CHAPTER 3

AFFECTED ENVIRONMENT

3.0 INTRODUCTION

The Affected Environment chapter of this environmental assessment (EA) for the proposed Anadarko Shallow Gas Development project discusses environmental, social, and economic factors as they currently exist within the Copper Ridge project area (CRPA). The material presented here has been guided by management issues identified by the Bureau of Land Management (BLM), Rock Springs Field Office; public scoping; and by interdisciplinary field analysis of the area.

This proposal could potentially affect critical elements of the human environment as listed in BLM's National Environmental Policy Act (NEPA) Handbook H-1790-1 (USDI-BLM 1988) (Table 3-1). This EA discusses potential effects of the project on range resources, air quality, transportation, geology/minerals/paleontology, soils, water resources, vegetation (including invasive and non-native species) and wetlands, wildlife, special status species, visual resources, noise, recreation, socioeconomics (including environmental justice), cultural resources (including native American religious concerns), and health and safety (including hazardous and solid waste). The resource elements to be analyzed in this EA are summarized in Table 3-2.

Table 3-1. Critical Elements of the Human Environment[1], Copper Ridge Shallow Gas Project Sweetwater County, Wyoming

Element	Status on the Project Area	Addressed in text of EA
Air Quality Issues	Potentially affected	Yes
Areas of critical environmental concern	None present	No
Cultural resources	Potentially affected	Yes
Environmental justice	Potentially affected	Yes
Prime or unique farmlands	None present	No
Floodplains	None present	No
Native American religious concerns	Potentially affected	Yes
Invasive plants	Potentially affected	Yes
Threatened and endangered species	Potentially affected	Yes
Hazardous or solid wastes	None present	No
Water quality (surface water)	Potentially affected	Yes
Wetlands/riparian zones	Potentially affected	Yes
Wild and scenic rivers	None present	No
Wilderness (study area)	None present	No

[1] As listed in BLM *National Environmental Policy Act Handbook H-1790-1* (BLM 1988b) and subsequent Executive Orders

Table 3-2. Other Elements for Analysis, Copper Ridge Shallow Gas Project Sweetwater County, Wyoming.

Element	Status on the Project Area	Addressed in text of EA
Geology/Minerals/Paleontology/Hazards	Potentially affected	Yes
Soils	Potentially affected	Yes
Vegetation	Potentially affected	Yes
Wildlife	Potentially affected	Yes
Special Status Species	Potentially affected	Yes
Noise	Potentially affected	Yes
Visual Resources/Recreation	Potentially affected	Yes
Ground Water	Potentially affected	Yes
Socioeconomic Issues	Potentially affected	Yes
Range/Other Uses	Potentially affected	Yes
Cumulative Impacts	Potentially affected	Yes

3.1 GEOLOGY/MINERALS/PALEONTOLOGY

3.1.1 Geology

3.1.1.1 Overview

The CRPA lies on the southeast flank of the Rock Springs Uplift, a major Laramide structural element, and is part of the Wyoming Basin Physiographic Province. The uplift is a north-south trending, doubly plunging asymmetric anticline that formed during Late Cretaceous time and showed intermittent activity during the Early Tertiary. Breaching of the anticline has exposed a complete section of Upper Cretaceous Mesaverde Group in its core. In ascending order, the Mesaverde consists of the marine Baxter and Blair Formations, the coal-bearing Rock Springs Formation, the fluvial Ericson Formation, and the coal-bearing Almond Formation. The Mesaverde Group is overlain by coal-bearing rocks of the Lance (Latest Cretaceous) and Fort Union (Paleocene) formations, the fluvial Wasatch Formation, and lacustrine Green River Formation that form the flanks of the uplift.

Structural dips on the southeast flank of the Rock Springs Uplift in the CRPA are gentle, measuring between 5 and 9 degrees to the southeast. A minor cross-trending fold, the Jackknife Springs Anticline interrupts the northeast strike of the beds. The axis of this fold plunges southeastward at 3° to 5°along a southeastward trend through the Brady Unit in section 32 T18N, R101W through section 11, T 16 N, R 101 W.

A major subsurface fault, the Brady Fault, bounds the northwest edge of the Brady Field. This high angle reverse fault strikes N20°E and dips 80°-85°to the southeast. At about 12,000 ft in depth, the fault crosses the center of section 10, the southeast part of section 3, and the northwest part of section 2, in T16N, R101W. The fault originates from Precambrian rocks underlying the area and dies out upward into Cretaceous rocks at a depth of about 5,000 ft (Roehler 1979). It is estimated that there are nearly 1,000 ft of structural closure along the southeast, upthrown side of the fault across the Brady Field.

Geologic mapping by the USGS and Wyoming Geologic Survey (Bradley 1964, Love 1970, Love and Christiansen 1985, Love et al. 1993, and Roehler 1977a, 1977b) document that sedimentary deposits of Quaternary and Early Tertiary age crop out in the project area. As mapped, these rocks are overlain at the surface in the drainages of Sand Wash, Black Butte Creek, Burley Draw, and Polly Draw by unconsolidated Quaternary alluvium.

Early Tertiary deposits in the CRPA consist chiefly of rocks that accumulated in swampy, terrestrial and lake environments that dominated the area during Paleocene and early Eocene time (Bradley 1964; Kirschbaum and others 1988, 1994; Love 1970; Roehler 1973 1977a-c; 1079, 1985, 1987 1991 a-b, 1992 a-c, 1993; Winterfeld 1982). These deposits comprise three geologic units, from youngest to oldest, the Green River Formation, Wasatch Formation, and Fort Union Formation. Stratigraphy of the Eocene Wasatch and Green River Formations in southwestern Wyoming is shown on Figure 3-1.

An angular unconformity separates the Fort Union Formation from the underlying Cretaceous rocks of the Lance Formation and apparently from overlying Eocene rocks of the Wasatch Formation. An intraformational unconformity, marked by a well-developed fossil soil horizon, separates the upper and lower unnamed units of the Fort Union Formation. The unconformities document the intermittent activity of the Rock Spring Uplift during Early Tertiary time.

Green River Formation

Rocks of the Green River Formation (Early Eocene) exposed within the CRPA include from youngest to oldest the Wilkins Peak Member, Tipton Tongue, and Luman Tongue. All three members crop out only along the eastern edge of the area and accumulated in the ancient Green River Lakes system. None of the members contain economic mineral deposits, but do produce vertebrate fossils of scientific significance.

Only the lower 60 ft or so of the Wilkins Peak Member occurs within the area. These rocks consist of brown flaky oil shale and thin interbedded gray tuff, gray and brown mudstone, gray dolomite, and tan algal limestone that accumulated in ancient Lake Gosiute (Roehler 1974, 1977a-b, 1991 a-b; 1992 a-c, 1993). The Wilkins Peak Member weathers to low slopes that form the top of Six Mile Rim.

The Tipton Shale consists of a maximum of about 60 feet of brown flaky oil shale and very thin interbedded brown ostracodal limestone and brown tuffaceous siltstone that underlie the Wilkins Peak Member of the and overlie the Niland Tongue of the Wasatch Formation. Beds of the Tipton and underlying upper rocks of the Niland Tongue weather to form Sixmile Rim. The Luman Tongue consists of a maximum of about 350 ft of organic-rich carbonaceous shale, limestone, sandstone, and mudstone that underlie the Niland Tongue and overlie the main body of Wasatch Formation. The Luman weathers to form a prominent bench below Sixmile Rim.

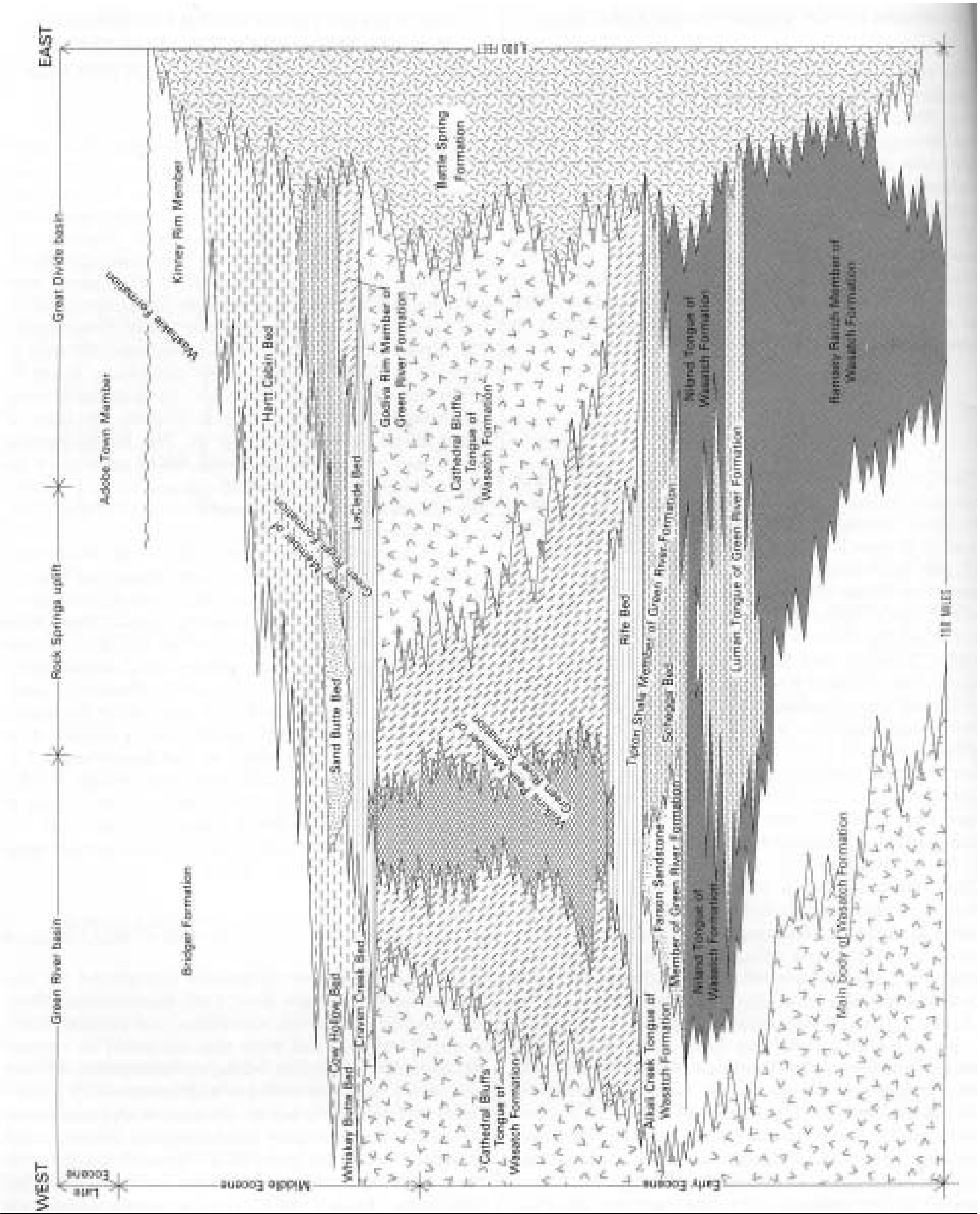


Figure 3-1. Stratigraphy of the Eocene Wasatch and Green River Formations in southwestern Wyoming

Wasatch Formation

Rocks of the Wasatch Formation (Early Eocene) exposed in the CRPA include two members, the Niland Tongue and main body. The Niland Tongue, the upper of the two forms the lower part of Six Mile Rim. The main body of the Wasatch Formation is broadly exposed over the central part of the area, where it weathers to a series of northeast trending, low-lying ridges and valleys. Neither member contains economic mineral accumulations, but both produce scientifically significant vertebrate fossils.

The Niland Tongue consists of terrestrial and fluvial sediment that lies stratigraphically between the overlying Tipton Tongue and underlying Luman Tongue of the Green River Formation. Deposits of the Niland Tongue include a maximum of about 400 ft of silty to sandy mudstone and sandstone interbedded with thin beds of brown flaky oil and carbonaceous shale and limestone. These deposits accumulated in smaller lakes, ponds, swamps, and flood plains following restriction of the Green River Lake system.

The main body of Wasatch Formation overlies the Fort Union Formation. The contact between the two formations trends along the Patrick Draw Road continuing southward along Burley Draw, with the main body occurring east of the road and draw. The main body includes a maximum of 1,500 ft of gray sandy mudstone and interbedded gray-green silty shale and gray very fine to fine grained sandstone that accumulated chiefly in fluvial and well drained flood plains during Early Eocene time.

Fort Union Formation

The Fort Union Formation (Paleocene) crops along the western edge of the CRPA. The formation is a maximum of about 1,300 ft thick and crops out chiefly west of the area. The formation consists of drab gray and brown mudstone and interbedded siltstone, sandstone, carbonaceous shale, orange to tan limestones and coal that accumulated in swampy to fluvial environment during the middle and late Paleocene. Like the main body of the Wastach, the Fort Union formation weathers to a series of northeast-trending low valleys and ridges. Pollen (Kirschbaum and others 1988, 1994, Nicols 1999) and vertebrate fossils (Winterfeld 1983, Wilf and others 1998) indicate that earliest Paleocene strata are missing from the section along the eastern flank of the Rock Springs Uplift because of an intraformational unconformity. The Fort Union Formation contains economic coal deposits, primarily in the lower half of the formation, and produces vertebrate fossils of scientific significance.

Older Sedimentary deposits

The Fort Union Formation is underlain by Phanerozoic sedimentary rocks, which with the exception of lacking Silurian and Ordovician deposits, range in age from Cretaceous to Cambrian in age. These are in turn underlain by Precambrian metamorphic bedrock that comprise part of the ancient North American cratonic shield and probably exceeds 2 billion years in age.

3.1.1.2 Mineral Resources

3.1.1.2.1 Locatable Minerals

No locatable mineral deposits have been mapped within the CRPA.

3.1.1.2.2 Leasable Minerals

Petroleum resources occur in Cretaceous, Jurassic, and Pennsylvanian age rocks underlying the CRPA. Coal occurs in Tertiary and Latest Cretaceous age rocks exposed at the surface to the west of the area, chiefly at a depth (450 ft +) too great to make strip mining economic. The coals contain potential coal bed methane resources underlying the CRPA.

Petroleum

Gas was first discovered in the Brady Field (then called the Jackknife Spring Field) in 1960 in the Almond, Rock Springs, and Blair Formations in the Mountain Fuels Supply Co. Jackknife Spring 1 well in Section 11, T16N, R101W. The discovery well was completed in the Rock Springs and Blair Formations at depths between 5,335 and 6,336 ft and had an initial flow potential of 7,220 MCF gas per day. The Brady 1 discovery well was drilled in 1972, also in section 11 and was completed in the Weber Sandstone and had an initial flow potential of 3,818 MCF gas and 976 bbl of condensate. The hydrocarbons are structurally trapped at the Brady Field by closure against the southeast, upthrown side of the Brady Fault (Roehler 1979). The field has proved productive in the Rock Springs, Blair, Dakota Sandstone (Entrada of drillers), Nugget, Park City, and Weber Formations.

Oil from the Nugget, Park City and Weber Formations has gravities ranging from 50-67 with pour points below 10° F. Gas from the Rock Springs, Blair, and Dakota formations is less than 1% inert and has high heating value. Gas from the Nugget, Park City, and Weber formations is 31-55% inert and has moderate heating value. Gas from the Park City is composed of more than 30% hydrogen sulfide. Since 1972, a total of 59 producing wells have been drilled and developed and production continues to date with cumulative production of 68,580,228 bbl oil and 572,277,598 MCF gas as of March 2003. A total of 8 additional, nonproducing wells have been plugged, abandoned and reclaimed.

Coal

Three coal beds that crop out west of the CRPA in the Fort Union Formation are projected to continue eastward beneath the area (Roehler 1977 a-b 1979). Two of these beds, the Big Burn and Hail occur within a 100 ft thick interval near the center of the upper part of the formation. These beds vary considerably in thickness laterally and do not exceed 9 ft in thickness for the Big Burn and 5 ft in thickness for the Hail bed. A third coal bed, the Little Valley Coal Bed, which is actually a zone of coal beds, crops out west of the CRPA and occurs within the lower 100 ft of the lower part of the Fort Union Formation. Individual seams within the Little Valley Coal vary considerably in thickness laterally, but may reach 15 ft thickness. Two coals, the Bluff and French coal beds, crop out near the base of the Lance Formation north and west of the CRPA area. These seams are less than 7 ft and 8.5 ft thick, respectively. They may not be present beneath the CRPA because of the unconformity at the base of the Fort Union Formation which progressively truncates the Lance southward.

Additional coal is present in the subsurface beneath the CRUA in the Mesaverde Group, including, in stratigraphic order from youngest to oldest include the Almond, Williams Fork (= Pine Ridge Sandstone) and Iles (= Allen Ridge) formations (Tyler and Hamilton 1994).

The middle of the Almond Formation of Cretaceous age underlying the Lance Formation has a

150 ft to 200 ft thick interval that contains as many as nine named and mapped coal beds. These coals are chiefly lenticular and vary considerably laterally with individual thickness. Net Almond coal thickness beneath the CRPA is less than 10 feet.

Coals in the Williams Fork (=Pine Ridge) Formation include the thickest and most extensive coals of the Upper Cretaceous in the Greater Green River Basin and are the basin's prime coalbed methane targets. These coals are interpreted to have accumulated in coastal plain environments and fluvial dominated, wave modified deltas, along a southwest-northeast oriented strand (beach) line that faced southeastward into the Cretaceous epicontinental seaway. Three depositional coal cycles are represented that accumulated in response to progradation as a result of sea level drop or changes in delta location, or both. The thickest coals in these cycles overlie shoreline sandstones with thinner and less continuous coals developed between deltaic distributary channel sandstones. Net Williams Fork coal thickness beneath the CRUA is 20 feet or less.

Coals of the Iles (Allen Ridge) Formation are thinner and not as well developed as those in the Williams Fork and the formation is considered a minor coal-bearing unit and coalbed methane target. These coals are interpreted to have accumulated in a variety of swampy environments above shoreline sandstones and in flood plains adjacent to delta river channels. Net Iles coal thickness beneath the CRUA area is less than 15 feet.

Channel samples of coal bed of the Big Burn, Little Valley and several of the coals in the Almond Formation have been analyzed. BTU values range from 6,000 to 8.900 Btu/lb which classifies them as Lignite B, Lignite, A, and Subbituminous C, but because these samples had been affected by surface weathering Roehler (1979) felt they should be ranked higher, possibly in the Lignite A to Subbituminous B range.

Coals in the Fort Union, Lance, and Almond Formations are currently being stripped mined at the Black Butte Mine about 10 miles to the north of the CRPA..

Coalbed Methane

In the Green River basin, coal and gas resources total 1,277 billion short tons, respectively (Hamilton and others 1994). The Mesaverde Group contains 627 billion tons and 264 Tcf, respectively and the Fort Union Formation contains 649 billion tons and 50 Tcf, respectively. At depths of less than 7,500 feet, coal and gas resources are estimated at 688 billion tons and 84 Tcf.

The Greater Green River Basin, including the CRPA is characterized by relatively low coal rank (Hamilton and others 1994). Coal ranks at exploitable drilling depths typically ranges from high –volatile C to high-volatile A bituminous and have barely reached the threshold of thermogenic gas generation. In the Mesaverde Group (Rock Springs and Almond Formations) coal rank around the Rock Springs Uplift is subbituminous to high-volatile C bituminous and increases with depth to high-volatile A bituminous at about 7,500 feet. Only below these depths have the coals reached ranks sufficient to generate large volumes of thermogenic gas. Fort Union coal rank around the Rock Springs Uplift is also subbituminous.

Gas contents of Greater Green River Basin coals are generally low, which is consistent with their low coal rank. Ash-free content values are typically less than 200 scf/ton for Mesaverde coals and less than 100 scf/ton for Fort Union coals. Coalbed gases are early thermogenic, thermogenic , and secondary biogenic.

Along the northeast flank of the Rock Springs Uplift, Fort Union, Almond, and Rock Springs coals have been tested. Of these, only the Rock Springs coals showed economic promise (Hamilton and others 1994). Because of their low gas content coals in the Fort Union Formation are considered to be secondary coal targets. Almond Formation coals are generally thin and are also considered secondary targets. Reservoir studies show that gas in the Almond Formation does not only originate from upper Almond sandstone, but also from numerous thin coals present in the upper Almond. These should be considered for completion.

3.1.1.3 Geologic Hazards

Naturally occurring geologic hazards include fault-generated earthquakes, floods, landslides or other mass movements. There are no known faults with surface expression or earthquake epicenters mapped within the CRPA (NEIC 2003, WGS 2003). The nearest earthquake epicenters recorded occurred within a 25 km radius of the area include those of 3 quakes that happened in 1984 a few miles northwest of Bitter Creek, Wyoming (T19N, R99W) and measured a magnitude of 3.2 on the Richter scale at a depth of 2 km.

There are no mapped landslide deposits in the area. Topographic relief is approximately 680 feet (6,960 ft to 7,640 ft) and slope over most of the area is gentle to rolling approximated by that along an east west transect to the eastern edge of the area along Black Butte Creek. There over a lateral distance of a mile elevation rises 420 ft. yielding a grade of about 8 % grade (Sec. 18, T16N, R100W). Slopes are steepest along Six Mile Rim (Sec. 32, T17N, R100W) where over a lateral distance of about 400 ft elevation rises on average 200 ft, yielding a grade of about 50%. Although steep, Six Mile Rim is developed in rocks (Wasatch and Green River Formations) that dip to the southeast opposite to the slope, which dips to the northwest, thus lessens the chance for naturally occurring mass movements.

The nearest landslides are mapped along the western edge of Sand Butte Rim about a mile east of the CRPA. These westward directed landslides are developed in the upper Wasatch Formation and overlying Green River Formation but these are of limited extent and do not extend into the project area

3.1.2 Paleontology

3.1.2.1 Paleontologic Overview

Paleontologic resources within sedimentary deposits exposed at the surface of the CRPA record the history of animal and plant life in Wyoming during the early part of the Cenozoic Era (Paleocene and Eocene Epochs). As described above, mapping documents four geologic deposits that are exposed at the surface of the CRPA. These include, from youngest to oldest: (1) unnamed deposits of Quaternary (Holocene) age; (2) Green River Formation of middle Eocene age; (3) Wasatch Formation of early Eocene age, and (4) Fort Union Formation of Paleocene age.

With the exception of the Holocene deposits that are too young to contain fossils, all sedimentary rock units exposed in the area have the potential to produce scientifically significant fossil resources. Scientifically significant fossil vertebrates have been recovered from within the area or immediately adjacent areas in the Wasatch (Morris 1954, Honey 1988, Roehler 1972, 1991 a-b, 1992 a-c, 1993, Roehler et al. 1988, Cassiliano 2003, Holroyd 2003) and Fort Union (Rigby 1980, Winterfeld 1981, Beard 2003) Formations.

Green River Formation

Plant, invertebrate (ostracod), and vertebrate fossils (fish and bird) are well known from the lower part of the Wilkins Peak Member. Freshwater gastropods, such as *Goniobasis tenera* and *Viviparus* sp., and the large unionid bivalve, *Lampsilis* as well as fish fossils occur abundantly in the Tipton Tongue, and at least one fossil mammal locality has been reported. The fossil mammal locality discovered in an ostracodal limestone, produced the mold of a jaw of the early horse *Hyracotherium*, with incisors preserved and molar impressions.

