Source: The Equality State Almanac, 1997

**TABLE 3-26
PHYSICAL OUTPUTS FOR THE 1998 BASE YEAR**

Sector	Units
Oil and Gas Wells Drilled	3
Oil and Gas Wells Completed	2
Oil Production (BBLs)	5,616
Gas Production (MMCF)	4,060.8
Livestock Grazing (AUM)	13,038
Nonresident Hunting Days	952
Resident Hunting Days	3,576
Non-resident Non-consumptive Recreation Days	31,950
Resident Non-consumptive Recreation Days	16,750

**TABLE 3-27
DIRECT ECONOMIC IMPACT FOR 1998 BASE YEAR**

Oil and Gas	\$8,603,640	78.2 percent
Livestock Grazing	\$422,833	3.8 percent
Nonresident Hunting	\$220,561	2.0 percent
Nonresident Non- consumptive	\$1,757,250	16.0 percent
Total Jack Morrow Hills	\$11,004,284	100.0 percent

**TABLE 3-28
TOTAL ECONOMIC IMPACT FOR 1998 BASE YEAR**

Oil and Gas	\$11,654,180	75.9 percent
Livestock Grazing	\$823,349	5.4 percent
Nonresident Hunting	\$304,049	2.0 percent
Nonresident Non- consumptive	\$2,580,921	16.8 percent
Total Jack Morrow Hills	\$15,362,499	100.0 percent

**TABLE 3-29
TOTAL LABOR EARNINGS FOR 1998 BASE YEAR**

Oil and Gas	\$1,074,640	63.7 percent
Livestock Grazing	\$150,992	8.9 percent
Nonresident Hunting	\$41,676	2.5 percent
Nonresident Non- consumptive	\$420,462	24.9 percent
Total Jack Morrow Hills	\$1,687,770	100.0 percent

**TABLE 3-30
TOTAL EMPLOYMENT IN ANNUAL JOB EQUIVALENTS FOR 1998 BASE YEAR**

Oil and Gas	33.2	42.1 percent
Livestock Grazing	9.2	11.7 percent
Nonresident Hunting	2.9	3.7 percent
Nonresident Nonconsumptive	33.6	42.6 percent
Total Jack Morrow Hills	78.9	100.0 percent

**TABLE 3-31
AVERAGE EARNINGS PER JOB FOR 1998 BASE YEAR**

Oil and Gas	\$32,369	151.3 percent
Livestock Grazing	\$16,443	76.9 percent
Nonresident Hunting	\$14,224	66.5 percent
Nonresident Non-consumptive	\$12,521	58.5 percent
Average Jack Morrow Hills	\$21,391	100.0 percent

**TABLE 3-32
TOTAL LOCAL GOVERNMENT REVENUE FOR 1998 BASE YEAR**

Oil and Gas	\$441,659	86.3 percent
Livestock Grazing	\$24,051	4.7 percent
Nonresident Hunting	\$3,502	0.7 percent
Nonresident Non-consumptive	\$42,501	8.3 percent
Total Jack Morrow Hills	\$511,713	100.0 percent

**TABLE 3-33
NET ECONOMIC VALUE OF RESIDENT RECREATION FOR 1998 BASE YEAR**

Resident Hunting	\$148,261	25.0 percent
Resident Non-consumptive	\$445,047	75.0 percent
Total Jack Morrow Hills	\$593,308	100.0 percent

**TABLE 3-34
PLANT SPECIES OF SPECIAL CONCERN OF THE JACK MORROW HILLS ECOSYSTEM**

Name of Plant	Heritage Rank	WYNDD List	Range	USFWS Status	Other Federal Status
Antennaria arcuata Meadow pussytoes	G2/S2	GR	R	*	SS-BLM
Astragalus nelsonianus Nelson's milkvetch	G3/S2	LD	R		
Carex parryana var. parryana Parry sedge	G4T4/S2	SR	P		
Cryptantha scoparia Desert cryptantha	G3/S1	SR	R		
Eriastrum wilcoxii Wilcox eriastrum	G5/S1S2	SR	P		
Erigeron uintahensis Uintah fleabane (E. speciosus var. uintahensis)	G4/S1	SR	R		
Eriogonum divaricatum Divergent buckwheat	G4G5/S1	SR	P		
Ipomopsis crebrifolia Compact gilia	G3/S2S3	LD	R		
Lesquerella macrocarpa Large-fruited bladderpod	G2/S2	GR	E	*	SS-BLM
Monolepis pusilla Red poverty-weed	G5/S1	SR	P		
*Oryzopsis contracta Contracted Indian ricegrass	G3/S3		R		SS-BLM
Oxytheca dendroidea	G4/SH	SR	P		

Tree-like oxytheca

TABLE 3-34 (continued)

Name of Plant	Heritage Rank	WYNDD List	Range	USFWS Status	Other Federal Status
Penstemon paysoniorum Payson beardtongue	G3/S3		E		
Phacelia demissa Intermountain phacelia	G5/S1	SR	P		
Phacelia salina Nelson phacelia	G3Q/SI	SR	P		
Phacelia scopulina var. scopulina Prostrate phacelia	G4/S1		P		

* Formerly designated as a Category 2(C2) candidate by the U.S. Fish and Wildlife Service. In July, 1995, USFWS revised its candidate system and eliminated the C2 designation. *Oryzopsis contracta* had previously been recommended for downgrading to 3C status by Fertig (1994).