Fossils of fresh water molluscs are abundant throughout the Luman Tongue and the assemblages of fossils are commonly characterized by the large prosobranch gastropods *Goniobasis tenera* and *Viviparus sp.*, and by the large unionid bivalve, *Lampsilis*. Fish, ostracod, and trace fossils are also common in the tongue (Roehler, 1991 a-b; 1992 a-c, 1993).

Wasatch Formation

The high paleontologic potential of the Wasatch Formation in southern Wyoming is well known. Along the east flank of the Rock Springs uplift both the Niland Tongue and main body contain accumulations of fossil vertebrates (fish, turtles, crocodiles, birds and mammals), invertebrates (snails and clams), and traces and tracks of these organisms and fossil plants. Vertebrate remains include isolated bones and teeth and rarely articulated skeletal parts. The fossil mammals include primates, insectivores, marsupials, condylarths (archaic hoofed animals), artiodactyls, perissodactyls, carnivores, creodonts, bats, rodents, arctocyonids, and tillodonts.

Review of institutional records (University of California, University of Colorado, and University of Wyoming) reveals that more than 250 fossil vertebrate localities have been identified in the Wasatch Formation along the east flank of the uplift. At least two dozen fossil localities are known from the main body of the formation exposed along the east side of Patrick Draw road immediately north and south of the area. Seven localities occur within the area, primarily concentrated in the southwestern and eastern parts of the area where outcrops are best exposed. Six fossil vertebrate localities occur in the Niland Tongue immediately north of the area. To date, more than 13,000 cataloged specimens in the University of California Museum of Paleontology, the University of Colorado Museum, the U.S. National Museum, and the University of Wyoming have come from sediments of the Wasatch Formation as exposed along Patrick Draw Road (Holroyd, 2003).

The localities and specimens from them are of high scientific significance and interest because they include: (1) mammalian mass death assemblages (Williamson, 2001, and McGee, 2001, 2002) preserving skulls and skeletons of multiple individuals; (2) small mammals (Gunnell, 2001, Cuozzo, 2002), lizards (e.g., Gauthier, 1982), birds, and amphibians, many of which are new species and are the subject of ongoing study by researchers at the University of California, University of Michigan, University of Colorado, Yale University, and Las Positas College; (3) localities showing the greatest fossil bird, reptile, and mammal diversity of any area localities of early Eocene vertebrates known from North America and perhaps the world (Stidham, 1999, Holroyd and Hutchison, 2000, Holroyd, 2001); and (4) localities that are tied closely to the basin-wide stratigraphic framework (Savage et al. 1972; Roehler, 1992; and field notes on file at UCMP).

Fort Union Formation

The high potential of the Fort Union Formation exposed along the eastern flank of the Rock Springs Uplift to produce scientifically significant fossils of vertebrates, invertebrates and plants is well documented (Rigby, 1980; Winterfeld, 1982, Wilf and others 1998). Fossils vertebrate remains are known from more than 50 fossil localities presently identified in the formation. Mammal fossils from these localities include at least 70 species representing multituberculates, marsupials, proteutherians, insectivores, primates, carnivores, condylarths, pantodonts, and taeniodonts of middle to late Paleocene age (Winterfeld 1982). The uppermost rocks of the formation contain fossil mammals that mark the transition to the Eocene epoch and document the appearance of modern mammalian families in North America as well as the disappearance of archaic forms (Wilf and others 1998).

To date more than 1,500 vertebrate specimens have been collected from the formation along the east flank of the uplift. These localities and specimens from them are of high scientific significance and interest for several reasons including: (1) they yield small mammals, reptiles and amphibians many of which are new species and are the subject of ongoing study by researchers at Idaho State University (Winterfeld 2003) and the Carnegie University (Beard 2003); (2) include among them a late Paleocene age locality (Clarkforkian age) with the greatest diversity of fossil mammals known from that age that is also not significantly biased against smaller forms (Wilf and other 1998); and (3) include localities that are closely tied with plant fossils allowing the study of mammalian evolution as it ties with climatic evolution.

Paleontology Ranking

The BLM considers the Wasatch and Green River Formations to be Class 5 paleo formations meaning they are highly fossiliferous geologic units that regularly and predictably produce vertebrate fossils and/or scientifically significant nonvertebrate fossils, and that are at risk of natural degradation and/or human-caused adverse impacts. The BLM considers the Fort Union Formation to be a Class 3 paleo formation, which means it is a fossiliferous sedimentary geologic unit where fossil content varies in significance, abundance, and predictable occurrence.

Class 5 paleo requires mitigation of ground disturbing activities. Class 3 paleo formations require sufficient mitigation to determine whether significant paleoresources occur in the area of the proposed action.

3.2 CLIMATE AND AIR QUALITY

3.2.1 Climate

The CRPA is located in a semiarid mid-continental climate regime typified by dry windy conditions, limited rainfall, and long cold winters. The elevation across the project area ranges from 7,000 feet to in excess of 7,600 feet, resulting in a relatively cool climate. In the wintertime, it is characteristic to have rapid and frequent changes between mild and cold spells.

The nearest National Weather Service (NWS) meteorological measurements were recorded at Bitter Creek, Wyoming (1962 to present). The Bitter Creek station is located approximately 20 miles northeast of the project area at an elevation of 6,720 feet (Western Regional Climate Center, 2003).

The annual mean precipitation at Bitter Creek is 6.72 inches, and ranges from a minimum of 2.59 inches recorded in 1988, to a maximum of 9.44 inches recorded in 1965. March is the driest month with an annual mean precipitation of 0.29 inches, and May is the wettest month with an annual mean of 1.15 inches. The annual average snowfall is 19 inches, with December, January and February being the snowiest months. A maximum snowfall of 34.5 inches was recorded in 1991.

The area is typically cool, with an annual mean temperature of 41.5 °F. Average winter temperatures range from 21°F to 34°F, while summer temperatures range from 44°F to 81°F. Recorded extreme temperatures are - 46°F in 1971 and 103°F in 1969.

The nearest comprehensive wind measurements are recorded at the Rock Springs, Wyoming airport, approximately 25 miles northwest of the project area. Winds originate predominately from the west to southwest 53 percent of the time, with an average wind speed of nearly 12 miles per hour (5.33 meters/second). Figure 3-2 presents a wind rose for the Rock Springs Airport for the years 1991 through 1995.

The frequency and strength of the wind greatly affects the transport and dispersion of air pollutants. The potential for atmospheric dispersion is relatively high for the project area due to the high frequency of strong winds. However, calm periods and nighttime cooling may enhance air stability, thereby inhibiting air pollutant transport and dilution.

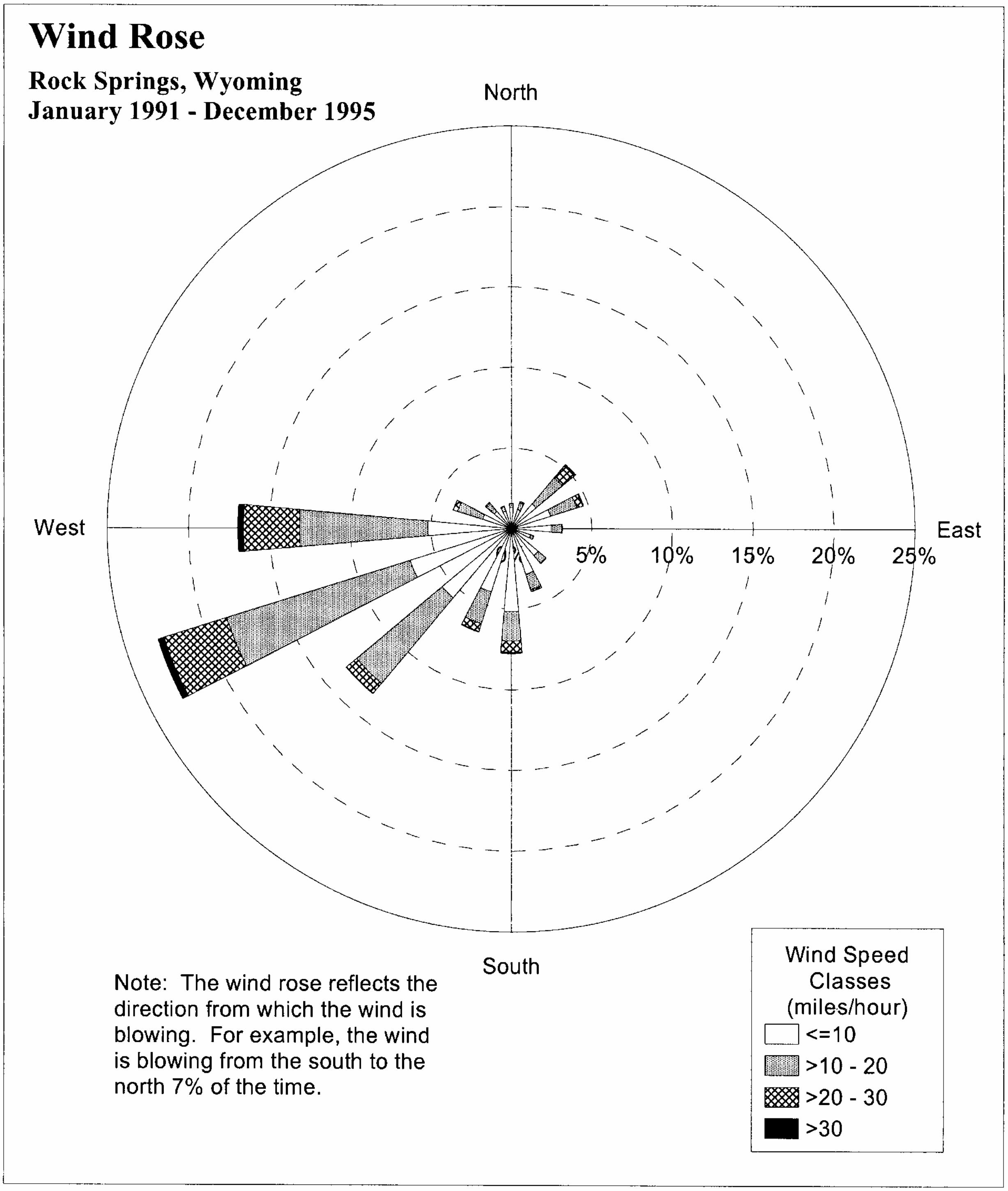
3.2.2 Air Quality

Specific air quality monitoring has not been conducted within the project area. However, air quality is expected to be relatively good due to the limited number of large industrial emission sources and predominately favorable atmospheric dispersion conditions. Industrial sources in the southwest quadrant of Wyoming include five large trona plants, several gas processing plants, two coal-fired power plants, numerous oil and gas production facilities and associated natural gas compressor stations (Wyoming Department of Environmental Quality, 2003).

Within the CRPA, the Wyoming Department of Environmental Quality – Air Quality Division (WDEQ-AQD) has primacy for implementing the Federal Clean Air Act and the permitting of air emission sources. Therefore, emission sources proposed under this action are subject to state permitting requirements including the application of Best Available Control Technology (BACT).

National and Wyoming Ambient Air Quality Standards (NAAQS and WAAQS) have been promulgated for the purpose of protecting human health and welfare with an adequate margin of safety. Pollutants for which standards have been set include sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), and particulate matter less than 10 or 2.5 microns in effective diameter (PM_{10} and $PM_{2.5}$). While no pollutant monitoring data are available for the project area, background values recorded in the region are below the NAAQS and WAAQS. Measured regional background concentrations are presented in Table 3-3 with the applicable ambient air quality standards.

Figure 3-2. Rock Springs, Wyoming Wind Rose



Under the Prevention of Significant Deterioration (PSD) provisions, incremental increases of specific pollutant concentrations are limited above a legally defined baseline level. Many national parks and wilderness areas are designated as PSD Class I. The PSD program protects air quality within Class I areas by allowing only slight incremental increases in pollutant concentrations. Areas of the state not designated as PSD Class I are classified as Class II. For Class II areas, greater incremental increases in ambient pollutant concentrations are allowed as a result of controlled growth. The PSD increments for both Class I and II areas are presented in Table 3-3.

The CRPA and surrounding region is federally designated as a PSD Class II area. The two nearest PSD Class I areas are Bridger and Fitzpatrick Wilderness areas located north of the project area. Contiguous with Bridger Wilderness are Pop Agie Wilderness and the Wind River Roadless Area, both designated as PSD Class II. Savage Run, a state designated PSD Class I area, is located east of the project area. Figure 3-3 presents a regional map indicating the location of the project area and the areas of special interest.

This NEPA analysis compares potential air quality impacts from the proposed Alternatives to applicable ambient air quality standards and PSD increments, but comparisons to the PSD Class I and II increments are intended to evaluate a threshold of concern for potential impacts, and do not represent a regulatory PSD Increment Consumption Analysis. Even though most of the development activities would occur within areas designated PSD Class II, the potential impacts on regional Class I areas are to be evaluated. For a new source review air quality permit application for a major source, the applicable air quality regulatory agencies may require a regulatory PSD increment analysis. More stringent emission controls beyond Best Available Control Technology may be stipulated in the air quality permit if impacts are predicted to be greater than the PSD Class I or II increments.

Areas of special concern, including some Class I and II wilderness areas, are monitored for Air Quality Related Value (AQRV) impacts. These AQRVs include wet and dry acid deposition, visibility and changes in lake acid neutralization capacity (ANC).

Atmospheric Deposition

Atmospheric deposition refers to the processes by which air pollutants are removed from the atmosphere and deposited on terrestrial and aquatic ecosystems, and is reported as the mass of material deposited on an area (kilograms per hectare). Air pollutants are deposited by wet deposition (precipitation) and by dry deposition (gravitational settling of particles and adherence of gaseous pollutants).

Wet Deposition

The **N**ational **A**tmospheric **D**eposition **P**rogram (NADP) assesses wet deposition by measuring the chemical composition of precipitation (rain and snow). The NADP station closest to the Copper Ridge project area is near South Pass City, Wyoming, northwest of the CRPA. Data are available from 1985 through 2000.

The mean annual precipitation pH in South Pass City ranges from 4.7 to 5.1. The natural acidity of precipitation is considered to range from 5.0 to 5.6 pH (Seinfeld, 1986).

Table 3-3. Air Pollutant Background Concentrations, National and State Ambient Air Quality Standards, and PSD Increments

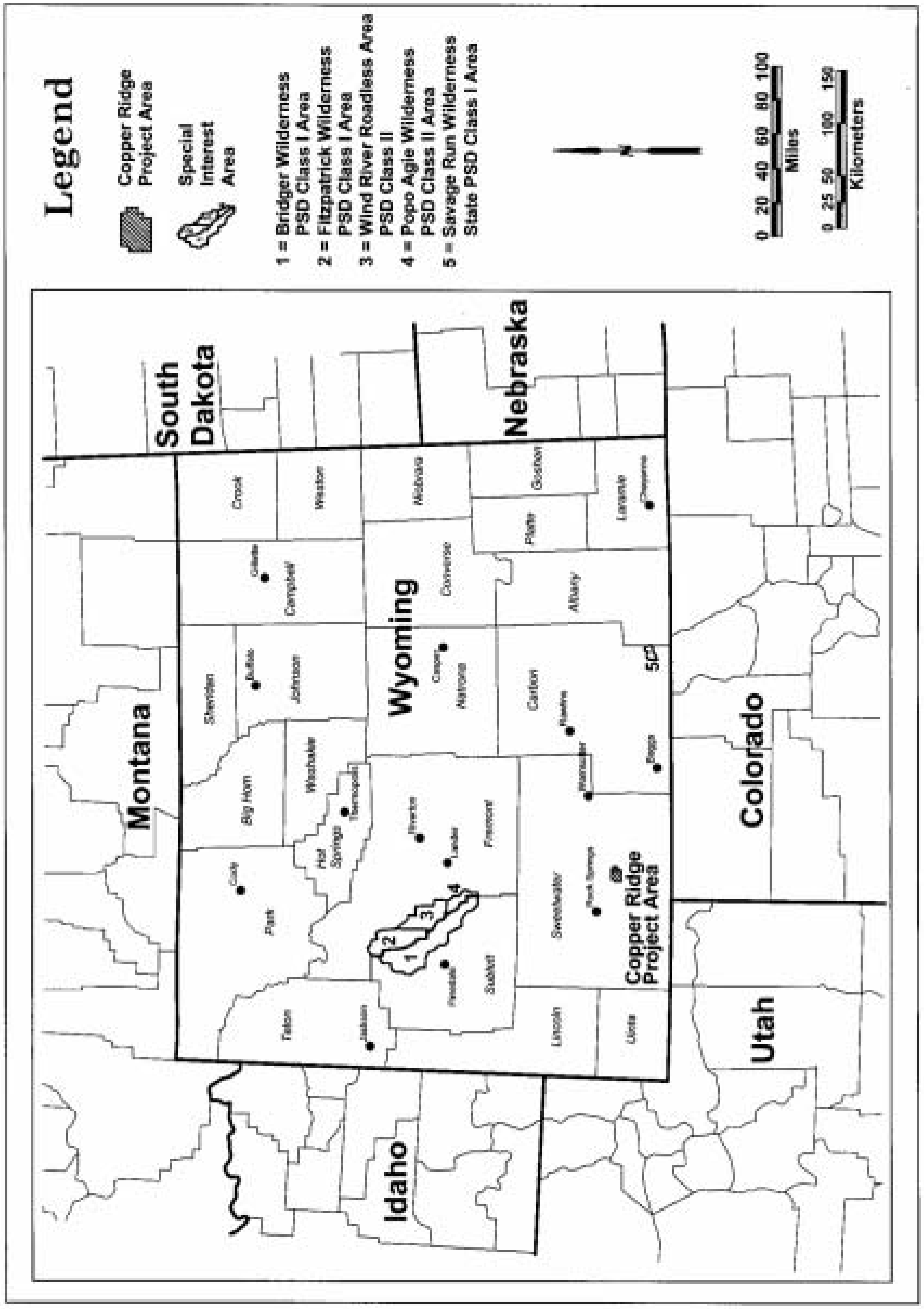
Pollutant And Averaging Time	Measured Background Concentration (μg/m³)	National and Wyoming Ambient Air Quality Standard (μg/m³)	PSD Class I Increment (μg/m³)	PSD Class II Increment (μg/m³)
Carbon Dioxide (CO)				
1-hour	2,299 a	40,000	n/a	n/a
8-hour	1,148 a	10,000	n/a	n/a
Nitrogen Dioxide (NO_2)				
Annual	3.4 b	100	2.5	25
Ozone (O_3)				
1-hour	169 c	235	n/a	n/a
8-hour	147 c	157	n/a	n/a
Particulate Matter (PM_{10})				
24-hour	47 d	150	8	30
Annual	16 d	50	4	17
Particulate Matter ($PM_{2.5}$)				
24-hour	15 d	65	n/a	n/a
Annual	5 d	15	n/a	n/a
Sulfur Dioxide (SO_2)				
3-hour	29 e	1,300	25	512
24-hour (National)	18 e	365	5	91
24-hour (Wyoming)	18 e	260	5	91
Annual (National)	5 e	80	2	20
Annual (Wyoming)	5 e	60	2	20

Note: Measured background ozone concentration value represents the top tenth percentile maximum 1-hour value. Other short-term background concentrations are second-maximum values.
n/a: Not Applicable.
Wyoming Ambient Air Quality Standards from: Wyoming Air Quality Standards and Regulations, Chapter 2 - Ambient Standards.
National Ambient Air Quality Standards from: 40 CFR part 50 National Primary and Secondary Air Quality Standards.
PSD Increments from: 40 CFR part 51.166 Prevention of Significant Deterioration of Air Quality.

Sources of Measured Background Concentrations

a Data collected at Rifle and Mack, Colorado in conjunction with proposed oil shale development during the early 1980's (CDPHE-APCD 1996)
b Data collected at Green River Basin Visibility Study site, Green River, Wyoming during the period January-December 2001. (ARS, 2002)
c Data collected at Green River Basin Visibility Study site, Green River, Wyoming during the period June 10, 1998 through December 31, 2001 (ARS, 2001).
d Data collected at the Emerson Building, Cheyenne, WY during 2002 (WDEQ, 2003).
e Data collected at the Crain Power Plant site and at Colorado Oil Shale areas from 1980 to 1984. (CDPHE-AQCD 1996)

Figure 3-3. Copper Ridge Project Area and Nearest PSD Class I Areas



Wet deposition of nitrogen compounds near South Pass City include ammonium ($NH4^+$) deposition of .5 kg/ha, nitrate (NO_3^-) deposition of 1.75 to 4.5 kg/ha, and inorganic nitrogen deposition of .75 to 2 kg/ha.

Dry Deposition

The **C**lean **A**ir **S**tatus and **T**rends **Net**work (CASTNet) measures dry deposition of nitrogen and sulfur compounds. The CASTNet station nearest to the CRPA is near Pinedale, Wyoming, northwest of the CRPA. Data are available from 1992 through 1999.

Dry deposition of nitrogen compounds near Pinedale include ammonium ($NH4^+$) deposition of .08 to .13 kg/ha, nitrate (NO_3^-) deposition of less than .1 kg/ha, and nitric acid (HNO_3) deposition of 1.2 to 2.2 kg/ha.

Total Deposition

Total deposition refers to the sum of airborne material transferred to the Earth's surface by both wet and dry deposition. Total deposition guidelines have been estimated for several areas, including the Bridger Wilderness in Wyoming (USFS, 1989). Estimated total deposition guidelines include the "red line" (defined as the total deposition that the area can tolerate) and the "green line" (defined as the acceptable level of total deposition). Total nitrogen deposition guidelines for Bridger include a red line set at 10 kg/ha/year, and a green line set at 3-5 kg/ha/year.

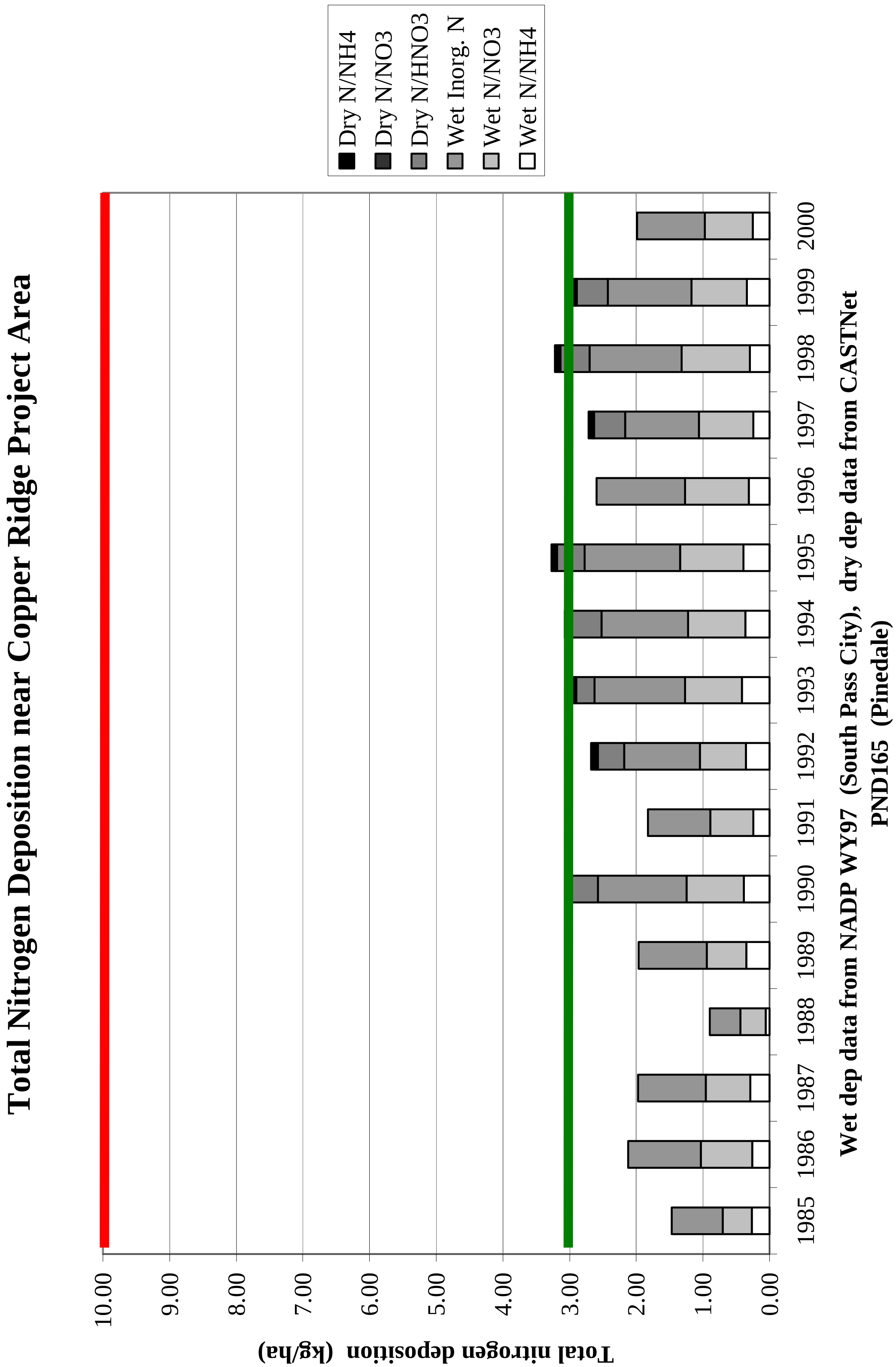
Total nitrogen deposition near the CRPA has been close to the Bridger Wilderness lower green line (3 kg/ha) from 1985 through 2000. Figure 3-4 presents a chart of the South Pass City and Pinedale deposition data along with the Bridger "red line" and lower "green line." Please note that wet deposition data are available from 1985 through 2000, while dry deposition data are available only from 1992 through 1999.

Visibility

Visitors to national parks and wilderness areas list the ability to view unobscured scenic vistas as an important part of a satisfying experience. Unfortunately, visibility impairment has been documented in many Class I areas. Most visibility impairment is in the form of regional haze. In the intermountain west, atmospheric sulfate, organics and elemental carbon are the main cause of regional haze and visibility impairment (FLAG 1999).

Visibility impairment is expressed in terms of deciview (dv). The deciview index was developed as a linear perceived visual change. A change in visibility of 1.0 dv represents a "just noticeable change" by the average person under most circumstances. Increasing deciview values represent proportionately larger perceived visibility impairments. The U.S. Forest Service (USFS) has identified specific "Level of Acceptable Change" (LAC) values that they use to evaluate potential air quality impacts within their wilderness areas (USDA-FS 1993). The USFS utilizes a visibility LAC threshold of 0.5 deciview.

Figure 3-4. Total Nitrogen Deposition near Copper Ridge Project Area



Visibility related background data collected as part of the Interagency Monitoring of PROtected Visual Environments (IMPROVE) program are available for the Bridger Wilderness area. Visibility conditions at Bridger Wilderness are typically very good with an average annual visual range of 109 miles (IMPROVE 2000).

Acid Neutralization Capacity

Aquatic bodies such as lakes and streams are important resources in most Class I areas. Acid deposition resulting from industrial emissions of sulfur and nitrogen based compounds may have a direct effect on the acid neutralization capacity (ANC) of sensitive lake ecosystems. Screening methodologies involving comparisons of sulfate and nitrate deposition fluxes to changes in background ANC values have been applied in New Source Review and NEPA processes to predict air pollution caused changes to the chemistry of sensitive lakes (USDA – Forest Service 2000). The following table (3-4) summarizes the background ANC values for selected lakes located in areas of special concern.

Table 3-4. Background Acid Neutralization Capacity for Sensitive Lakes

Lake Name	Special Concern Area	Managing Agency	Background ANC Concentrations (µeq/l)
Black Joe	Bridger Wilderness	USFS	69.0
Deep	Bridger Wilderness	USFS	61.0
Hobbs	Bridger Wilderness	USFS	68.0
Upper Frozen	Bridger Wilderness	USFS	5.8
Ross	Fitzpatrick Wilderness	USFS	61.4
Lower Saddlebag	Popo Agie Wilderness	USFS	55.5

3.3 SOILS

3.3.1 Topography

The topography within the project area varies from nearly flat alluvial bottom lands in and bordering the drainages of Black Butte Creek, Burley Draw, Sand Wash, and Alkali Wash, to steep, along the western exposed edges of east-southeast-dipping hogbacks of the middle Eocene Green River Formation. Between these extremes are subdued ridge and valley badland exposures of the Paleocene Fort Union Formation, sharper and steeper badlands of the lower Eocene Wasatch Formation, as well as, broad areas of gently sloping residual uplands. Relief within the study area is 730 feet, with a low elevation of 6970 feet along Black Butte Creek in the NW1/4 NW1/4 Section 34, T17N, R101W, and a maximum elevation of 7700 feet in the NE1/4 NE1/4 Section 5, T16N, R100W.

3.3.2 Soils

3.3.2.1 General Soil Characteristics

Soils within the project area are distributed according to differences in parent material, elevation, moisture, and topographic slope and position. They are primarily included in the Torriorthents-Camborthids-Haplargids association that formed under a dry, cool (frigid) climate with spring moisture. Soils of this association have low organic matter and are formed from residuum on Tertiary bedrock-controlled uplands and in Quaternary alluvium and colluvium along stream courses.

Most of the soils in the project area are developed on shales, mudstones, and sandstones of Tertiary age (Fort Union Formation, Wasatch Formation, and Green River Formation), and on alluvium locally derived from those rocks. A subsidiary but very important component of the soils, consists of fine-grained aeolian (wind-blown) sand that either has become mixed with deeply weathered bedrock, or occurs as patches of dune sand stabilized by vegetation.

Streams draining the project area all originate in areas of easily weathered and eroded bedrock sandstone, shale, and mudstone, and thus accumulations of gravel are practically nonexistent, except in the floors of those stream reaches that are proximal to outcrop. The few benches in the area that appear to have formed through stream erosion lack gravels and appear to be rock-cut (bedrock) terraces.

Geomorphic Setting, Soil Texture and Slope

In the absence of baseline soils information field investigation was utilized to gather site-specific data on soil characteristics grouped according to geomorphic landform. Five broad categories are recognized in the project area and include: (1) Alluvial Bottom, (2) Upland Slope, (3) Residual Colluvial areas, (4) Stabilized Sand Dunes, and (5) Outcrop (Figure 3.xxx).

Soil textures consist primarily of sandy loams, sandy clay loams, clay loams, and sandy clays, and are best developed in Alluvial Bottomland Soils and Upland Slope Soils-the soils which occur in areas with minimal slope. Residual Colluvial Soils are formed on steeper slopes and consist of slope washed parent materials, including angular blocks of sandstone and shale debris mantling their source rocks. Outcrop consists of bare exposed rock that has not undergone any appreciable soil development. Remnants of Stabilized Sand Dunes are usually developed on gently sloping surfaces otherwise covered by the Upland Slope Soils. These dune remnants are dominantly composed of fine sand.

Soil covered slopes within the project area vary from 0-2% on Alluvial Bottomland Soils, to 0-55% on Outcrop (short cliff faces are developed in limestones in the Green River Formation). Upland Slope Soils show slopes of 0-10%, whereas Residual Colluvial Soils vary from 5-15% in slope. Slopes of Rock Outcrop vary from gentle to nearly vertical.

Soil Depth

All soils in the Copper Ridge Unit project area are shallow (less than 60 cm in total thickness), their combined A (top) and B (subsurface) horizons measuring from only 15 to 44 cm in thickness. The thickest soils are the Alluvial Bottomland Soils (27-44 cm depth), and the thinnest (excluding Residual Colluvial Soils) are the Upland Slope Soils (15-19 cm depth). In test pits, nearly all the Alluvial Bottomland Soils and Upland Slope Soils exhibit effective rooting into the top of the C (unweathered parent material) horizon.

Soil Permeability and Erosion Potential

The majority of soils in the project area are moderately permeable due to their mixed sand and clay compositions. In the more highly clay-rich subsurface parts of the soils, permeability is diminished. The surfaces of most of the soils are quite sandy and thereby show relatively rapid permeability; however, all of these soils will become less permeable upon compaction.

Alluvial (stream) and aeolian (wind) erosion potential is a function of soil texture which, in turn, is related to degree of soil development on differing parent materials. Clay-rich soils or clay-rich soil horizons have relatively low erosion potential due to their low permeability but they are subject to surface collapse because of the high absorptive properties of the clay minerals which, when wetted and dried, form puffy surface crusts. Sand-rich soils are more easily eroded by both water and wind, especially in places where the vegetation cover is scant or absent.

The presence of small areas covered by Stabilized Sand Dunes and the high percentage of aeolian (wind-blown) sand-especially prevalent in the Upland Slope Soils-is indicative of both active erosion and deposition of soil materials by wind during the time of soil formation. However, appreciable wind erosion of soils in the project area is unlikely unless the natural vegetation cover is substantially reduced.

Stream erosion due to runoff, bank collapse, and piping is common in and near drainages with deeply incised channels, as seen in Alluvial Bottomland Soils. Shallow gullying was also seen on rutted dirt roads on which the ruts had penetrated the relatively permeable A (upper) horizon of the soil and had exposed the more impermeable clay-enriched B (subsurface) soil horizon. Erosion may be accelerated by surface disturbance such as the blading off vegetation and of the very shallow yet more permeable A horizons of the soils. However, because all soils in the project area are shallow (less than 60 cm depth-maximum 45 cm), it is probable that most blading will completely remove the topsoil and expose bedrock. Exposed bedrock (*Outcrop*) is generally less susceptible to erosion than are the soil veneers, but much of the Fort Union, Wasatch, and Green River formations are comprised of clay-rich mudstones and shales that become exceedingly muddy after even minimal rainfalls. Therefore, runoff potential is low on most of the area of undisturbed soils in the project area, but can be expected to increase to moderate/high with surface disturbance of soils. Exceptions are where soil slopes are relatively steep, or the soils are proximal to gullies.

3.3.2.2 Site Specific Soil Characterizations

Site-specific field investigation of soils in the CRU were undertaken to determine soil characteristics such as developing horizons, texture, color, permeability, and topographic distribution. The five soil types distinguished during this study include: (1) Alluvial Bottomland Soils; (2) Upland Slope Soils; (3) Residual Colluvial Soils; (4) Stabilized Sand Dunes; and (5) Outcrop.

Alluvial Bottomland Soils

This type of soil is developed over about 10% of the project area and is confined to locations with low slopes immediately adjacent to the larger principal drainages. Soils of this type are shallow and formed on alluvial parent materials derived from local outcrops of sandstones, shales, and mudstones of the Fort Union, Wasatch, and Green River formations. Four examples of Alluvial Bottomland Soils are developed as follows:

Site CPSO1

UTM 12: 685747E, 4577529N; slopes = 0-1%; permeability moderate with low runoff except near drainages.

A = Slightly calcareous sandy clay loam with blocky to slightly platy texture; 4 cm.

Bt = Calcareous sandy clay with platy texture; 10YR6/3 (pale brown); 40 cm.

C= Deeply weathered sandy mudstone of Wasatch Formation; faintly bedded; calcareous.

Site CPSO2

UTM 12: 682933E, 4579982N; slope = 0-1%; permeability moderate with low runoff; erosion potential low except near drainages where piping may occur.

A = Moderately calcareous and granular sandy loam; 6 cm.

Bt = Calcareous sandy clay loam; 2.5Y6/3 (light yellowish-brown); 23 cm.

Btk = Sandy clay loam with rare filaments of $CaCO_3$; much harder than Bt horizon and with lighter color (2.5Y7/3 = pale yellow); 20 cm.

Site CPSO4

UTM 12: 686530E, 4583716N; slope approximately 0%; moderate permeability with low runoff potential; erosion potential great as site lies proximal to gullied drainage system.

A = Moderately calcareous sandy clay loam; granular, loose, friable; 3-4 cm.

Bt = Very calcareous clay loam; 10YR5/4 (yellowish-brown); no visible $CaCO_3$; 29 cm.

C = Parent alluvium with thin bedding preserved; moderately calcareous.

Site CPSO5

UTM 12: 687450E, 4585684N; slope = 0-2%; highly permeable with low runoff and erosion potential.

A = Sandy loam, friable (probably some aeolian component); 3 cm.

Bt = Slightly calcareous sandy clay loam; pH = 7.0; 10YR4/4 (dark yellowish-brown); 24 cm.

Ck = Weathered sandy mudstone of Wasatch Formation; highly calcareous.

Upland Slope Soils

Upland Slope Soils are developed over approximately 35% of the project area and are the dominant features of flat to gently sloping (0-10% slopes) lands lying between the alluvial bottomland areas and exposures of *Residual Colluvial Soils* and *Outcrop*. Soils of this type are very shallow and formed on a parent material consisting of mixed weathered rock, slopewashed mud and clay, and aeolian (wind-blown) sand. The following description of an Upland Slope Soil is typical:

Site CPSO3

UTM 12: 684000E, 4583152N; slope about 3%; permeability moderate to high with low runoff potential and low erosion potential, except where gullying might be instigated by loss of vegetation.

> **A** = Residual clay fragments, paleosol calcrete glaebules, and sandstone granules of deeply weathered Wasatch Formation mixed with aeolian sand; 4 cm.
>
> **Bw** = Very calcareous sandy loam; 2.5Y6/3 (light yellowish-brown); pH = 6.5; no visible CaC03 filaments or pisoliths; 15 cm.
>
> **Cox** = Weathered clay balls and paleosol calcrete glaebules of Wasatch Formation.

Stabilized Sand Dunes

Stabilized Sand Dunes form a veneer over other surface soils in about 1% of the survey area, although their distribution might be somewhat greater due to the high percentage of sand of apparent aeolian origin in both Alluvial Bottomland Soils and Upland Slope Soils. The dunes generally blanket moderate 0-10% slopes otherwise marked by the development of Upland Slope Soils. The dunes are generally less than a few feet in thickness and trend more-or-less WSW-ENE or SW-NE. Because of their high sand content, the dunes are highly permeable and are unlikely to be an erosion problem unless dune fields are stripped of their dominantly sagebrush cover.

Residual Colluvial Soils

This soil type occupies about 9% or less of the project area, where it is found adjacent to Outcrop on slopes of approximately 5-15%. Colluvial cover consists of slopewashed shale and mudstone, as well as, varying amounts of angular sandstone blocks of pebble to boulder size. Because of the relatively high slopes, Residual Colluvial Soils might be subject to small to massive slumping, earthflow, and creep, and are therefore unstable and highly erodable, although no areas of mass movement are mapped or noted in the area.

Outcrop

Outcrop includes exposed bedrock of the Fort Union, Wasatch, and Green River formations. The Fort Union and Wasatch are characterized by mudstones of varying colors interbedded with about 20% sandstone, and supported with minor amounts of lignite, lignitic mudstone, and limestone concretions and nodules. In the report area, the Green River Formation is volumetrically dominated by shale and sandy shale, with less important amounts of sandstone and thin units of bedded limestone. The sandstones and limestones are quite resistant to stream and aeolian erosion; however, the mudstones and shales are susceptible to minor to severe gullying and badland development, especially where they form steep slopes on the fronts of hogbacks. Outcrop forms slopes of 0-55%, and makes up the surface of approximately 45% of the Copper Ridge Unit project area.

3.4 WATER RESOURCES

Water resources in the project area include both surface water and groundwater. Surface water resources include numerous ephemeral streams and a few shallow ponds that are both natural and man-made. The project area lies entirely within the Bitter Creek watershed. Bitter Creek, an intermittent to ephemeral stream, is a major tributary to the Green River in the Colorado River watershed. Headwaters of ephemeral tributaries of Bitter Creek originate in the project area. The named tributaries are Black Butte Creek, Sand Wash, Burley Draw, Cedar Draw, and Polly Draw. Sand Wash is a tributary of Black Butte Creek. Burley Draw, Cedar Draw, and Polly Draw are tributaries to Alkali Wash, which is tributary to East Salt Wells Creek, which is a tributary of Salt Wells Creek. Salt Wells Creek, an intermittent stream, is a tributary of Bitter Creek. Some unnamed ephemeral tributaries of Patrick Draw also occur in the northeastern portion of the project area. Patrick Draw is also an ephemeral tributary of Bitter Creek. No naturally occurring seeps or springs occur within the project area. Groundwater resources include free water contained within relatively shallow aquifers that are or could be used for domestic, agricultural and/or industrial purposes. The occurrence and distribution of water resources in the project area are dependent on climate, soils, and structural geology (Geology Section 3.1).

3.4.1 Precipitation

Mean annual precipitation is expected to be approximately seven to eight inches in the project area, with Bitter Creek and Rocks Springs Airport stations having an annual average of 6.72 inches and 9.03 inches, respectively. Precipitation is somewhat evenly distributed throughout the year with a peak in May. At Bitter Creek, the average monthly precipitation for the month of May is 1.15 inches. At the Rock Springs Airport, the average monthly precipitation for the month of May is 1.21 inches (WRCC 2003). The majority of precipitation falls as rain from frontal systems and thunderstorms. Concerning intensity of rainfall events, the 50-year, 24-hour precipitation rate is 2.4 inches (Miller et al. 1973). Mean snowfall depth for the year is greater at the Rock Springs Airport (about 45 inches) than further east at Bitter Creek (about 19 inches). The greatest snowfall occurs in December and January at Bitter Creek and in March at the Rock Springs Airport (WRCC 2003). Due to the effect of ablation and snow drifting, a discontinuous snow cover is usually present during the winter.

<u>Other Climate Characteristics</u>. Mean annual evaporation ranges from 50 inches (lake) to 70 inches (pan) and annual potential evapotranspiration is roughly 21 inches (Martner 1986). Compared to the mean annual precipitation of eight inches, this gives a mean annual water balance deficit of approximately 13 inches. The project area is subject to strong, gusty winds. Comprehensive wind measurements are collected at the Rock Springs Airport. The prevailing wind is from the west and southwest at an average of about 12 miles per hour. Violent weather is relatively common in the area; thunderstorms occur an average of 30 days per year and hail an average of three days per year. These meteorological and climatological characteristics of the project area combine to produce a predominantly dry, cool, and windy climate punctuated by quick, intense precipitation events.

3.4.2 Surface Water

3.4.2.1 Surface Water Quantity

Numerous ephemeral stream channels, both named and unnamed (see Figure 3-5), occur within the project area. Typically, under this flow regime, streamflow will last for only a brief period of time following a runoff-producing snowmelt or precipitation event. The project area falls entirely within the Bitter Creek drainage basin (USGS Basin #14040105) and is located approximately seven miles south of the Bitter Creek channel at its closest point. Bitter Creek is considered an intermittent stream that carries water most of the time over most of its course, although there are periods of no flow, especially during fall and winter. Most flow occurs in the spring during snowmelt or after storm events. The Bitter Creek watershed (2,207 square miles) discharges into the Green River near the town of Green River, Wyoming. The Green River flows into the Colorado River, which ultimately flows to the Pacific Ocean.

The project area overlies the following twelfth-order watersheds: Patrick Draw (140401050204) containing 23,145 acres, Upper Black Butte Creek (1401050401) encompassing 29,749 acres, Big Flat Draw (140401050609) having 1,241 acres, Lower Salt Wells Creek (140401050607) containing 24,516 acres, and Polly Draw (140401050608) with 18,814 acres. Black Butte Creek and its named tributary Sand Wash drain the northern and eastern portion of the project area. Alkali Wash and its named tributaries Burley Draw, Cedar Draw, and Polly Draw are all within the Lower Salt Wells Creek watershed and drain the southern and western portion of the project area. Tributaries of Patrick Draw drain a small part of the northeastern corner of the project area. There are no internally drained areas in the project area.

A few naturally occurring, shallow, ponds exist along the Sand Wash channel in Sections 11 and 12, T16N, R101W. Water levels in these ephemeral ponds are erratic and typically fluctuate in response to the frequency of runoff events. The source of water for these ponds appears to be primarily from surface runoff as there are no springs or seeps located upstream. There are also some small ponds that were constructed to contain water produced from existing gas wells within the project area (Figure 3-4). No springs or flowing wells have been identified within the project area.

Flow within the stream channels correlates directly with precipitation; surface runoff occurs during spring and early summer as a result of snowmelt and rainfall (Lowham et al. 1985). Based on the peak flow records from the U.S. Geological Survey's crest gage station 09216560 (located on Bitter Creek near Point of Rocks, Wyoming), the most probable month for peak runoff is April (BBCC 1998). Streams receive little to no support from groundwater discharge to sustain flow; consequently, there are extended periods of time when stream channels are dry. Active stream channels in the project area exhibit ephemeral flow only during snowmelt and high-intensity, short-duration summer thunderstorms. Rainstorm runoff can cause large peak flows, although the duration of flow from rainfall is relatively short in comparison to snowmelt runoff. Because precipitation varies from year to year, runoff volumes vary as well.