Codes (Fertig 1996b):

Heritage Rank: G = global rank, S=state rank, T=trinomial rank.

WYNDD List; GR=globally rare, LD=limited distribution, SR=state rare

Range; R=regional endemic, E=state endemic, P=peripheral

**TABLE 3-35
JACK MORROW HILLS STREAM PFC SUMMARY**

YEAR	Stream	Reach	RATING (miles)					Total
			PFC	FAR			NF	
				up	n/a	down		
1995	Jack Morrow Creek	All		18.00		2.00		20.00
1995	Rock Cabin Creek	All		12.8		3.20		16.00
1995	Pacific Creek	Segment 1	1.50					1.50
1995	Pacific Creek	Segment 2		1.20				1.20
1995	Pacific Creek	Segment 3				2.00		2.00
1995	Parnell Creek	Segment 1 - upper	2.00					2.00
1995	Parnell Creek	Segment 2 - lower				8.00		8.00
1995	Pacific Creek	Segment 4				11.00		11.00
1997	Sand Creek	All			1.25			1.25
1997	Dickie Springs Creek	All	.50					0.50
1997	Oregon Slough Creek	All	1.00					1.00
1999	Robin Creek (BLM name)	All	1.50					1.50
1999	Oregon Buttes Creek (BLM name)	All	2.50					2.50
1999	Pacific Creek	Project area			4.00			4.00
1999	Bear Creek	All	7.50					7.50
TOTALS			16.50	32.00	5.25	26.20	0.00	79.95
Percentage			20.60	40.00	6.60	32.80		100.00

**TABLE 3-36
WYOMING DEQ TDS GUIDELINES**

Use	Domestic ¹	Agricultural	Livestock
Maximum Concentration ppm ²	500	2,000	5,000

¹ Potability of water is not determined solely by the level of dissolved solids. Additional biological and chemical tests are required.

² ppm = Parts Per Million. Can also be represented as mg/l = milligrams per liter.

**TABLE 3-37
WATERS SUBJECT TO THE COLORADO RIVER SALINITY COMPACT**

Stream	Number of Samples	Average TDS ppm	Suggested Use
Pacific Creek	16	1,071	Agricultural
Jack Morrow Creek	16	3,565	Livestock
Killpecker Creek	21	1,644 ¹	Agricultural
Sweetwater River	14	45	Domestic

¹ The Total Dissolved Solids (TDS) listed for Killpecker Creek is an average that sits towards the high end of the agricultural range. Several samples had TDS levels greater (>)2,000 ppm. Therefore, it is not an ideal agricultural water.

**TABLE 3-38
CREEK INFORMATION SUMMARY**

	PFC'd ¹	WGF	DEQ	Miles		
				Public	State	Private
Pacific Creek Drainage						
Pacific Creek	Y	4	2			
Jack Morrow Creek	Y	5	4	22.5	3.0	0
Parnell Creek	Y	5	4 ²			
Rock Cabin Creek	Y	5	3			
Mowing Machine Draw	Y	5	3 ²			
Alkali Creek (Wash)	N	5	2 ^{2,3}			
White Horse Creek	N	5	2 ^{2,3}			
Sweetwater River Drainage						
Sweetwater River	Y	3	1			
Oregon Slough	N	4	2			

				Miles		
	PFC'd ¹	WGF	DEQ	Public	State	Private
Dickey Springs Creek	N	5	2 ²			
Meadow Creek	N	5	2 ²			
Oregon Gulch	N	5	2 ²	4.0		2.0
Long Slough	N	5	4			
Harris Slough	N	4	2			
Killpecker Drainage						
Killpecker Creek	N	5	4			
Nitchie Creek	N	5	4			
Red Desert	PFC'd ¹	WGF	DEQ			
Alkali Draw	N	5	4			
Bush Creek	N	5	4			
Bear Creek	N	5	4			
Red Creek	N	5	4			
Sand Creek (willows)	N	5	4			
Flockets (Dune ponds)						
Flockets	N	?	?			

¹ Surveyed using the Proper Functioning Condition method as of 1996

² Waters unlisted in Chapter 1 Water Quality Rules & Regulations. Wyoming DEQ 1990

³ Ephemeral channel, May be DEQ class 4

**TABLE 3-39
STREAMS CONTAINING FISH LIFE**

Streams	Fish Life Within
Sweetwater River	Rainbow Trout
	Brown Trout
	Brook Trout
	Yellowstone Cutthroat
	Snake River Cutthroat
	White Sucker
	Longnose Sucker
	Mountain Sucker
	Creek Chub
	Lake Chub
	Longnose Dace
	Fathead Minnow
Harris Slough	Brook Trout
	Brown Trout
Oregon Slough	Brook Trout
	White Sucker
	Longnose Sucker
	Creek Chub
	Lake Chub
Pacific Creek	Brook Trout
	Mountain Sucker
	Flannelmouth Sucker
	White Sucker
Jack Morrow Creek	Unidentified Cyprinid species