Within the general vicinity of the project area, runoff frequency may be insufficient to maintain active stream channels. Most of the small, lower-order stream channels that are identified on 7.5-minute USGS topographic maps are more accurately described as vegetated swales and lack active channels. Specific stream courses may grade between active channels and vegetated swales along their length. Similarly, some of the larger, higher-order streams such as

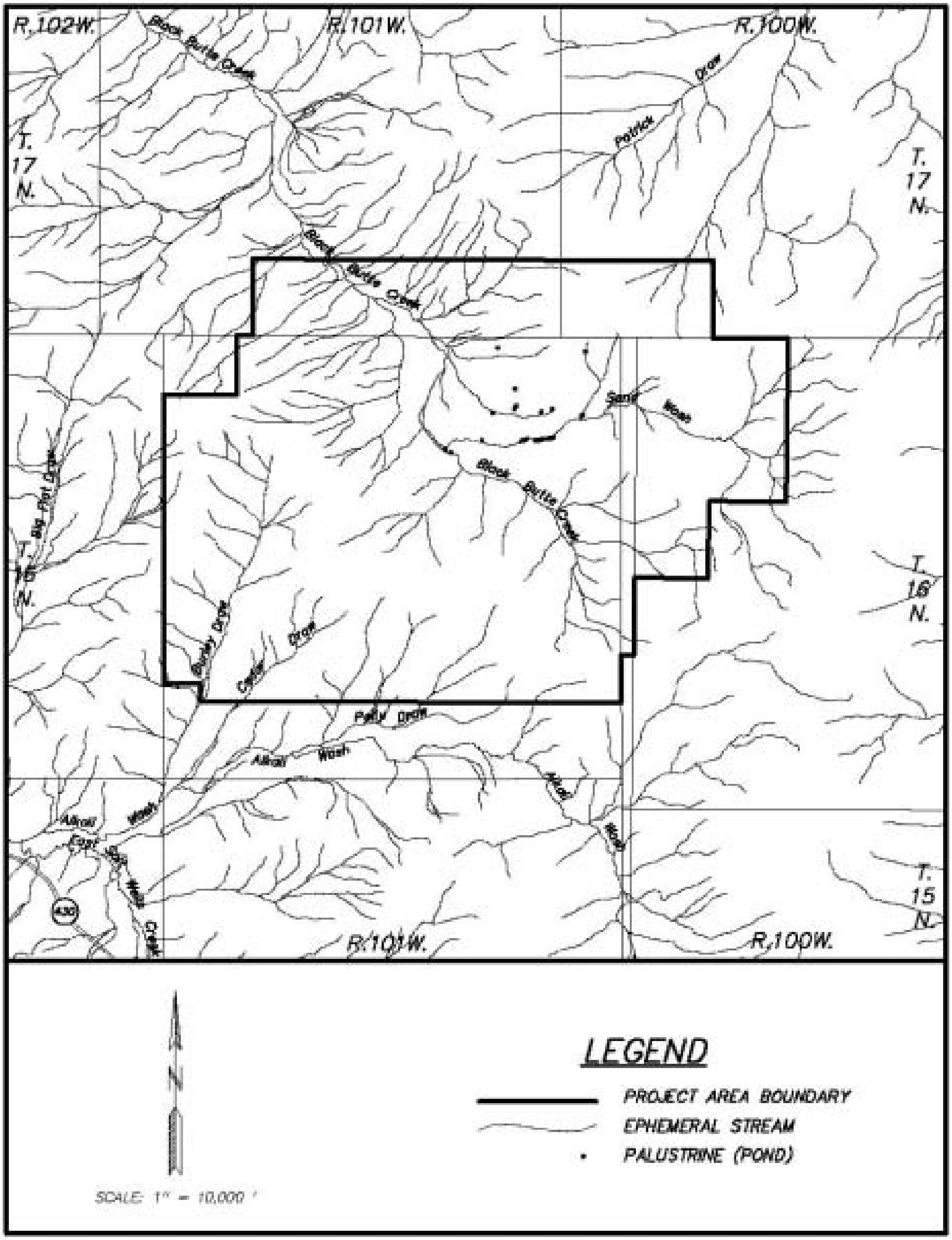


Figure 3-5. Surface Water Features in the CRPA.

Bitter Creek may exhibit intermittent flow in one section of the channel and ephemeral flow in another section.

There are no USGS surface water gaging stations within the project area. The closest USGS streamflow gaging stations are located on Bitter Creek, Salt Wells Creek, and Big Flat Draw (a tributary of East Salt Wells Creek). Historical streamflow data recorded on these streams (USGS 2003) are as follows:

- USGS Station 09216545, Bitter Creek near Bitter Creek, Wyoming, was maintained from 1975 through 1981. This site was located immediately upstream of the Patrick Draw confluence and, therefore, is upstream of any runoff contribution from the project area. The mean annual streamflow recorded at this location ranges from 1.5 cubic feet per second (cfs) (in 1976) to 11.2 cfs (in 1980). Instantaneous peak discharges recorded at this site range from 75 cfs (in 1981) to 346 cfs (in 1980).

- USGS Station 09216562, Bitter Creek Above Salt Wells Creek Near Salt Wells, Wyoming, was maintained from 1975 through 1981. The mean annual streamflow recorded at this location on Bitter Creek, which was downstream of the Black Butte Creek confluence and upstream of the Salt Wells Creek confluence, ranges from 3.6 cfs (in 1978) to 15.7 cfs (in 1980). Instantaneous peak discharges at this site ranged from 280 cfs (in 1980) to 888 cfs (in 1979).

- USGS Station 09216750, Salt Wells Creek Near Salt Wells, Wyoming, was maintained from 1975 through 1981. This site was located upstream of Salt Wells Creek's confluence with Bitter Creek. The mean annual flow recorded at this location ranges from 1.99 cfs (in 1978) to 8.10 cfs (in 1980). Instantaneous peak discharges at this site ranged from 87 cfs (in 1978) to 1,650 cfs (in 1976). Based on the five years of record obtained at this site, the average runoff for Salt Wells Creek is about 2,000 to 3,000 acre-feet per year (Lowham et al. 1982).

- The USGS maintained crest-stage gages at Station 09216700, Salt Wells Creek Near Rock Springs, Wyoming, from 1959 through 1976. This site was located roughly 10 miles upstream of Station 09216750. Instantaneous peak discharges at this site ranged from 75 cfs (in 1961) to 3,750 cfs (in 1962). A review of the weather records for the area indicates that flood event resulted from a rain on snow pack (Lowham et al. 1982).

- The USGS maintained crest stage gages at Station 09216580, (Big Flat Draw Near Rock Springs, Wyoming) from 1973 through 1981. A small portion of Big Flat Draw watershed, a tributary of East Salt Wells Creek, overlaps the western edge of the project area (Figure 3-3). Instantaneous peak discharges at this site, located at the mouth of Big Flat Draw, ranged from 11 cfs (in 1975) to 217 cfs (in 1979). Big Flat Draw has a drainage area of approximately 20 square miles.

Given the arid climate of the project area and the lack of well-established active channels, mean annual runoff (or watershed yield) is relatively low at less than 0.5 inch per year, or about 2.5 percent of the total annual precipitation (Wyoming Water Research Center 1990).

Runoff estimates prepared for the Bitter Creek watershed by the Black Butte Coal Company (BBCC 1998) indicate that the annual runoff from the Bitter Creek watershed will average between 4,000 and 8,000 acre-feet, which results in a unit runoff of 1.8 to 3.6 acre feet per square mile.

Based upon a recent (February 2003) review of the records, of the Wyoming State Engineer's Office (SEO) there is currently one active surface water right in the project area. This water right is associated with the Brady Gas Plant and permitted for miscellaneous use, the amount being unspecified and unadjudicated. One other surface water right existed within the project area, although it was a temporary right to use surface water that was hauled from Salt Wells Creek for oil and gas drilling.

3.4.2.2 Surface Water Quality

The surface water quality in the Green River drainage basin, in general, is addressed in several reports published by the USGS (i.e., DeLong 1977, DeLong and Wells 1988, Ringen 1984). A report published by the USGS on the hydrology of Salt Wells Creek (Lowham et al. 1982) provides surface water quality information that is more specific to the project area. Dissolved solids, suspended sediments, and salinity are the constituents that are primarily evaluated, as they are typically indicators for the evaluation of water for various uses. These reports also relate streamflow discharge to these constituents.

Surface water quality in semiarid regions is seasonal and dependent on the magnitude and frequency of discharge events, although the dissolved solids concentration typically increases in the downstream direction. During periods of little to no precipitation, evaporation and capillary action produce a salt residue on the surfaces of bedrock, soils, and channel deposits. Runoff from rainfall and snowmelt then periodically flushes the accumulated salts downstream. During high-intensity thunderstorm events, the dissolved solids concentration increases rapidly during the early period of runoff, but then will decrease after the initial flushing of salts has taken place. During less intense, low-flow events, the dissolved solids concentration generally increases in the downstream reaches. In streams where base flows are responsible for a very small part of overall streamflow, flushing of salts by floods appear to be the major mechanism by which dissolved solids are transported from the basin. The flushing action is a process that affects the quality of plains streams of southwestern Wyoming (Lowham et al. 1982). In less arid areas, less evaporation and more frequent flushing of accumulated salts would generally result in lower dissolved solids concentrations throughout the year.

Due to the erosive nature of the area, relatively high-suspended sediment concentrations are expected, particularly during high flow events. Ephemeral streams in the area also commonly exhibit very high suspended sediment concentrations during the first flows of a flood wave, apparently the result of a flushing action similar to the flushing of salts. During periods of several months or more without flow, basin surfaces and stream channels accumulate loose material due to weathering, wildlife and livestock movements, bank caving, and wind deposits. These loose materials are then readily picked up and transported (flushed) by the turbulent first flows of a floodwave. Once the initial flush has occurred, the amount of sediment transported is dependent upon supply (erosion) and magnitude of discharge (Lowham et al. 1982).

Although the amount of runoff from small ephemeral streams may be small in relation to that of the larger receiving streams (i.e., Salt Wells and Bitter Creek), the flushing process results in relatively large concentrations of dissolved and suspended materials that may constitute a shock load to receiving streams, particularly during low flow summer months. Runoff from arid and semiarid plains areas can therefore have an important affect on the water quality of the perennial streams (i.e., Green River) receiving such runoff (Lowham et al. 1982).

As indicated in the previous section, there are no established surface water quality sampling stations within the project area. The USGS (Lowham et al. 1982) reported increasing dissolved solids concentrations in the downstream direction are typical of Salt Wells Creek during runoff events, and that the total dissolved solids concentration at USGS Station 09216750 (Salt Wells Creek near Salt Wells, Wyoming) commonly exceeds 3,000 mg/L. Within the same USGS report, large concentrations (sometimes exceeding 100,000 mg/L) of total suspended solids (TSS), or sediment, result from the flushing phenomena. After the initial flush, TSS concentrations generally increase with increasing discharge. Flows in the late summer and early autumn tend to have high amounts of dissolved and suspended solids, evidence of the erosiveness of the system. Winter and early spring flows tend to have low sediment loads, as runoff often occurs over ice and snow (BBCC 1998).

The water quality of Bitter Creek was monitored by the USGS at Stations 09216545 (Bitter Creek near Bitter Creek, Wyoming) and 09216562 (Bitter Creek Above Salt Wells Creek Near Salt Wells, Wyoming) from 1975 through 1981 (USGS 2003). Streamflow recorded at these two sites was discussed above in Section 3.4.2.1. The following surface water quality conditions of Bitter Creek can be expected in the general vicinity of the project area:

- At site 09216545, the pH ranged from 7.8 to 9.3, the average pH was 8.58, and the median pH value was 8.5. The TDS concentration ranged from 280 to 4,500 mg/L, the average concentration was 1,755 mg/L, and the median concentration was 1,780 mg/L. The TSS concentration ranged from 22 to 21,900 mg/L, the average concentration was 1,843 mg/L, and the median concentration was 246.

- At site 09216562, the pH ranged from 7.6 to 8.8, while both the average and median pH values were 8.3. The TDS concentration ranged from 530 to 12,300 mg/L, the average concentration was 3,527 mg/L, and the median concentration was 2,860 mg/L. The TSS concentration ranged from 22 to 51,800 mg/L, the average concentration was 5,074 mg/L, and the median concentration was 635.

The USGS collected miscellaneous TSS samples at Station 09216580, Big Flat Draw Near Rock Springs, Wyoming, in 1976 and 1977. Instantaneous peak discharges recorded at this site from 1973 to 1981 are presented above in Section 3.4.2.1. The TSS concentrations ranged from 1,050 mg/L to 147,000 mg/L. Big Flat Draw streamflow recorded at the time these samples were collected was 0.05 cfs and 28 cfs, respectively.

Western Wyoming College collected a grab sample from East Salt Wells Creek at a location just upstream of the Salt Wells Creek confluence in August 1976 (WRDS 2003). The streamflow was 12 cfs, the pH was 7.8, the TDS concentration was 414 mg/l, and the TSS concentration was not analyzed. The BLM collected two grab samples from Black Butte Creek at a location approximately 15 miles downstream of the project area in April 1980 (WRDS 2003). The sample that was collected when the streamflow was reported to be essentially zero had a pH of 8.4, a TDS concentration of 1,520 mg/L, and a TSS concentration of 670 mg/L. The sample that was collected when the streamflow was reported to be 0.63 cfs had a pH of 7.8, a TDS of 230 mg/L, and a TSS concentration of 3,790 mg/L.

No other site-specific data are available. In general, the data that are currently available suggest that surface water quality in the project area is not suitable for domestic uses and is marginally suitable for agricultural and industrial uses, although should be suitable for wildlife and livestock watering. Surface water, when present in the project area, is expected to be of relatively poor quality due primarily to high dissolved solids, suspended sediment, and turbidity.

Point pollution sources have not been documented in the project area, and if they have occurred, they were probably accidental and of limited areal extent and of short duration. The primary non-point pollution source is natural erosion of geologic units, which are easily eroded. Grazing, oil and gas development, and poor road construction may further increase the high erosion rates described in the Soils Section (USDI-BLM 1999).

The Wyoming Department of Environmental Quality (WDEQ 2000) classifies Wyoming surface water resources according to quality and degree of protection. Four classes have been identified as follows:

Class 1. Those surface waters in which no further water quality degradation by point source discharges other than from dams will be allowed. Nonpoint sources of pollution shall be controlled through implementation of appropriate best management practices. Considerations employed during the designation of these waters include water quality, aesthetic, scenic, recreational, ecological, agricultural, botanical, zoological, municipal, industrial, historical, geological, cultural, archaeological, fish and wildlife, the presence of substantial quantities of developable water and other values of present and future benefit to the people.

Class 2. Those surface waters other than Class 1 determined to be presently supporting game fish or drinking water supplies or where these uses are attainable.

Class 3. Those surface waters, other than those classified as Class 1, that because of natural habitat conditions, do not support nor have the potential to support fish populations or spawning. Class 3 waters provide support for invertebrates, amphibians or other flora and fauna that inhabit water at some stage of their life cycles. Generally, Class 3 waters have wetland characteristics, which are a primary indicator used in identifying Class 3 waters.

Class 4. Those surface waters, other than those classified as Class 1, where it has been determined that aquatic life uses are not attainable.

Bitter Creek is a Class 2 stream; Salt Wells Creek, East Salt Wells Creek, and Alkali Wash are all Class 3 streams as are Black Butte Creek and Patrick Draw. All other ephemeral streams in the project area (i.e., Sand Wash, Burley Draw, Cedar Draw, and Polly Draw) are undesignated and by default take on the classification of the first stream they run in to; therefore, they are all Class 3 streams.

The WGFD has also classified surface waters in regard to the quality of fishery habitat and/or the importance of fisheries provided by the surface water bodies. All streams within the Bitter Creek drainage basin are Class 5 streams (incapable of supporting trout) (WGFD 1991).

Salinity. A primary water quality concern is increased salinity levels in area surface waters. Salinity has been noted as a key factor that limits water use and is a concern relative to downstream water uses. Salinity has become a major concern within the Colorado River drainage basin. The 1972 Clean Water Act (CWA) required the establishment of numeric criteria for salinity for the Colorado River. In 1973, seven Colorado River basin states created the Colorado River Basin Salinity Control Forum. The Forum developed water quality standards for salinity including numeric criteria and a basin-wide plan of implementation. The plan consists of a number of control measures to be implemented by State and Federal agencies. In 1974, Congress enacted the Colorado River Basin Salinity Control Act. The Act was amended in 1984. The amendments required the Secretary of Interior to develop a comprehensive program to minimize contributions from lands administered by the BLM.

Moderately erosive and saline soils naturally occur within and around the project area. Saline soils are associated with parent material from sedimentary rocks of the Tertiary Green River and Wasatch Formations. Once the soil is disturbed (i.e., from construction of a road or well pad), the potential for the release of residual soil sediment is increased. It is possible that oil and gas activities in the general area have and will continue to contribute to both sedimentation and salinity levels presently being experienced in the Green River. All of the soils within the project area have the potential of creating water quality-related sediment and salinity problems when disturbed.

3.4.2.3 Waters of the U.S.

Most of the surface water features in the project area qualify as Waters of the United States. Waters of the U.S. include the territorial seas; interstate waters; navigable waterways (such as lakes, rivers, and streams), special aquatic sites, and wetlands that are, have been, or could be used for travel, commerce, or industrial purposes; tributaries; and impoundments of such waters. All channels that carry surface flows and that show signs of active water movement are waters of the U.S. Similarly, all open bodies of water (except ponds and lakes created on upland sites and used exclusively for agricultural and industrial activities or aesthetic amenities) are waters of the U.S. (EPA 33 CFR § 328.3(a)). Such areas are regulated by the EPA and Department of Army Corps of Engineers (COE). As described previously, many of the drainage channels identified on the USGS topographic maps are vegetated swales, which are not considered to be waters of the U.S. by the COE. Any activity that involves discharge of dredge or fill material into or excavation of such areas is subject to regulation by the COE pursuant to Section 404 of the CWA. Activities that modify the morphology of stream channels are also subject to regulation by the Wyoming SEO. Special aquatic sites and wetlands are discussed in greater detail in the Vegetation Section (Section 3.5).

3.4.3 Groundwater

Groundwater resources include deep and shallow, confined and unconfined aquifers. The project area occurs in the Colorado Plateau and Wyoming Basin groundwater regions described by Heath (1984); the Upper Colorado River Basin groundwater region described by Freethey (1987); and the Great Divide and Washakie basins described by Collentine et al. (1981) and Welder and McGreevy (1966). Site-specific groundwater data for the project area are limited, although some miscellaneous information from water wells located in the general vicinity are available from the Wyoming SEO (SEO 2003), the Wyoming Oil and Gas Conservation Commission (WOGCC 2003), and the Wyoming Water Resources Data System (WRDS 2003). Other sources of information on groundwater resources in the general area come from Lowham et al. (1982), which includes information on the quality of groundwater from different geologic units underlying the Salt Wells Creek drainage basin. In addition, groundwater resources in the general area of the Black Butte Coal Mine, a large-scale strip mining operation located between the project area and Point of Rocks, Wyoming, are included in Black Butte Coal Company's Wyoming Department of Environmental Quality mining permit (BBCC 1998).

Groundwater Location and Quantity

The project area is located at the western edge of the Washakie Basin and the eastern flank of the Rock Springs uplift. The shape of the Washakie basin is nearly symmetrical and the strata in the basin dip toward the center at two to 12 degrees. Beneath the project area, geologic strata dip gently eastward into the basin (Geology Section 3.1). Groundwater in the basinward-dipping strata is almost entirely found in confined aquifers, although it also occurs under unconfined conditions locally in some alluvial valleys and where saturated rocks are near the surface (Welder and McGreevy 1966). The major system for unconfined groundwater in this area is the Bitter Creek alluvium (BBCC 1998). Welder and McGreevy (1966) suggest that the direction of groundwater movement in the deeper formations is down-dip toward the center of the structural basin and upward into the overlying formations; therefore, groundwater occurring within the project area is generally flowing eastward at a gradient roughly equal to the stratigraphic dip. Recharge occurs along the outcrop areas of formations and low-lying subcrops where water availability is high. Discharge occurs as evaporation, seeps, pit openings and pumped water from wells (BBCC 1998). Recharge to the water bearing strata of the Washakie Basin is principally from the infiltration of precipitation (direct rainfall, overland flow, and snowmelt). However, most of the precipitation leaves the area as surface runoff before it can infiltrate. The estimated recharge rate for the general area ranges from 0.01 to 2.0 inches per year (Heath 1984). Groundwater discharge from the basin is principally by evaporation and underflow beneath stream channels. Discharge via water wells and transpiration by plants is not considerable (Welder and McGreevy 1966).

Several rock units can be classified as water-bearing zones (aquifers) within the Washakie structural basin of southwest Wyoming. As described in Table 3-5, these aquifers vary in thickness, potential well yields, and water quality. The formations underlined in Table 3-5 are those encountered within the project area (Geology Section 3.1) to a depth of approximately 10,000 feet below land surface. The two geologic units that outcrop within the project area are the Fort Union Formation and the main body of the Wasatch Formation. These two Tertiary-age formations are widely distributed in the Washakie basin and most wells and springs produce and issue from them (Eddy-Miller et al. 1996). The Tertiary aquifer system is the most extensively distributed and accessible source of groundwater in the Washakie and Great Divide basins (Collentine et al. 1981). The Tertiary aquifer system is described as all the water-bearing strata between the Laney Shale Member of the Green River Formation and the Fox Hills Sandstone, inclusive. Sandstones in the Wasatch Formations generally contain groundwater under artesian conditions (Welder 1968). The majority of the groundwater in the Washakie basin is obtained from Tertiary units and the total estimated use in the basin is between 80,000 and 89,000 acre-feet per year (Collentine et al. 1981).

The Mesaverde Formation is also a major aquifer within the Washakie basin, although due to water quality variability, it is considered a groundwater source near outcrop areas only. Likewise, all of the water-bearing units below the Mesaverde are considered important sources of groundwater only in the vicinity of their outcrops due to water quality considerations. The majority of groundwater presently withdrawn from the Washakie basin is from the Tertiary aquifer system, and where drilling depths permit, the Mesaverde aquifer (Collentine et al. 1981). The Mesaverde Formation is situated between the major confining units of the Lewis Shale above and the Baxter Shale below. The Mesaverde aquifer consists of, in ascending order, the

Table 3-5. Hydrostratigraphy of Southwest and South Central Wyoming, Including the Great Divide and Washakie Basins.

ERA	PERIOD	GEOLOGIC UNIT	THICKNESS (ft)	HYDROLOGIC PROPERTIES
Cenozoic	Quaternary		0-70	• Sand and gravel deposits; fine-grained lake deposits produce poor yields • Used extensively in Little Snake River valley and area north of Rawlins uplift • Well yields generally <30 gpm; springs south of Ferris Mountains flow up to 20 gpm • Transmissivity estimates from area east of Rock springs uplift 168 to 560 gpd/ft • Permeabilities from area east of Rock Springs uplift from 21 to 62 gpd/ft^2 • TDS vary from 200 > 60,000 mg/L
	Tertiary	North Park Formation	0-800	• Minor aquifer, supplies excellent quality spring water to Rawlins • Three wells yield 4 to 20 gpm • Transmissivity estimates from 2 pump tests; 150 and 1,000 gpd/ft • TDS generally < 500 mg/L
		Browns Park Formation	0-1,200	• Excellent aquifer with good interstitial permeability; possible saturated zone 870 ft thick • Well yields range from 3 to 30 gpm • Transmissivity estimates from 100 to 10,000 gpd/ft • Numerous springs maintain baseflow of streams south of the Rawlins area; one spring flows 343 gpm • TDS generally < 500 mg/L
		Bishop Conglomerate	0-200+	• Major aquifer in Rock Springs uplift area • Absence of thick, saturated zones limits well yields; one well yields 42 gpm • Good interstitial permeability
		Uinta/Bridger Formations (Washakie Formation)	0-3,200+	• Relatively impermeable unit with only one questionably identified well and no spring data reported • Very low yields are expected
		Green River Formation (including Tipton, Wilkins Peak, and Laney members)	0-1,500	• Laney Member wells yield up to 200 gpm; other members relatively impermeable and would produce low-yield wells • Laney transmissivity range 110 to 300 gpd/ft; permeability averages 10 gpd/ft^2 • TDS generally <3,000 mg/L

ERA	PERIOD	GEOLOGIC UNIT	THICKNESS (ft)	HYDROLOGIC PROPERTIES
		Wasatch Formation	0-4,000+	• Major aquifer; water-bearing sandstone lenses yield 5 to 250 gpm although most yield 30 to 50 gpm; possible yields of 500 gpm from thick, saturated sequences • Wells tapping the lower sands are artesian in some areas • Transmissivity estimates range from 150 to 10,000 gpd/ft • Porosity and permeability are 16 to 38 percent and 0.04 to 18.2 gpd/ft^2, respectively • TDS generally < 1,000 mg/L but some over 3,000 mg/L
Cenozoic	Tertiary	Battle Springs Formation	0-4,700	• Major aquifer in eastern Great Divide Basin • Well yields range from 1 to 157 gpm • Transmissivity estimates from 29 to 3,157 gpd/ft • Porosity at one oil field was 15 to 25 percent • TDS generally < 1,000 mg/L
		Fort Union Formation	0-2,700+	• Major aquifer, especially around border of basins; discontinuous, isolated water-bearing zones • Well yield ranges from 3 to 300 gpm • Transmissivity estimate generally <2,500 gpd/ft • Porosity 15 to 39 percent • Permeability <1 gpd/ft^2; permeability largely fault-related on east side of Rock Springs uplift • TDS generally from 1,000 to 5,000 mg/L
Mesozoic	Upper Cretaceous	**Lance Formation**	0-4,500+	• Minor aquifer, with well yields generally <25 gpm • Transmissivity estimates generally <20 gpd/ft, with some estimates up around 150 to 200 gpd/ft • Oil field porosity 12 to 26 percent • Oil field permeability 0.007 to 8.2 gpd/ft^2 • TDS generally from 1,000 to 5,000 mg/L
		Fox Hills Sandstone	0-400	• Minor aquifer • Well and spring yields not available • Porosity 20 percent • Transmissivity 10 to 20 gpd/ft • Permeability 0.9 gpd/ft^2

ERA	PERIOD	GEOLOGIC UNIT	THICKNESS (ft)	HYDROLOGIC PROPERTIES
		Lewis Shale	0-2,700+	• Constricting layer mostly of impermeable shale but scattered sandstone lenses may be capable of yielding stock water supplies • Porosity ranges from 6 to 24 percent • Permeability ranges from 0.002 to 0.9 gpd/ft^2 • Transmissivity ranges from 0.03 to 50 gpd/ft
		Mesaverde Group (includes Blair, Rock Springs, Ericson and Almond Formations)	0-2,800	• Major aquifer with maximum well yield of 470 gpm from Rock Springs Formation; most yield less than 100 gpm • Transmissivity estimates generally < 3,000 gpd/ft and much lower in the Almond Formation • Porosity ranges from 8 to 26 percent • Ericson Formation is best water source near Rock Springs uplift • TDS range from 500 to over 50,000 mg/L (below 1,000 mg/L only at outcrops)
Mesozoic	Upper Cretaceous	**Baxter Shale (includes Cody and Steele shales and Niobrara Form)**	2,000-5,000+	• Major regional constricting layer throughout area west of Rawlins uplift • Thin sandstone beds may yield small quantities of water, but high TDS concentrations likely
		Frontier Formation	190-900+	• Productive aquifer; yields range from 1 to >100 gpm • Transmissivity estimates 15,000 to 20,000 gpd/ft for water well pump tests; however, generally <100 gpd/ft for drill stem tests, with maximum of 6,500 gpd/ft • TDS range from 500 to 60,000 mg/L (<1,500 mg/L near outcrops)
	Lower Cretaceous	Mowry Shale	150-525	• Regional constricting layer; well and spring data not available
		Thermopolis Shale (includes Muddy Sandstone Member)	20-235	• Leaky confining unit; water produces from Muddy Sandstone Member in northeast Great Divide Basin • Well and spring data not available
		Cloverly Formation	45-240	• Major aquifer which crops out on Rawlins uplift; deeply buried over most of area • Well yields range from 25 to >120 gpm • Transmissivity estimates range from 1 to 1,700 gpd/ft (combined water well and drill stem) • TDS range from 200 to 60,000 mg/L (1,500 mg/L near outcrops)
	Upper Jurassic	Morrison Formation	170-450+	• Confining unit • Well and spring data not available

ERA	PERIOD	GEOLOGIC UNIT	THICKNESS (ft)	HYDROLOGIC PROPERTIES
		Sundance Formation	130-450+	• Artesian flow to several wells in Rawlins area • Well yields between 27 and 35 gpm • Transmissivity ranges from 12 to 3,500 gpd/ft • TDS range from 1,100 to 40,000 mg/L (<1,500 mg/L near outcrops)
	Lower Jurassic-Upper Triassic	Nugget Sandstone	0-650+	• Well yield data limited but range from 35 to 200 gpm • Maximum transmissivity from drill stem tests 2,166 gpd/ft • TDS range from 1,100 to 40,000 mg/L (<1,500 mg/L near outcrops)
	Triassic	Chugwater Formation	900-1,500+	• Confining unit; hydrologic data not available
Mesozoic/ Paleozoic	Lower Triassic-Permian	Phosphoria Formation	170-460	• Water-bearing capabilities poorly known; probably poor due to low permeability of rock units • TDS generally between 5,000 to 10,000 mg/L
Paleozoic	Permian-Pennsylvanian	Tensleep Formation	0-840+	• Important water-bearing zone; well yields range from 24 to 400 gpm • One spring flows 200 gpm in Rawlins area • Transmissivity generally low, range 1 to 374 gpd/ft • TDS generally > 3,000 mg/L
Paleozoic	Lower and Middle Pennsylvanian	Amaden Formation	0-260+	• Hydrologic data not available; unit probably has poor water-bearing potential due to predominance of fine-grained sediments • TDS generally > 10,000 mg/L
	Mississippian	Madison Limestone	5-325+	• Major aquifer; excellent secondary permeability development due to solution channeling, caverns, and fractures • Well yields up to 400 gpm • Transmissivities highly variable • TDS range from 1,000 to >10,000 mg/L
	Cambrian	Undifferentiated	0-800+	• Major water-bearing zone, especially near Rawlins • Well yields between 4 and 250 gpm • Transmissivity data are suspect • TDS generally <1,000 mg/L but some areas with 5,000 to 10,000 mg/L
Precambrian			unknown	• Frequently used aquifer in northwestern corner of Great Divide Basin near South Pass City • Well yields typically range from 10 to 20 gpm • Reported transmissivities are <1,000 gpd/ft • Generally high permeability in fractured and weathered zone in upper 200 ft of unit

Adapted from Collentine et al. (1981); additional sources include Lowham et al. (1985), Heath (1964), and Freethey (1967)

Blair, Rock Springs, Ericson, and Almond formations (Collentine et al.1981). The upper part of the Almond Formation consists of permeable massive beds of fossiliferous sandstone, which overlie low-permeability carbonaceous shale, siltstone, mudstone, and coal beds of variable thickness and quality (Collentine et al. 1981). Dana (1962) reported that one well completed in the upper sandstone yields 250 gpm. Transmissivity values determined from coal mine pumping tests on saturated coal beds of the Almond Formation are relatively low, between 0.7 and 15.8 gpd/ft (Collentine et al. 1981). The Fort Union consists of gray or brown carbonaceous shale, gray shale, gray and green mudstone, gray very fine to medium-grained sandstones and minor thin gray limy siltstones, gray claystone and coal. The sandstone in this unit has been found to contain some zones of high permeability and may yield up to 25 gpm. However, the sand layers are not large in extent and are discontinuous over the region (BBCC 1998).

Beneath the project area the Wasatch Formation varies from zero to about 2,200 feet thick; the Fort Union Formation varies from about 800 feet to 1,800 feet thick; and the Mesaverde Formation is around 4,000 feet thick. The Copper Ridge Shallow Gas Project is proposing varying drilling depths between approximately 2,000 feet and 4,500 feet. Coal seams of the Fort Union Formation and Almond Formation occur at these depths in the project area.

The Black Butte Coal Mine, which is located about 10 to 20 miles north of the project area, is actively mining coal seams of the Fort Union, Lance, and Almond Formations. Black Butte Mine's mining permit describes these coal seams as the most regionally-extensive, water-bearing strata in the general area of the mine. Through drilling programs and monitor well installations at the Black Butte Mine facility, it is observed that the Wasatch is generally dry. Water in quantities sufficient for industrial supply is found in the Ericson. Other formations with water in varying quantities include the Almond, Lance, and Fort Union. Saturated zones of these formations are often discontinuous and occur as perched systems at the Black Butte mine site (BBCC 1998).

Most of the mine's Fort Union and Almond Formation coal seam monitoring wells are 100 to 400 feet deep and typically yield around 5 to 25 gpm. The coal seams are confined between relatively impermeable shales and the average transmissivity value for the Fort Union and Almond Formation coal seams are 100 gpd/ft and 30 gpd/ft respectively. The Fort Union Formation sandstones exhibit high transmissivity values, averaging about 8835 gpd/ft. These sandstones are generally soft, fine grained, and saturated, especially when located close to the Bitter Creek valley (BBCC 1998).

At the Black Butte Coal Mine, the coal seams within the Fort Union and Lance Formations are the only important lithologic units that are extensive in areal extent. The sandstones within these formations, however, are discontinuous and of limited areal extent and are therefore, only important as local potential aquifers (BBCC 1998). A recent (January 2003) SEO records review revealed that there are currently no active groundwater permits in the project area.

3.4.3.2 Groundwater Quality

Groundwater quality is largely related to the depth of the respective source aquifer, flow between aquifers, and the rock type. The quality of water in the various geologic formations underlying the Washakie Basin ranges from poor to good (Welder 1966). The total dissolved solids (TDS) concentration is an indication of salinity. Elevated TDS is caused by a variety of factors, including evapotranspiration, mixing of adjacent aquifers, the presence of soluble material, and restriction of flow by faults or impermeable strata. TDS ranging from less than

1,000 mg/L (considered fresh) to roughly 2,000 mg/L (slightly saline to saline) is typically found within shallow members of the Tertiary aquifer system and near the outcrop areas of the Mesaverde Formation and older aquifers. Shallow groundwater (<1,500 feet) from all members of the Tertiary aquifer system generally have a TDS concentration of less than 3,000 mg/L. Saturated alluvial aquifers that are associated with larger, intermittent streams in the area, such as Bitter Creek and Salt Wells Creek, commonly have high TDS concentrations. The TDS concentration is usually higher when an aquifer is interbedded with lake deposits that contain evaporate minerals (i.e., Washakie Formation).

The TDS concentration of groundwater from the Mesaverde Group varies from less than 500 to over 50,000 mg/L (Collentine 1981). The rate of increase in TDS away from the outcrop is variable, with the most saline Mesaverde waters found along the east flank of the Rock Springs uplift at a relatively short distance from the outcrop. The high TDS levels that exist basinward may result from a fault-related restriction of ground-water circulation, or alternatively, through a fracture-controlled influx of saline waters from stratigraphically adjacent shales and/or overlying alluvium. The existence of stratigraphic gas traps and the generally low permeability (<1 gpd/ft^2) of Mesaverde gas reservoir rocks in this area indicate that zones of highly restricted flow also contribute to the high salinity levels (Collentine 1981). Major ion composition of Mesaverde aquifer water varies with salinity, and therefore with location within the Washakie basin. Water containing 1,000 to 3,000 mg/L TDS is enriched in calcium sulfate, probably from gypsum/anhydrite dissolution. Increasingly saline water is characterized by dissolved sodium, chloride, and bicarbonate, and is essentially free of sulfate.

A search of the Wyoming Water Resources Data System (WRDS 2003) was conducted for the analyses of groundwater samples collected from any wells located near the project area. The search revealed the chemical analyses of miscellaneous samples collected from eight wells: two completed in the Green River Formation; one completed in the Wasatch/Fort Union Formation; three completed in the Almond Formation; and two completed in the Baxter Shale. None of these wells are located closer than about six miles from the project area. One sample was collected from the Wasatch/Fort Union well and the water type was a calcium sulfate with a TDS concentration of 2,400 mg/L. Seventeen samples were collected from one of the Almond wells and the water type was a sodium bicarbonate with an average TDS concentration of 2,040 mg/L. Eleven samples were collected from the second Almond well and the water type was a calcium sulfate with an average TDS concentration of 3,740 mg/L. One sample was collected from the third Almond well and the water type was a sodium sulfate with a TDS concentration of 711 mg/L.

Because the Copper Ridge Shallow Gas Project is proposing drilling to depths between approximately 2,000 feet and 4,500 feet, and coal seams of the Fort Union and Almond Formations occur at these depths, the chemical characteristics of groundwater from Fort Union and Almond coal seams as identified by the Black Butte Coal Mine are included. The predominant ionic constituents of groundwaters within these coal seams are sodium and bicarbonate. Wells at the Black Butte Mine facility show that both the Fort Union and Almond formations are sodium bicarbonate/sulfate types. Wells completed in the Fort Union formation demonstrate sodium concentrations ranging from 441 to 1267 mg/L, with a mean of 860 mg/L. The SAR values range from 16.5 to 39, with a mean of 36 and have a TDS range from 1230 to 3497 mg/L. A well completed in the Almond formation is of the sodium bicarbonate sulfate type. Sodium, bicarbonate and sulfate concentrations are 723 mg/L, 892 mg/L, and 263 mg/L, respectively. A low recharge and slow movement of water in these aquifers often are the major causes of a high degree of mineralization (BBCC 1998).

The confining beds restrict the movement of groundwater between aquifers, hence, movement of potential contaminants between aquifers. Although there is some downward movement of the water from the shallow surficial units, most of the groundwater movement, if any, is upward from the deeper aquifers to the shallower aquifers. Concerns have been raised for several gas field projects in southwest Wyoming regarding groundwater quality degradation due to the piercing of confining layers and vertical and horizontal migration and mixing of water of variable qualities. Data suggesting this is a current problem in the project area are not available. Improperly completed injection wells could also be a potential source of contamination between aquifers.

3.5 VEGETATION, WETLANDS AND NOXIOUS WEEDS

3.5.1 General Vegetation

Vegetation on the CRPA is primarily dominated by Wyoming big sagebrush/mixed grass prairie and desert shrub communities. The project area is located within the Green River and Great Divide Basin (7" - 9") precipitation zone, Region 4 (USDA-SCS 1986). Accordingly, native plants in this area of southwest Wyoming are primarily drought-tolerant low shrub, grass, and flowering forb species.

3.5.1.1 Vegetation Cover Types

A vegetation cover-type map of the CRPA (Figure 3-6) was provided by the Wyoming Geographic Information Science Center (WYGISC 2003) and used to delineate primary and secondary land cover type boundaries. Information for secondary vegetation types and plant species of concern was provided by the Wyoming Natural Diversity Database (WYNDD 2003).

Based upon the Wyoming Gap Analysis Program (GAP, Merrill et al. 1996), Wyoming big sagebrush (97.4 percent) and desert shrubs (2.6 percent) are the primary cover types on the project area (Table 3-6). Secondary cover types are desert shrub populations in the northwestern quadrant of the area (25.1 percent), Wyoming big sagebrush in the southwestern quadrant (2.6 percent), with the remainder of the area classified as a mixed grass prairie type (72.3 percent).

<u>Wyoming big sagebrush</u>: Wyoming big sagebrush (*Artemesia tridentada* ssp.*wyomingensis*) is the most extensive cover type in the project area, covering 24,304.2 acres (97.4%). The description of this cover type from the Wyoming GAP analysis is as follows (Merrill et al. 1996),"Total shrub cover in this type comprises more than 25% of the total vegetative cover. This type is variable in Wyoming and ranges from dense, homogeneous Wyoming big sagebrush to sparsely vegetated arid areas where Wyoming big sagebrush is the dominant shrub. Often, patches of Wyoming big sagebrush are found with patches of mixed grasses. In these cases the type is classified as Wyoming big sagebrush steppe if the sagebrush patches occupy more than 50% of the total landscape area and as mixed grass if the grasses occupy more than 50% of the total area." Resolution of the GAP layer is approximately 100 hectares (248 acres), therefore, smaller stands of some secondary cover-types such as basin big

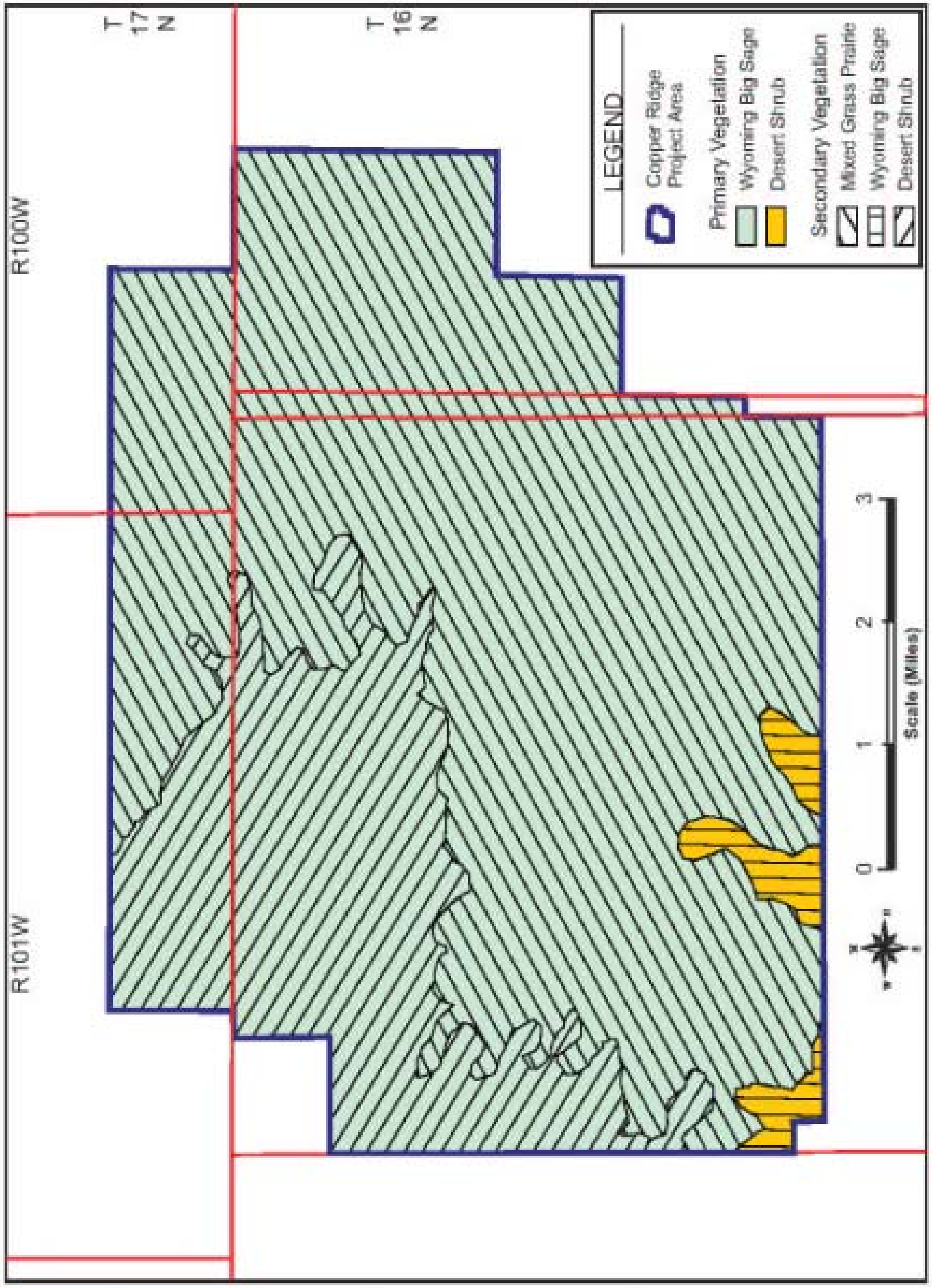


Figure 3-6. Vegetation Cover Types on the Copper Ridge Project Area.

sagebrush (*Artemisia tridentata* ssp. *tridentata*) and cushion plant communities, although present, may fail to appear on the map and their extent cannot be calculated.

Table 3-6. Vegetation Cover Types within the Copper Ridge Project Area.

	Primary		Secondary	
Vegetation Cover Type	Acres	Percent	Acres	Percent
Wyoming big sage	24304.2	97.4	648.8	2.6
Desert shrub	648.8	2.6	6263.2	25.1
Mixed grass prairie	0.0	0.0	18041.0	72.3
TOTAL	24953.0	100.0	24953.0	100.0

Mixed grass prairie: This is a "catch-all" type for grasslands that contain a mixture of short grass and tall grass prairie species. These grasslands do not contain buffalo grass, considered an indicator of short grass prairie. Mixed grass prairie often occurs in patches intermixed with shrub species such as sagebrush. Dominant plant species in this cover type include: thickspike wheatgrass (*Agropyron dasystachyum*), western wheat grass (*Agropyron smithii*), bottlebush squirreltail (*Sitanion hystrix*), needle-and-thread (*Stipa comata*), Indian ricegrass (*Oryzopsis hymenoides*), Sandberg bluegrass (*Poa secunda*), bluebunch wheatgrass *(Agropyron spicatum*), and threadleaf sedge (*Carex filifolia*). Forbs and especially woody crowned half-shrubs such as Hood's phlox (*Phlox hoodii*), Hooker's sandwort (*Arenaria hookeri*), cushion wild buckwheat (*Eriogonum ovalifolium*), green rabbitbrush (*Chrysothamnus viscidiflorus*), winterfat (*Eurotia lanata*), and broom snakeweed (*Gutierrezia sarothrae*) occur in some locations as understory dominants with the sagebrush. These sites are usually alkaline with limited permeability, and often occur on thin soils with rocky or gravelly subsurface materials. Locoweed (*Oxytropis* ssp.) and milkvetch (*Astragulus* spp.) are poisonous plants often occurring with this cover type (Merrill et al. 1996).

Desert shrub: This type is a "catch-all" for a mixture of shrubs usually associated with dry, saline habitats. Shrub cover is often dominated by alkaline/saline adapted species such as shadscale saltbush (*Atriplex confertifolia*), but can be a mixture of Gardner's saltbush (*Atriplex gardneri*), greasewood (*Sarcobatus vermiculatus*) and/or desert cushion plants (Merrill et al. 1996).

3.5.1.2 Biological Soil Crusts

An often overlooked, but extremely vital component of Wyoming's semiarid rangelands, especially in the Wyoming big sagebrush cover type, are the biological soil crusts that occupy most of the open space not occupied by vascular plants. Biological soil crusts predominantly are composed of cyanobacteria (formerly blue-green algae), green and brown algae, mosses, and lichens. Liverworts, fungi, and bacteria can also be important components. Because they are concentrated in the top 1-4 mm of soil, they primarily affect processes that occur at the soil surface or soil-air interface, including soil stability, decreased erosion potential, atmospheric N-fixation, nutrient contributions to plants, soil-plant-water relations, infiltration, seeding germination, and plant growth (Belnap et al. 2001). Crusts are well adapted to severe growing conditions, but poorly adapted to compressional disturbances such as trampling by humans and livestock, wild horses, wildlife, or vehicles driving off roads. Disruption of the crusts decreases organism diversity, soil nutrients, stability, and organic matter (USGS 2002).

3.5.2 Noxious Weeds

On 3 February 1999, Executive Order (EO) 13112 ("Invasive Species") was signed by President Clinton. The primary purpose of this EO is to prevent the introduction of invasive species and provides for their control and to minimize the economic, ecological, and human health impacts that invasive species cause. In Wyoming, some 428 taxa have been documented as invasive (Hartman and Nelson 2000). Of these 428 taxa, 22 are designated as noxious by the State of Wyoming (Rice 2002) and are shown in Table 3-7.

Noxious weeds are very aggressive and invading infestations tend to exclude other native plant species thereby reducing the overall forage production of desirable shrubs, herbaceous grasses and forbs. The project area is vulnerable to infestations of noxious weeds, especially on newly disturbed surfaces. Current drought conditions in Wyoming (NOAA 2003) increase the probability that noxious weeds will become established in stressed or disturbed habitats.

Table 3-7. Designated Noxious Weeds in Wyoming.[1]

Scientific Name	Common Name
Agropyron repens	Quackgrass
Ambrosia tomentosa	Skeletonleaf bursage
Arctium minus	Common burdock
Cardaria draba, C. pubescens	Hoary cress, whitetop
Carduus acanthoides	Plumeless thistle
Carduus nutans	Musk thistle
Centaurea diffusa	Diffuse knapweed
Centaurea maculosa	Spotted knapweed
Centaurea repens	Russian knapweed
Chrysanthemum leucanthemum	Ox-eye daisy
Cirsium arvense	Canada thistle
Convolvulus arvensis	Field bindweed
Cynoglossum officinale	Houndstongue
Euphorbia esula	Leafy spurge
Isatis tinctoria	Dyers woad
Lepidium latifolium	Perennial pepperweed
Linaria dalmatica	Dalmatian toadflax
Linaria vulgaris	Yellow toadflax
Lythrum salicaria	Purple loosestrife
Onopordum acanthium	Scotch thistle
Sonchus arvensis	Perennial sowthistle
Tamarisk spp.	Salt cedar

[1]Designated Noxious Weeds, Wyoming Stat. § 11-5-102 (a)(xi) and Prohibited Noxious Weeds, Wyoming Stat. § 11-12-104.

3.5.3 Waters of the United States, Including Wetlands

<u>Waters of the US</u> - Most of the surface water features in the project area qualify as Waters of the United States. Waters of the U.S. include territorial seas; interstate waters; navigable waterways (such as lakes, rivers, and streams); special aquatic sites and wetlands that are, have been, or could be used for travel, commerce, or industrial purposes; tributaries; and impoundments of such waters. All channels that carry surface flows and that show signs of active water movement are waters of the U.S. Similarly, all open bodies of water (except ponds and lakes created on upland sites and used exclusively for agricultural and industrial activities or aesthetic amenities) are waters of the U.S. (EPA 33 CFR § 328.3(a)). Such areas are regulated by the EPA and COE. Many of the drainage channels identified on the USGS topographic maps are vegetated swales, which are not considered to be waters of the U.S. by the COE. Any activity that involves discharge of dredge or fill material into or excavation of such areas is subject to regulation by the COE pursuant to Section 404 of the CWA. Activities that modify the morphology of stream channels are also subject to regulation by the state engineer's office (SEO) of Wyoming.

Wetlands - Wetlands are a unique and important cover type due to their ecological value and protection under the federal Clean Water Act (CWA) of 1972, as amended. Jurisdictional wetlands and other aquatic habitats merit special concern due to their relative rarity in the arid West, their functional role in and as components of hydrologic systems, their unique and important wildlife habitat and forage value, their heritage value, and their protection and regulation under the CWA.

The Green River RMP (USDI-BLM 1997) defines wetlands as lands transitional between terrestrial and aquatic systems where the water is usually at or near the surface or the land is covered by shallow water. Wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominately hydrophytes, (2) the substrate is predominantly undrained hydric soil, and (3) the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year. The most common wetland classification system used in Wyoming is the Cowardin System (Cowardin et al. 1979). Under this system, all wetlands in Wyoming belong to one of three different inland systems: (1) Palustrine (marsh or pond-like), (2) Lacustrine (lake-like), or (3) Riverine (river-like).

The location and classification of potential wetlands in the CRPA were determined from a draft USFWS National Wetlands Inventory (NWI) map (Figure 3-7) provided by the WYGISC (2003). Several polygon wetlands are located near the Brady Plant in Section 11, T16N:R101W. The Cowardin System classifies these locations as follows: PEMC (Palustrine, emergent, seasonally flooded), PUBFx (Palustrine, unconsolidated bottom, semi-permanently flooded, excavated), PUSAh (Palustrine, unconsolidated shore, temporarily flooded, diked/impounded), and PUSCh (Palustrine, unconsolidated shore, seasonally flooded, diked/impounded). In Wyoming, PEMC classified wetlands are usually associated with irrigated meadows and hay fields. The linear wetland feature shown in Section 8, T16N:R100W is classified as Riverine (intermittent streambed). All drainages (streams, draws, washes) in the CRPA are within the WDEQ fifth order hydrologic unit WYGR14040105 and eventually drain into the Green River (WDEQ 2001).

3.6 RANGE RESOURCES

The CRPA is located within the Rock Springs grazing allotment (No. 13018) which encompasses a total of about 2,127,200 acres. Land surface area of the CRPA (24,953 acres) represents about 1.3% of the total land area of the Rock Springs allotment. A total of 180,234 AUM's (public 105,584; other federal 5,015; State 1,182; and private 68,453) are authorized by the BLM for the allotment, however, this amount may be reduced in drought years, to protect the

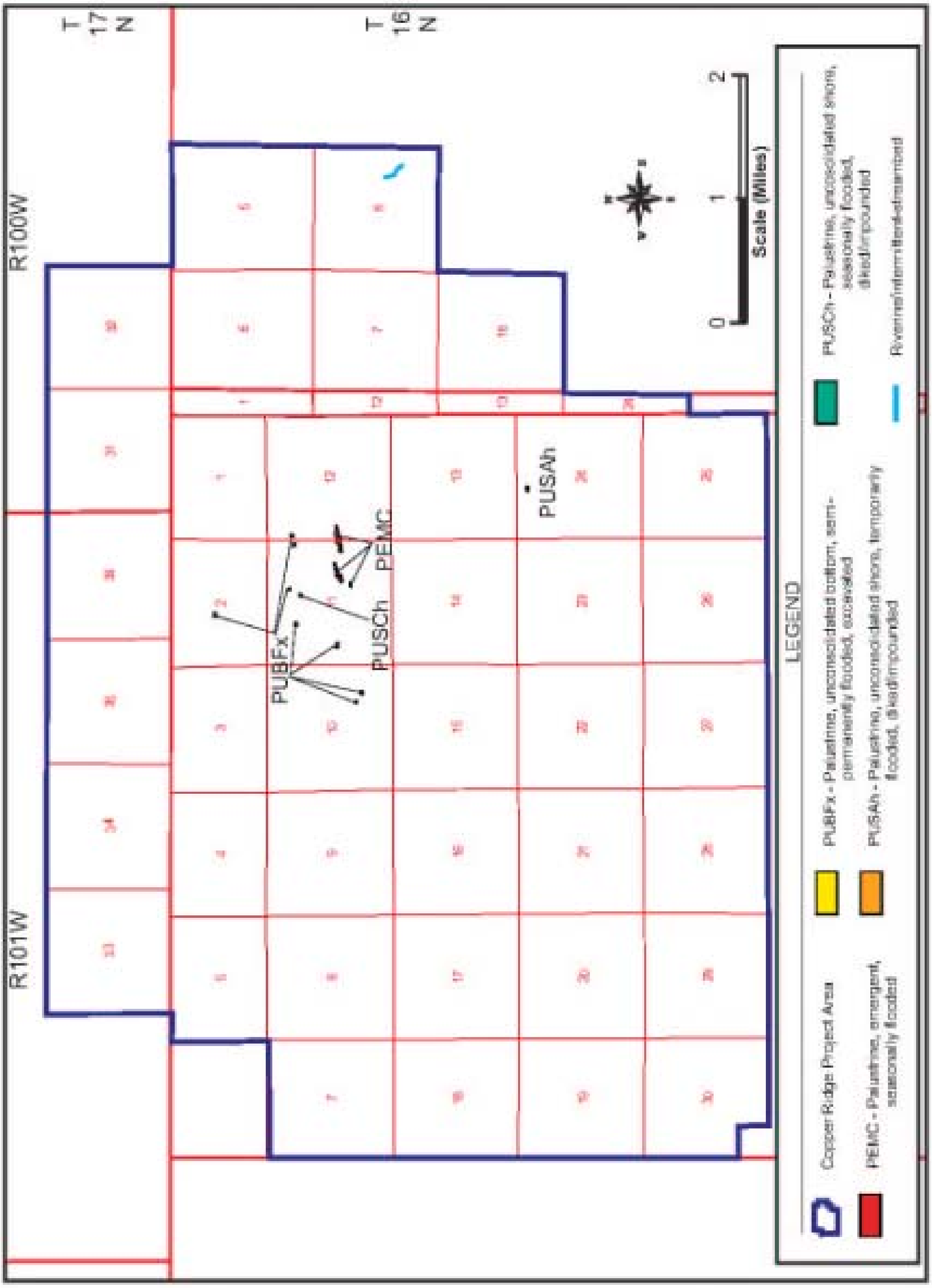


Figure 3-7. Wetland Cover Types on the CRPA

rangeland resource (Lloyd, pers. comm. 2003). An AUM is defined as the amount of forage required to sustain one mature cow or the equivalent based on an average daily forage consumption of 26 pounds of dry matter per day for one month (780 pounds per month). The grazing ratio on the Rock Springs allotment is about 14.0 acres per AUM. The RSGA predominantly supervises cattle and sheep grazing on the CRPA.

3.7 WILDLIFE

3.7.1 Introduction

The CRPA lies within the BLM's Green River Resource Area administered by the Rock Springs Field Office. Objectives for wildlife management on the resource area are directed by the Green River RMP (USDI-BLM 1997). The RMP provides for multiple use planning and management of public lands and resources in a combination designed to meet present and future needs.

The project area is small (24,953 acres) relative to the overall size of the RSFO resource area (5.36 million acres), yet this area provides diverse habitat that supports a wide variety of resident, migrant, and seasonally resident wildlife species. Because many wildlife species are highly mobile and can readily move in and out of the project area, records of current and historical wildlife species occurrences were obtained for the project area and a six-mile zone surrounding it. Since activities within the permit area could potentially affect nesting raptors and greater sage-grouse breeding activities that are outside the project area, the area of analysis was expanded for these species to include a 1-mile and 2-mile buffer zone, respectively.

Information concerning current and historical wildlife locations was obtained from several sources. Information regarding greater sage-grouse lek and raptor nest locations was obtained from the BLM Rock Springs Field Office. Additional information was acquired from the Wyoming Game and Fish Department (WGFD) Wildlife Observation System (WOS). This listing contains records for all types of wildlife (birds, mammals, reptiles, amphibians). The Atlas of Birds, Mammals, Reptiles and Amphibians in Wyoming (WGFD 1999) was also used to assess the potential occurrence of species in the project area. This atlas divides Wyoming into 28 degree blocks, and the presence or absence and breeding activity of vertebrate species are documented by degree block. The project area is located in degree block 24. A species was considered to have the potential for occurrence in the project area if it was reported as observed, breeding, or historically present within degree block 24. Annual big game herd unit reports from the WGFD were also used. Finally, data was acquired from Wyoming Natural Diversity Database (WYNDD). Location records for vertebrate species of special concern (federal or state) within a township buffer of the project area were obtained from WYNDD (2002). Although wild horses are not managed as a wildlife species by the WGFD and BLM, they are included in the wildlife sections of this document.

3.7.2 Wildlife Habitat

Wildlife habitats that could be affected by the project include both the areas which would be physically disturbed by the construction of gas wells, related roads, pipelines, and production facilities, as well as zones of influence surrounding them. Zones of influence are defined as those areas surrounding, or associated with, project activities where impacts to a given species or its habitat could occur. The shape and extent of such zones varies with species and circumstance.

Two primary wildlife habitats are found in the project area. These habitat types correspond with vegetation cover types described in Section 3.5 of this document. Upland habitats include: (1) Wyoming big sagebrush steppe, and (2) desert shrub. Wetland habitats include non-permanent marsh and intermittent streambed habitats.

3.7.3 General Wildlife

A total of 309 species has been recorded on or proximal to the project area either as residents or migrants and includes 57 mammal species, 242 bird species, 4 amphibian species, and 6 reptile species (Appendix B). The presence of these wildlife species was determined solely from the sources of information discussed in Section 3.7.1. Wildlife surveys for raptors, greater sage-grouse, mountain plovers, and white-tailed prairie dogs were conducted on the CRPA by HWA during the spring of 2003 and results of these surveys are given in the appropriate sections of this document.

Although all species in Appendix B are important members of a functioning ecosystem and wildlife community, most are common and have wide distributions in the region. Consequently, the relationship of most of these species to the proposed project are not discussed in the same depth as species which are threatened, endangered, rare, of special concern, of special economic interest, or are otherwise of high interest or unique value.

3.7.4 Big Game

Three big game species: mule deer (*Odocoileus hemionus*), elk (*Cervus elaphus*), and pronghorn antelope (*Antilocapra americana*) occur on the project area. Big game populations are managed by the WGFD within areas designated as herd units and are discussed in that context.

The types of big game habitat designated by WGFD (1996, 2002a), and discussed in this document, include yearlong, winter/yearlong, crucial winter/yearlong, and undetermined. Winter/yearlong ranges are occupied throughout the year but during winter, they are used by additional animals that migrate from other seasonal ranges. Yearlong ranges are occupied throughout the year and do not receive an influx of animals during winter. Crucial range (i.e. crucial winter/yearlong) describes any seasonal range or habitat component that has been documented as a determining factor in a population's ability to maintain itself at a specified level (theoretically at or above the population objective) over the long term. Crucial ranges are typically used 8 out of 10 winters. Areas designated as UND (or undetermined) contain habitats of undetermined importance to the species.

Mule Deer. The project area lies within the South Rock Springs Herd Unit. This unit covers 1,477,156 acres of habitat in southwest Wyoming (WGFD 1996). This migratory herd is shared with Colorado and Utah making it difficult to estimate the Wyoming population during and after the hunting season. The 2001 posthunt population estimate for the herd unit was 7,000, approximately 40% below the herd objective of 11,750 animals (WGFD 2002a). The project area is located within hunt area 101; 2001 hunter success in this area was 73% with a harvest of 90 mule deer bucks. Approximately 28% of the mule deer harvest in the South Rock Springs Herd Unit was from hunt area 101 in 2001.

Two types of mule deer seasonal ranges are located within the project area (Figure 3-8). The entire project area is classified as some type of mule deer winter range: either winter/yearlong or crucial winter/yearlong (Table 3-9). Nearly 5% (1,108 acres) of the project area is crucial winter/yearlong mule deer range, located in the southeastern portion of the project area. The remaining 23,845 acres (95%) of the project area is mule deer winter/yearlong range.

Elk. The project area lies within the 1,836,488-acre Petition Herd Unit. The herd unit consists of isolated groups of elk that utilize the higher elevation ridges and adjacent habitats within a desert area. It is difficult to determine a population estimate for this herd because there are few animals scattered over a large area and a portion of the herd is migratory and interchanges with elk herds in Colorado. The estimated population for this herd unit is 250 - 300 animals (WGFD 2002a). The project area is located in hunt area 124, and in 2001 hunter success in this area was 53.8% with a harvest of 5 bulls and 30 antlerless elk.

There are approximately 55 acres (0.2%) of elk yearlong range in the project area (Table 3-9). This yearlong range is located in the southern and eastern portion of the project area (Figure 3-9). The remainder of the project area (over 99%) is of undetermined value and has not been classified as any type of elk seasonal range.

Pronghorn. The project area lies within the Bitter Creek Herd Unit. This unit contains hunt areas 57 and 58 and covers 1,835,828 acres of sagebrush-grasslands, greasewood and saltbush flats, juniper woodlands, barren badlands, and irrigated agricultural field habitats (WGFD 2002a). The population objective for this herd unit is 25,000 and the 2001 posthunt population estimate was 13,000. The CRPA is located in hunt area 58, and in 2001 hunter success was 76% with a harvest of 145 males, 3 females, and 2 juveniles (WGFD 2002a).

Approximately 10% or 2,433 acres of the project area is classified as crucial winter/yearlong habitat (Table 3-9). Crucial winter/yearlong pronghorn range is found only in the northern portion of the project area (Figure 3-10). The remaining portion (90%) of the project area is used during winter and year-round (winter/yearlong) by pronghorn.

Big Game Summary. Overall, the entire project area is used year-round by two big game species (antelope and mule deer). The northern portion of the project area provides crucial habitat for antelope, while the southeastern portion of the project area provides crucial habitat for mule deer. Although the value of elk habitat throughout most of the project area has not yet been determined, portions of the project area are classified as elk yearlong range indicating habitat found in that area is important.

Table 3-8. Big game seasonal ranges within the Copper Ridge Project Area.

Seasonal Range[1] Areas (acres)				
Species	WYL	YRL	CWYL	UND
Mule Deer	23,845	-	1108	-
Elk	-	55	-	24,898
Pronghorn	22,520	-	2,433	-

[1] - WYL: Winter/Yearlong, YRL: Yearlong, CWYL: Crucial Winter/Yearlong, UND: Undetermined

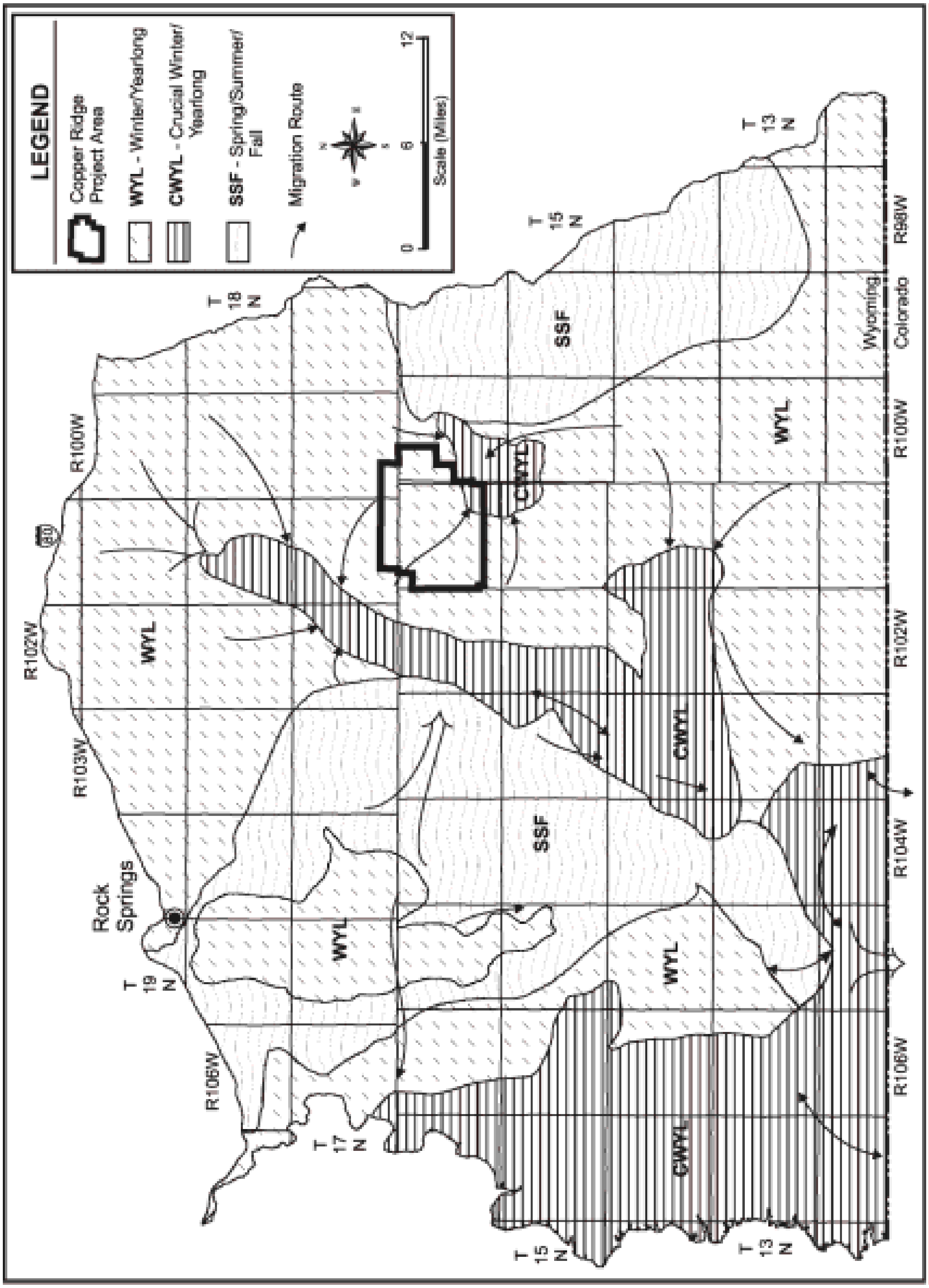


Figure 3-8. South Rock Springs Mule Deer Herd Unit Seasonal Ranges in Relation to the CRPA.

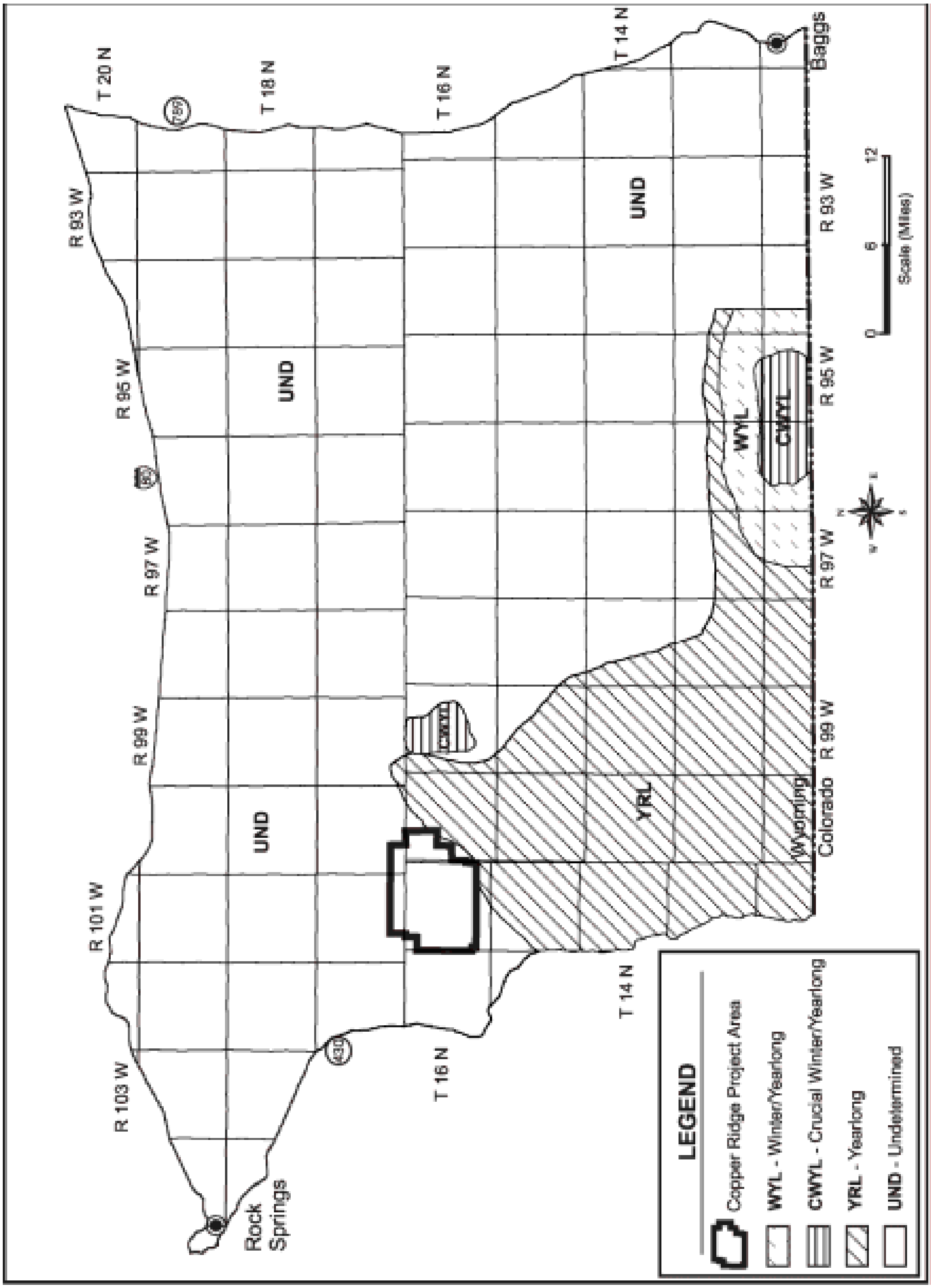


Figure 3-9. Petition Elk Herd Unit Seasonal Ranges in Relation to the CRPA.

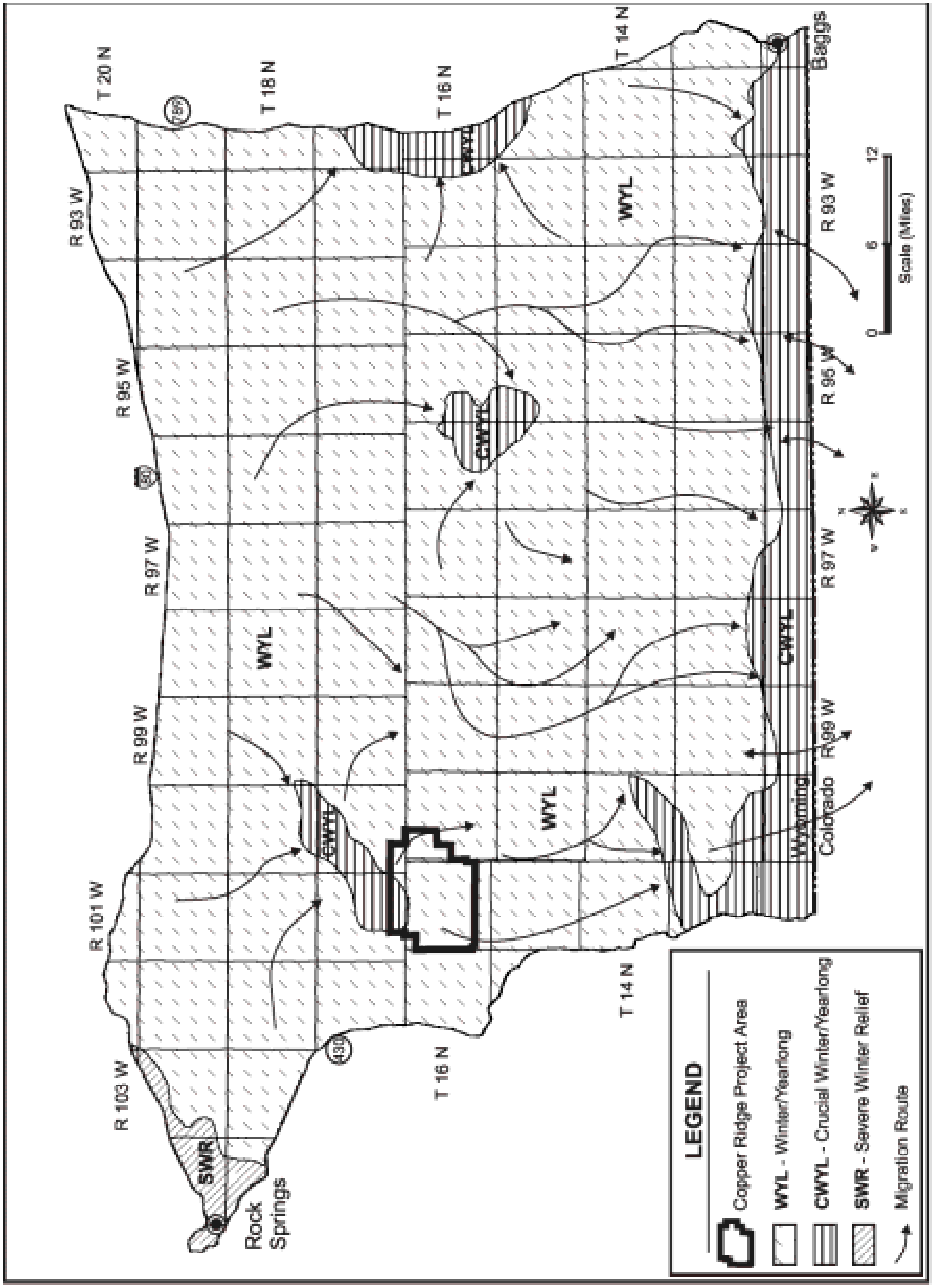


Figure 3.10. Bitter Creek Pronghorn Herd Unit in Relation to the CRPA.

3.7.5 Wild Horses

The CRPA lies within the Salt Wells and Adobe Town Wild Horse Herd Management Areas (HMA), which encompasses about 1,573,585 acres. Boundaries of the HMAs extend from Highway 191 south of Rock Springs east into to the Rawlins Field Office area boundary and south to the Wyoming-Colorado state line (USDI-BLM 1999). The total surface area of the CRPA represents about 1.5% of the total land surface area of the two HMAs.

The BLM establishes an appropriate management level (AML) for each HMA. The AML is the population objective for the HMA that will ensure a thriving ecological balance among all the users and resources of the HMA. The AML for the Salt Wells HMA ranges from 251 to 365 (USDI-BLM 1999). The current (11.17.03) wild horse population estimate for the Salt Wells HMA is 345 animals due to recent gathering operations. The Adobe town HMA is managed by the Rawlins Field Office. Both HMAs share a common, unfenced boundary.

With no known natural predators, the historical annual rate of increase in wild horse populations in the RSFO area is about 20 percent (USDI-BLM 1999). The human-made hazards to wild horses in the CRPA of importance would be roads and fences. High traffic levels increase the potential for human-caused injuries. Minimal fencing exists in the HMA; these are mostly associated with deeded property or associated with major highways (i.e., Interstate 80, Highways 191 and 430). Most grazing allotments as well as checkerboard lands are unfenced in the Salt Creek HMA (USDI-BLM 1999).

3.7.6 Upland Game Birds

The greater sage-grouse and mourning dove are the only upland game bird species known to occur on or around the project area, which lies within the Flaming Gorge Upland Game Management Area (UGMA # 6).

Greater Sage-Grouse. The greater sage-grouse is the upland game bird of primary interest in the project area. The greater sage-grouse is identified by the RSFO of the BLM as a sensitive species, and it has declined over much of its range in the western states during recent years and may be petitioned for listing under the ESA by the USFWS. Populations in Wyoming have recently been in a decline due to a wide range of possible factors including drought, habitat loss, and habitat degradation.

The project area is located within the extensive sagebrush steppe habitat of southern Wyoming where greater sage-grouse are common. Important habitats are strutting grounds (leks), nesting areas, brood-rearing areas, and wintering areas. All of these sage-grouse habitats may occur in a contiguous or patchy and disconnected pattern. Leks may be located between summer and winter ranges, but in some cases, summer and winter ranges may be the same (Call and Maser 1985). According to Call (1974), Braun et al. (1977), and Hayden-Wing et al. (1986), preferred nesting habitat is usually located within two miles of leks.

The estimated greater sage-grouse harvest in UGMA # 6 in 2001 was 812 sage grouse, roughly 6.4% of the statewide harvest (WGFD 2002b).

Sage grouse lek locations on and within two miles of the border of the project area, were obtained through the BLM Rock Springs Field Office: two documented leks within the project area boundary and two documented leks within a 2-mile buffer of the project area boundary

(Figure 3-9). Field surveys were conducted during April, 2003 to determine which leks were being used by sage grouse. At the time of the surveys, the four previously documented leks were active, with 6-20 males displaying at each lek. In addition, three strutting males were observed approximately ¼ mile south of the lek located in Section 8, T16N:R101W.

Mourning Dove. Mourning doves are found west of the project area during the spring and summer months (WGFD 2002c) and are associated with sagebrush-grass, mountain shrub, and riparian habitats. It is likely that some mourning doves utilize the CRPA during the breeding season. Brood production is tied closely to spring and summer precipitation. Availability of sufficient seeds and water likely increases mourning dove productivity. The estimated mourning dove harvest for UGMA # 6 in 2001 was 537 (WGFD 2002b) out of 29,075 for the entire state.

3.7.7 Waterfowl and Shorebirds

Primary use of the project area by waterfowl and shorebirds is minimal because of the small amount of open water and wetlands available (see Section 3.5.2). However, the limited wetlands available may still provide adequate cover and nesting habitat for a limited number of waterfowl.

3.7.8 Raptors

According to the WOS data (WGFD 2002c), two raptor species have been observed on or within six miles of the CRPA: ferruginous hawk (*Buteo regalis*) and bald eagle (*Haliaeetus leucocephalus*). Data from the BLM Rock Springs Field Office show records, from 1986, of eight raptor nests on or within two miles of the project area: seven golden eagle nests and one ferruginous hawk nest.

An aerial survey of the CRPA and surrounding 1-mile buffer was conducted by HWA on June 6, 2003 to locate and determine the activity status of raptor nests. The CRPA and 1-mile buffer area was overflown in a 180 Cessna aircraft; transects were flown approximately ½ mile apart and at 100-200 feet above the ground. All nest locations obtained from the BLM were checked and any new nests were documented and their location recorded. A ground survey was conducted on June 13, 2003 to verify findings of the aerial survey. No active raptor nests were found on the CRPA or 1-mile buffer area. Six inactive Golden Eagle nests and 7 inactive Ferruginous Hawk nests were found (Figure 3-11).

3.8 SPECIAL STATUS WILDLIFE, FISH, AND PLANT SPECIES

Special status species include: (1) threatened, endangered, candidates, or those petitioned for listing as threatened or endangered by the FWS under the Endangered Species Act (ESA) of 1973, as amended; and (2) those designated by the BLM State Director as sensitive (USDI-BLM 2002).

3.8.1 Threatened, Endangered or Proposed for Listing Species of Wildlife, Fish, and Plants

The FWS has determined that one mammal, three bird, four fish, and one plant species listed as either threatened, endangered, candidate or proposed under the ESA may potentially be found

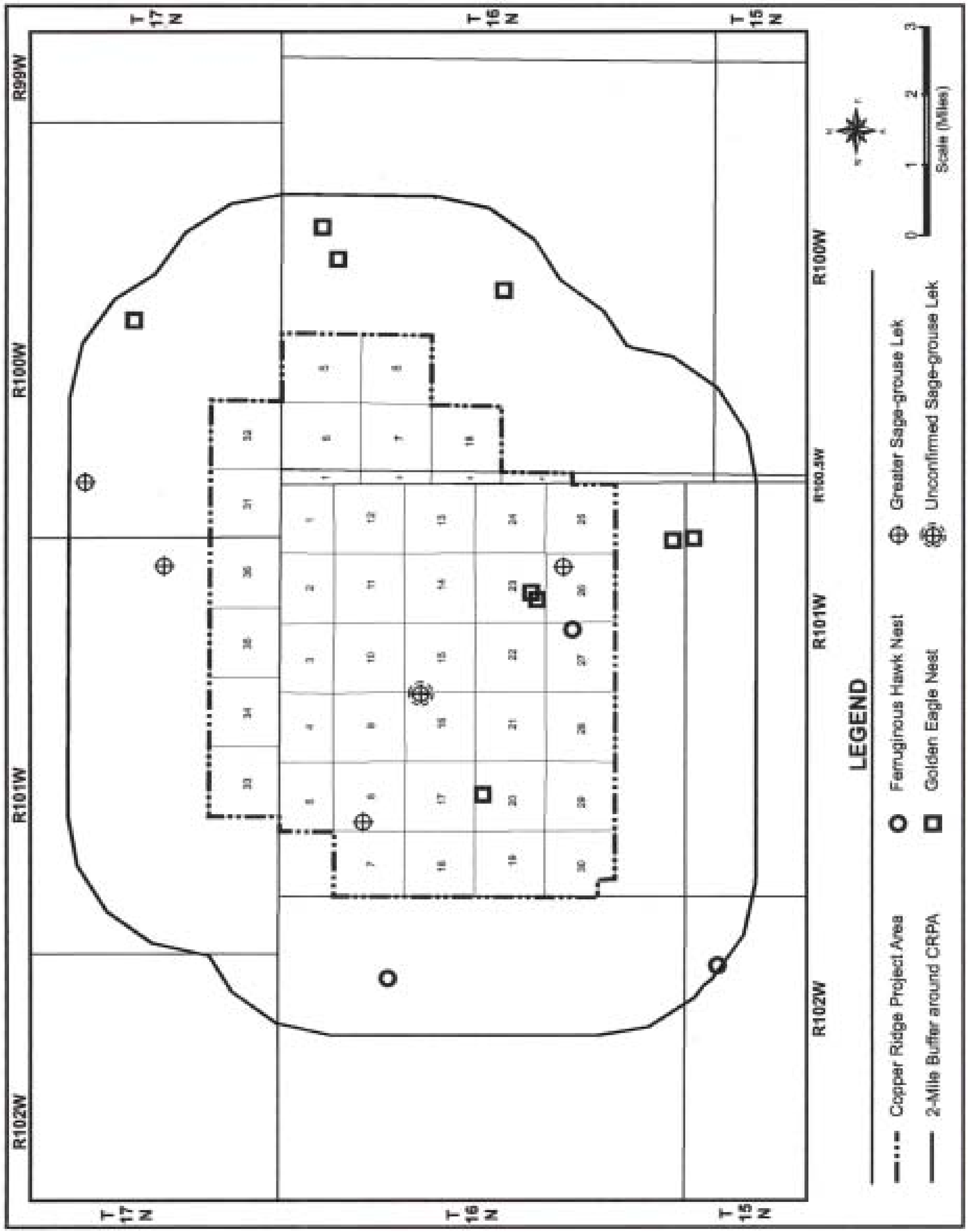


Figure 3-11. Raptor Nest and greater sage-grouse Lek Locations in Relation to the CRPA.

in the project area or be affected by activities conducted on the project area (USDI-FWS 2002a). These species and their federal status under the ESA are listed in Table 3-9. The black-footed ferret, bonytail, Colorado pikeminnow, humpback chub, and razorback sucker are listed as endangered. The yellow-billed cuckoo is a candidate for listing as endangered under the ESA and the bald eagle and Ute ladies'-tresses are classified as threatened. Four endangered fish species, which are downstream residents of the Colorado River System, are included in this analysis because of potential impacts to their habitat. The mountain plover was a species proposed for listing as threatened when public scoping occurred but the FWS has since determined the species does not warrant listing. BLM treats this species as a sensitive species (see Section 3.8.2.2).

Table 3-9. Threatened, endangered, proposed, and candidate species potentially affected by or present on the CRPA.

Species	Scientific Name	Status
Mammals		
Black-footed ferret	*Mustela nigripes*	Endangered
Birds		
Bald eagle	*Haliaeetus leucocephalus*	Threatened
Yellow-billed cuckoo	*Coccyzus americanus*	Candidate
Fish		
Bonytail	*Gila elegans*	Endangered
Colorado pikeminnow	*Ptychocheilus lucius*	Endangered
Humpback chub	*Gila cypha*	Endangered
Razorback sucker	*Xyrauchen texanus*	Endangered
Plants		
Ute ladies'-tresses	*Spiranthes diluvialis*	Threatened
Source: USDI-FWS 2002		

3.8.1.1 Mammals

Black-footed Ferret and Associated White-tailed Prairie Dog Colonies. The black-footed ferret's original distribution in North America closely corresponded to that of prairie dogs (Hall and Kelson 1959, Fagerstone 1987). In Wyoming, white-tailed prairie dog (*Cynomys leucurus*) colonies provide essential habitat for black-footed ferrets. Black-footed ferrets depend almost exclusively on prairie dogs for food and they also use prairie dog burrows for shelter, parturition, and raising their young (Hillman and Clark 1980, Fagerstone 1987). Based upon communications with the RSFO and a query of species locations from the WYNDD (2002) and the WOS (WGFD 2002c), it is known that several small white-tailed prairie dog colonies do exist on the project area. Existing white-tailed prairie dog colonies located on the CRPA were mapped by HWA on April 29 and May 1, 2003. Boundaries of the colonies were mapped from the ground using a hand-held GPS receiver. Four small colonies are located in the northern portion of the CRPA; these colonies cover a total of 279.8 acres, with 180.5 acres occurring within the CRPA boundary (Figure 3-12). One of the four colonies, which covered 43.7 acres, was not active during the spring of 2003. Therefore, a total of 136.8 acres of active white-tailed prairie dog colonies occurs on the CRPA. The BLM has made a “no effect” determination for presence of black-footed ferrets for which the FWS has concurred (August 29, 2003). Black-footed ferrets will not be given further consideration in this analysis.

3.8.1.2 Birds

Bald Eagle. Bald eagles typically build stick nests in the tops of coniferous or deciduous trees along streams, rivers, or lakes. Selection of nests likely depends upon availability of food in the early nesting season (Swenson et al. 1986). The habitat on the project area lacks large perennial water bodies and nesting trees for bald eagles, therefore nesting on the project area is not likely. Wintering areas are typically associated with concentrations of food sources including major rivers that remain unfrozen where fish and waterfowl are available and ungulate winter ranges where carrion is available. One record of bald eagle occurrence within six miles of the project area was recorded in the WOS in August 1987 (WGFD 2002c). Although nesting and wintering habitat is limited, bald eagles may occasionally utilize the project area for hunting habitat. The BLM has made a “no effect” determination for the bald eagle and this species will not be considered further in this analysis.

Yellow-billed Cuckoo. The yellow-billed cuckoo is a neotropical migrant that winters primarily in South America and migrates north into the United States during April and May. The yellow-billed cuckoo feeds primarily on large insects: caterpillars, katydids, cicadas, grasshoppers, and crickets. Occasionally small frogs, lizards, eggs, and young birds are eaten (Hughes 1999). It is a riparian obligate species that requires at least 25 acres of mature riparian woodland, especially cottonwood (*Populus* spp.) or willow (*Salix* spp.) with low, dense undergrowth at elevations below 7,000 feet. The cuckoo prefers 100 acres or more of deciduous woodland at least 100 meters wide. Marginal habitat is at least 10 acres of riparian habitat more than 50 meters in width. Nests are located less than 8 meters above the ground in at least 2.5 acres of dense deciduous vegetation near water (Cerovski et al. 2001).

Due to the lack of adequate habitat on the project area and the fact that no records are documented within six miles of the project area (WGFD 2002c, WYNDD 2002) it is unlikely that the yellow-billed cuckoo occurs on the project area. Thus, this species will not be considered further in this analysis.

3.8.1.3 Fish Species

The Copper Ridge Project Area is located in the Green River drainage of southwest Wyoming. The project area is drained by intermittent/ephemeral streams fed primarily by runoff of winter snows. Four federally endangered fish species may occur as downstream residents of the Colorado River system: bonytail, Colorado pikeminnow, humpback chub, and razorback sucker (USDI-FWS 2002a). However, these fish species are likely extirpated from the Colorado River system above Flaming Gorge Dam on the Green River (Baxter and Stone 1995). None of these four endangered fish species is likely to be found in streams and tributaries within the project area. However, the potential for project-related impacts (water quality or quantity reduction) to waters that feed into the Green River warrant their inclusion in this NEPA document.

Bonytail. Habitat of the bonytail is primarily limited to narrow, deep canyon-bound rivers with swift currents and white water areas (Valdez and Clemmer 1982, Archer et al. 1985, Upper Colorado River Endangered Fish Recovery Program 2002). Little is known about the specific habitat requirements of bonytail but it is thought that flooded bottomland habitats are

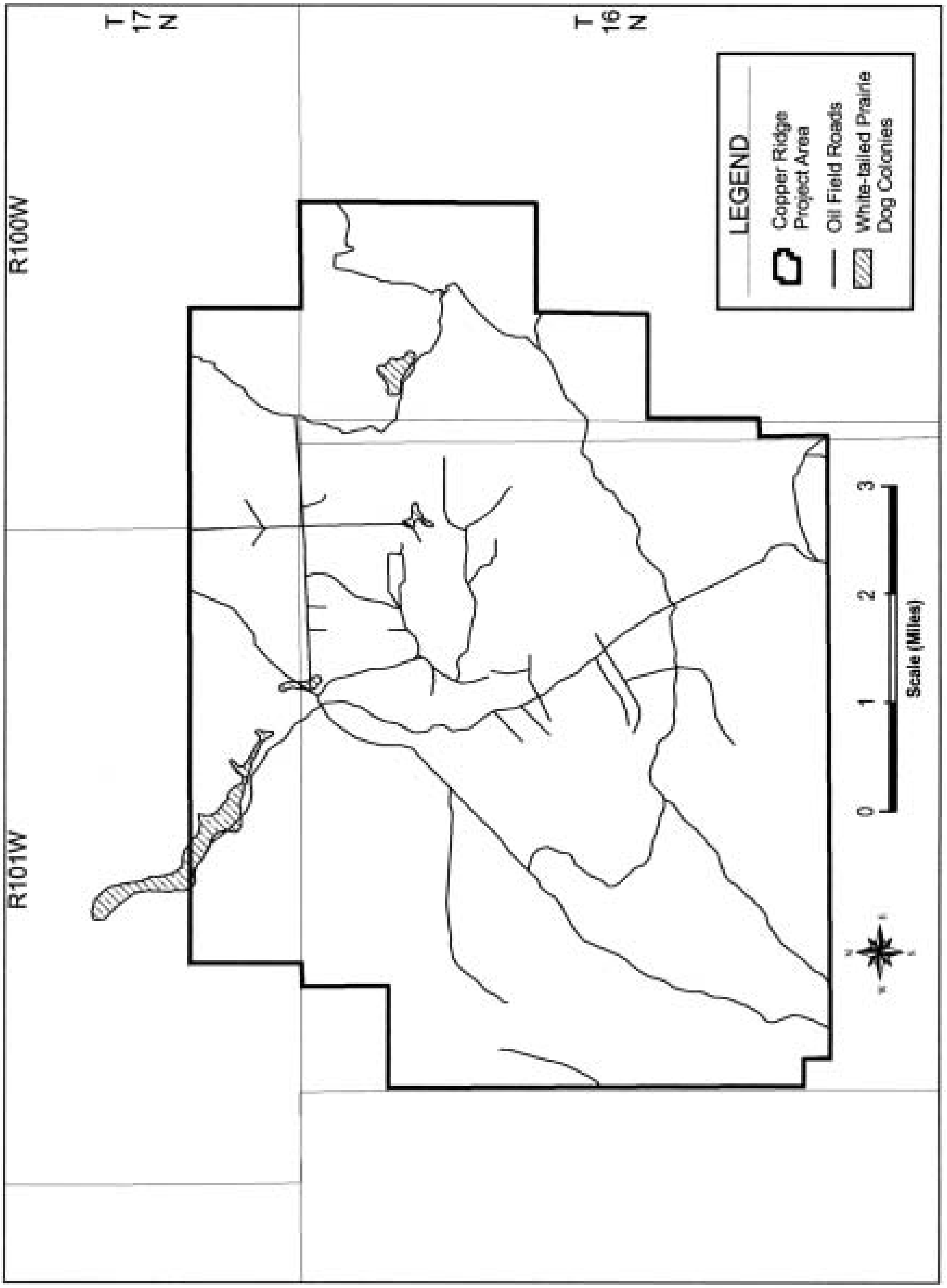


Figure 3-12. White Tailed Prairie Dog Colonies in Relation to the CRPA.

important nursery and growth areas for young. Adults reach a maximum size of 550 mm (21.7 in) in length and 1.1 kg (2.4 lbs) in weight (USDI-FWS 2002b). With no known reproducing populations in the wild, the bonytail is thought to be the rarest of the endangered fishes in the Colorado River Basin. The bonytail was historically found in portions of the upper and lower Colorado River basins. Today, in the upper Colorado River Basin, only small, disjunct populations of bonytail are thought to exist in the Yampa River in Dinosaur National Monument, in the Green River at Desolation and Gray canyons, and in the Colorado River at the Colorado/Utah border and in Cataract Canyon (Upper Colorado River Endangered Fish Recovery Program 2002).

Colorado Pikeminnow. The Colorado pikeminnow is the largest member of the minnow family and occurs in swift, warm waters of Colorado Basin rivers. Adults attain a maximum size of approximately 1.8 meters (5.9 feet) in length and 36 kg (79.4 lbs) in weight (USDI-FWS 2002c). The species is adapted to rivers with seasonally variable flow, high silt loads, and turbulence. Pools and eddies outside the main current are used by adult pikeminnow. Backwater areas are inhabited by young-of-the-year. The species was once abundant in the main stem of the Colorado River and most of its major tributaries throughout Wyoming, Colorado, Utah, New Mexico, Arizona, Nevada, California, and Mexico. Today the species is primarily limited to the Green River below its confluence with the Yampa River; the lower Duchesne River in Utah; the Yampa River below Craig, Colorado; the White River from Taylor Draw Dam near Rangely, downstream to the confluence with the Green River; the Gunnison River in Colorado; and the Colorado River from Palisade, Colorado, downstream to Lake Powell (Upper Colorado River Endangered Fish Recovery Program 2002); and there are small numbers of wild individuals, with limited reproduction, in the San Juan River subbasin. The Colorado pikeminnow has been reintroduced into the Gila River subbasin, where it exists in small numbers in the Verde River (USDI-FWS 2002c).

Humpback Chub. Humpback chub are restricted to deep, swift, canyon regions of the mainstem and large tributaries of the Colorado River Basin. Adults attain a maximum length of 480mm (18.9 in) and 1.2 kg (2.6 lbs) in weight (USDI-FWS 2002d). Historically, the humpback chub inhabited the canyons of the Colorado River and four of its tributaries: the Green, Yampa, White, and Little Colorado rivers. Now, two relatively stable populations are found in Westwater Canyon, Utah and Black Rocks, Colorado. Smaller numbers have been found in the Yampa and Green Rivers in Dinosaur National Monument, Desolation and Gray canyons on the Green River in Utah, Cataract Canyon on the Colorado River in Utah, and the Colorado River in Arizona. The largest known population is in the Little Colorado River in the Grand Canyon, where there may be up to 10,000 fish. There are no population estimates available for the rest of the upper Colorado River Basin (Upper Colorado River Endangered Fish Recovery Program 2002).

Razorback Sucker. The razorback sucker, an omnivorous bottom feeder, is one of the largest fishes in the sucker family reaching a length of 1 meter (3.3 ft) in length and 5-6 kg (11-13 lbs) in weight (USDI-FWS 2002e). Adult razorback sucker habitat use varies depending on season and location. Adults are adapted for swimming in swift currents, but they may also be found in eddies and backwaters away from the main current. Young require nursery habitats consisting of quiet, warm, shallow water, such as backwaters or inundated floodplains, river tributary mouths, and coves and shorelines in reservoirs (USDI-FWS 2002e). This species was once widespread throughout most of the Colorado River Basin from Wyoming to Mexico. Today, in the upper Colorado River Basin, populations of razorback suckers are only found in the upper Green River in Utah, the lower Yampa River in Colorado and occasionally in the Colorado River near Grand Junction. Small numbers of razorback suckers have also been found in Lake Powell, San Juan River, and Colorado River (Upper Colorado River Endangered Fish Recovery Program 2002).

3.8.1.4 Plant Species

Ute ladies'-tresses. The Ute ladies'-tresses (*Spiranthes diluvialis*), a threatened species, is a perennial, terrestrial orchid, endemic to moist soils near wetland meadows, springs, lakes, and perennial streams. It occurs generally in alluvial substrates along riparian edges, gravel bars, old oxbows, and moist to wet meadows at elevations from 4,200 to 7,000 feet. The orchid colonizes early successional riparian habitats such as point bars, sand bars, and low-lying gravelly, sandy, or cobbly edges, persisting in those areas where the hydrology provides continual dampness in the root zone through the growing season. It is known to occur in a number of locations in Daggett County, Utah, with the closest being about 39 miles south of the project area and also along the Snake River in Idaho. Because potential habitat for the plant is present in Sweetwater County, the FWS requires the BLM to conduct field surveys for its presence to satisfy NEPA requirements for EAs and EISs. The probability of suitable habitat for this species occurring on the CRPA is very low. The BLM has made a "no effect" determination; thus, this species will not be given further consideration in this document.

3.8.2 Sensitive Wildlife, Fish, and Plant Species

Although these species have no legal protection under the ESA, the BLM and FWS still maintain an active interest in their numbers and status. Sensitive species are those included on the BLM Wyoming State sensitive species list (USDI-BLM 2002). The BLM views "management of sensitive species as an opportunity to practice pro-active conservation; this management should not be onerous, or a show-stopper of other legitimate, multiple use activities" (USDI-BLM 2002). The BLM Wyoming Sensitive Species list is meant to be dynamic, and the list will be reviewed annually. The plant, wildlife, and fish species and their sensitivity status/rank are listed in Table 3-10. A summary discussion of these species follows. In addition, the RSFO identified several of these species to be considered in more detail.

3.8.2.1 Mammals

Nine sensitive mammal species may potentially be found on the CRPA (USDI-BLM 2002, Table 3-5). These include: Idaho pocket gopher, Wyoming pocket gopher, pygmy rabbit, white-tailed prairie dog, swift fox, spotted bat, fringed myotis, long-eared myotis, and Townsend's big-eared bat. The RSFO identified four of these species that should be considered in more detail: swift fox, Wyoming pocket gopher, pygmy rabbit, and white-tailed prairie dog.

Swift Fox. The swift fox inhabits short grass and mid-grass prairies over most of the Great Plains including eastern Wyoming (Clark and Stromberg 1987). The swift fox commonly prefers areas with relatively flat to gently rolling topography (Fitzgerald et al. 1994, Olson 2000). Swift foxes prey on a variety of small rodents, lagomorphs, birds, and insects (Cutter 1958, Olson 2000). This species has been studied in Wyoming (Olson 2000), and recent surveys conducted by Woolley et al. (1995) show that it is much more widely distributed in Wyoming than previously thought. Woolley's studies have documented occurrences in northeastern Sweetwater County but his study area did not include the Copper Ridge Project Area in southern Sweetwater County.

No records of swift fox were documented in the WOS (WGFD 2002c) or WYNDD (WYNDD 2002) within six miles of the project area. Although the majority of the project area is not ideal habitat, some portions of the project area may provide limited foraging habitat for swift fox.

Wyoming Pocket Gopher. Little is known about the Wyoming pocket gopher. The species is the only mammal restricted to Wyoming, and the only known populations occur in the south-central portion of the state (Clark and Stromberg 1987).

Like all pocket gophers, the Wyoming pocket gopher spends most of its life underground. The species is frequently found along dry ridge tops and is associated with gravelly, loose soils and greasewood vegetation communities (*Sarcobatus* spp.) (Clark and Stromberg 1987). Within these habitats, the Wyoming pocket gopher digs two types of tunnels: (1) deep burrows with chambers used for shelter, nesting, food storage, and deposition of fecal material, and (2) long, winding, and shallow tunnels used to forage for roots, tubers, and other vegetation material from above (Nowak 1999). The shallow food tunnels are often visible from the ground surface and are useful in detecting the presence of pocket gophers. The limited behavioral information available on the species suggests that except during the breeding season, Wyoming pocket gophers lead solitary lives with only one individual per burrow system (Nowak 1999).

Limited potential habitat exists within the project area for Wyoming pocket gophers. Although the species has not been documented within a six-mile radius of the project area (WGFD 2002c, WYNDD 2002), its fossorial behavior makes the Wyoming pocket gopher difficult to detect.

Pygmy Rabbit. The former range of the pygmy rabbit was thought to be limited to portions of Idaho and Utah until their presence was confirmed in southwest Wyoming (Campbell et al. 1982). Pygmy rabbit sightings were documented by HWA in1994 south of Fontenelle Reservoir in eastern Lincoln and western Sweetwater Counties (HWA 1994). Pygmy rabbits are limited to areas of dense and tall big sagebrush in predominantly sandy soils (Campbell et al. 1982, Clark and Stromberg 1987, Heady et al. 2002). Burrows are located in areas with greater cover, higher shrub density, taller vegetation, and greater forb cover (Heady et al. 2002).

No pygmy rabbit records within six miles of the project area were documented in the WOS (WGFD 2002c) or the WYNDD (WYNDD 2002). The project area is primarily dominated by Wyoming big sagebrush and it is possible that pygmy rabbits could occur on the project area.

3.8.2.2 Birds

Thirteen sensitive bird species may potentially be found on the CRPA (USDI-BLM 2002, Table 3-5). These include: mountain plover, sage sparrow, Brewer's sparrow, long-billed curlew, sage thrasher, western burrowing owl, loggerhead shrike, greater sage-grouse (See Section 3.7.6), white-faced Ibis, trumpeter swan, peregrine falcon, ferruginous hawk, and northern goshawk. The RSFO requested that the mountain plover, sage thrasher, loggerhead shrike, Brewer's sparrow, sage sparrow, and burrowing owl be considered in more detail.

Mountain Plover. The mountain plover nests over much of Wyoming, but its preferred habitat may be limited throughout its range in the state (Oakleaf et al. 1982, Dinsmore 1983, Leachman and Osmundson 1990). This ground-nesting species is typically found in areas of short (less than four inches) vegetation on slopes of less than three percent. Any short grass, very short shrub, or cushion plant community could be considered plover nesting habitat (Parrish et al. 1993), however, mountain plovers prefer shortgrass prairie with open, level or slightly rolling

Table 3-10. Sensitive Wildlife, Fish, and Plant Species Potentially Present in the CRPA.[1]

Wildlife Species			
Common Name	**Scientific Name**	**Sensitivity Status**[2]	**Occurrence Potential**[3]
Mammals			
Idaho pocket gopher	*Thomomys idahoensis*	G4/S2?, NSS3	Unlikely
Wyoming pocket gopher	*Thomomys clusius*	R2, G2/S1S2, NSS4	Likely
Pygmy rabbit	*Brachylagus idahoensis*	G4/S2, NSS3	Possible
White-tailed prairie dog	*Cynomys leucurus*	G4/S2S3, NSS3	Present
Swift fox	*Vulpes velox*	R2, G3/S2A3	Possible
Spotted bat	*Euderma maculatum*	R2/R4,G4/S1B, SZ?N, NSS2	Unlikely
Fringed myotis	*Myotis thysanodes*	R2, G5/S1B, S1N, NSS2	Unlikely
Long-eared myotis	*Myotis evotis*	G5/S1B, S1?N, NSS2	Unlikely
Townsend's big-eared bat	*Corynorhinus townsendii*	R2/R4, G4/S1B, S2N, NSS2	Unlikely
Birds			
Mountain Plover	*Charadrius montanus*	G2/S2B,SZN	Unlikely
Sage Sparrow	*Amphispiza belli*	G5/S3B, SZN	Possible
Brewer's Sparrow	*Spizella breweri*	G5/S3B, SZN	Possible
Long-billed Curlew	*Numenius americanus*	G5/S3B, SZN, R2, NSS3	Unlikely
Sage Thrasher	*Oreoscoptes montanus*	G5/S3B, SZN	Likely
Western Burrowing Owl	*Athene cunicularia*	R2, G4/S3B, SZN, NSS4	Possible
Loggerhead Shrike	*Lanius ludovicianus*	G5/S4B, SZN, R2	Likely
greater sage-grouse	*Centrocercus urophasianus*	G5/S3	Present
White-faced Ibis	*Plegadis chihi*	G5/S1B, SZN, R2, NSS3	Unlikely
Trumpeter Swan	*Cygnus buccinator*	R2/R4, G4/S1B, S2N, NSS2	Unlikely
Peregrine Falcon	*Falco peregrinus*	G4/T3/S1B, S2N, R2, NSS3	Unlikely
Ferruginous Hawk	*Buteo regalis*	R2, G4/S3B, S3N, NSS3	Present
Northern Goshawk	*Accipiter gentilis*	R2/R4, G5/S23B, S4N, NSS4	Unlikely
Reptiles			
Midget-faded rattlesnake	*Crotalus viridis concolor*	G5T3/S1S2	Unlikely
Amphibians			
Boreal toad	*Bufo boreas boreas*	G4T4/S2, R2, R4, NSS2	Unlikely
Great Basin spadefoot toad	*Spea intermontanus*	G5/S4, NSS4	Possible
Northern leopard frog	*Rana pipiens*	G5/S3, R2, NSS4	Unlikely
Spotted frog	*Rana pretiosa*	G4/S2S3, R2, R4, NSS4	Unlikely
Fish			
Leatherside chub	*Gila copei*	G3G4/S2, NSS1	Unlikely
Roundtail chub	*Gila robusta*	G2G3/S2?, NSS1	Unlikely
Bluehead sucker	*Catostomus discobolus*	G4/S2S3, NSS1	Unlikely
Flannelmouth sucker	*Catostomus latipinnis*	G3G4/S3, NSS1	Unlikely
Colorado River cutthroat trout	*Oncorhynchus clarki pleuriticus*	R2/R4, G4T2T3/S2, NSS2	Unlikely

Table 3-10. Sensitive Wildlife, Fish, and Plant Species Potentially Present in the CRPA.[1]

Plant Species				
Common Name	**Scientific Name**	**Sensitivity Status[2]**	**Habitat**	**Occurrence Potential[3]**
Meadow pussytoes	*Antennaria arcuata*	GS/S2	Moist, hummocky meadows, seeps or springs surrounded by sage/grasslands 4,950-7,900'	low
Small rock cress	*Arabis pusilla*	G1/S1 Removed from Federal Candidate list 10/25/99	Cracks/crevices in sparsely vegetated granite/pegmalile outcrops within sage/grasslands 8,000-8,100'	low
Mystery wormwood	*Artemisia biennis var. diffusa*	G5T1/S1	Clay flats and playas 6,500'	low; known-private land ownership
Nelson's milkvetch	*Astragalus nelsonianus*	G2/S2 CO	Alkaline clay flats, shale bluffs and gullies, pebbly slopes, and volcanic cinders in sparsely vegetated sagebrush, juniper, and cushion plant communities at 5,200-7,600'	low
Precocious milkvetch	*Astragalus proimanthus*	G1/S1, BLM	Cushion plant communities on rocky, clay soils mixed with shale on summits and slopes of white shale hills at 6,800-7,200 feet.	low
Cedar Rim thistle	*Cirsium aridum*	G2Q/S2	Barren, chalky hills, gravelly slopes and fine textured, sandy-shaley draws 6,700-7.200'	possible
Ownbey's thistle	*Cirsium ownbeyi*	G3/S2	Sparsely vegetated shaley slopes in sage and juniper communities 6,440-8,400;	low
Wyoming tanseymustard	*Descurania torulosa*	G1/S1	Sparsely vegetated sandy slopes at base of cliffs of volcanic breccia or sandstone 8,300-10,000'	low
Large-fruited bladderpod	*Lesquerella macrocarpa*	G2/S2	Gypsum-clay hills and benches, clay flats, and barren hills 7,200-7,700'	low
Stemless beardtongue	*Penstemon acaulis var. acaulis*	G3T2/S1	Cushion plant or black sage grassland communities on semi-barren rocky ridges, knolls, and slopes at 6,500-7,000'	low
Beaver Rim phlox	*Phlox pungens*	G2/S2	Sparsely vegetated slopes on sandstone, siltstone, or limestone substrates 6,000-7,600'	possible
Tufted twinpod	*Physaria condensata*	G2/S2	Sparsely vegetated shale slopes and ridges 6,500-7,000''	possible
Green River greenthread	*Thelesperma caespitosum*	G1/S1	White shale slopes and ridges of Green River Formation 6,300'	low
Uinta greenthread	*Thelesperma pubescens*	G1/S1 FSR4	Sparsely vegetated benches and ridges on coarse, cobbly soils of Bishop Conglomerate 8,500'	low
Cedar Mountain Easter daisy	*Townsendia mircrocephala*	G1/S1	Rocky slopes of Bishop Conglomerate 8,500'	low

[1] - Source: USDI-BLM (2002), WYNDD (2002), WGFD (2002).
[2] - Definition of status

G Global rank: Rank refers to the range-wide status of a species.
T Trinomial rank: Rank refers to the range-wide status of a subspecies or variety.
S State rank: Rank refers to the status of the taxon (species or subspecies) in Wyoming. State ranks differ from state to state.
1 Critically imperiled because of extreme rarity (often known from 5 or fewer extant occurrences or very few remaining individuals) or because some factor of a species' life history makes it vulnerable to extinction.
2 Imperiled because of rarity (often known from 6-20 occurrences) or because of factors demonstrably making a species vulnerable to extinction.
3 Rare or local throughout its range or found locally in a restricted range (usually known from 21-100 occurrences).
4 Apparently secure, although the species may be quite rare in parts of its range, especially at the periphery.
5 Demonstrably secure, although the species may be rare in parts of its range, especially at the periphery.
H Known only from historical records. 1950 is the cutoff for plants; 1970 is the cutoff date for animals.
X Believed to be extinct.
A Accidental or vagrant: A taxon that is not known to regularly breed in the state or which appears very infrequently (typically refers to birds and bats).
B Breeding rank: A state rank modifier indicating the status of a migratory species during the breeding season (used mostly for migratory birds and bats)
N Nonbreeding rank: A state rank modifier indicating the status of a migratory species during the non-breeding season (used mostly for migratory birds and bats)
ZN or ZB Taxa that are not of significant concern in Wyoming during breeding (ZB) or non-breeding (ZN) seasons. Such taxa often are not encountered in the same locations from year to year.
U Possibly in peril, but status uncertain; more information is needed.
Q Questions exist regarding the taxonomic validity of a species, subspecies, or variety.
? Questions exist regarding the assigned G, T, or S rank of a taxon.
R2 Designated sensitive in U.S. Forest Service Region 2 (Rocky Mountain Region).
R4 Designated sensitive in U.S. Forest Service Region 4 (Intermountain Region).

WGFD Native Species Status Codes - Fish and Amphibians

NSS1 - Populations are physically isolated and/or exist at extremely low densities throughout range. Habitats are declining or vulnerable. Extirpation appears possible. The Wyoming Game and Fish Commission mitigation category for Status 1 species is "Vital". The mitigation objective for this resource category is to realize "no loss of habitat function". Under these guidelines, it will be very important that the project be conducted in a manner that avoids alteration of habitat function.
NSS2 - Populations are physically isolated and/or exist at extremely low densities throughout range. Habitat conditions appear to be stable. The Wyoming Game and Fish Commission mitigation category for Status 2 species is also "Vital". The mitigation objective for this resource category is to realize "no loss of habitat function". Under these guidelines, it will be very important that the project be conducted in a manner that avoids alteration of habitat function.
NSS3 - Populations are widely distributed throughout its native range and appear stable. However, habitats are declining or vulnerable. The Wyoming Game and Fish Commission mitigation category for Status 3 species is "High". The mitigation objective for this resource category is to realize "no net loss of habitat function within the biological community which encompasses the project site". Under these guidelines, it will be important that the project be conducted in a manner that either avoids the impact, enhances similar habitat or results in the creation of an equal amount of similarly valued fishery habitat.
NSS4-7 - Populations are widely distributed throughout native range and are stable or expanding. Habitats are also stable. There is no special concern for these species.
WGFD Native Species Status Codes - Birds and Mammals
NSS1 - Populations are greatly restricted or declining, extirpation appears possible. AND On-going significant loss of habitat.
NSS2 - Populations are declining, extirpation appears possible; habitat is restricted or vulnerable but no recent or on-going significant loss; species may be sensitive to human disturbance. OR Populations are declining or restricted in numbers and/or distribution, extirpation is not imminent; ongoing significant loss of habitat.
NSS3 - Populations are greatly restricted or declining, extirpation appears possible; habitat is not restricted, vulnerable but no loss; species is not sensitive to human disturbance. OR Populations are declining or restricted in numbers and/or distribution, extirpation is not imminent; habitat is restricted or vulnerable but no recent or on-going

significant loss; species may be sensitive to human disturbance. OR Species is widely distributed; population status or trends are unknown but are suspected to be stable; on-going significant loss of habitat.
NSS4 - Populations are declining or restricted in numbers and/or distribution, extirpation is not imminent; habitat is not restricted, vulnerable but no loss; species is not sensitive to human disturbance. OR Species is widely distributed, population status or trends are unknown but are suspected to be stable; habitat is restricted or vulnerable but no recent or on-going significant loss; species may be sensitive to human disturbance.
NSS5 - Populations are declining or restricted in numbers and/or distribution, extirpation is not imminent; habitat is stable and not restricted. OR Species is widely distributed, population status or trends are unknown but are suspected to be stable; habitat is not restricted, vulnerable but no loss; species is not sensitive to human disturbance.
NSS6 - Species is widely distributed, population status or trends are unknown but are suspected to be stable; habitat is stable and not restricted.
NSS7 - Populations are stable or increasing and not restricted in numbers and/or distribution; habitat is stable and not restricted.

[3] - Occurrence potential based upon presence of habitat, known distribution, and personal communications with RSFO biologists J. Dunder (wildlife) and J. Glennon (botany).

areas dominated by blue grama and buffalograss (Graul 1975, Dinsmore 1981, Dinsmore 1983, Kantrud and Kologiski 1982). These habitats are quite often associated with prairie dog colonies, and researchers have found that plovers use prairie dog colonies more often than other areas (Knowles et al. 1982, Knowles and Knowles 1984, Olson and Edge 1985). Loss of wintering and breeding habitats and prey-base declines from pesticide use are thought to be factors contributing to the decline of mountain plovers on the North American Continent (Wiens and Dyer 1975, Knopf 1994).

No mountain plover records within the 6-mile buffer of the project area were reported in the WOS (WGFD 2002c) or WYNDD (WYNDD 2002). While not providing ideal mountain plover habitat, some portions of the project area provide limited nesting opportunities for mountain plovers. Areas providing potential mountain plover habitat were mapped from the ground by HWA on April 29 and May 1, 2003. Several small habitat patches, covering a total of 245.6 acres were found in the north central portion of the CRPA (Figure 3-13). Surveys were then conducted to determine mountain plover presence or absence in these habitat patches. Survey protocol followed the USFWS guidelines (USDI-FWS 2002), which require that three surveys be conducted between May 1 and June 15, with each survey being separated by at least 14 days. The three surveys were conducted on May 1, May 30, and June 13, 2003; no mountain plovers were observed in any of the potential habitats located on the CRPA.

Sage Thrasher. The sage thrasher generally occurs within shrub-dominated valleys and plains of the western United States and is considered a sagebrush (*Artemesia* spp.) obligate. Insects are the primary food source and foraging occurs almost exclusively on the ground. For successful breeding, the Sage Thrasher requires large patches of sagebrush steppe habitat and typically nests in taller shrubs with wider crowns (Reynolds et al. 1999).

Suitable habitat exists in the area with 10 records of sage thrashers occurring within six miles of the project area (WGFD 2002c). It is likely that sage thrashers use the larger patches of taller sagebrush within the project area.

Loggerhead Shrike. The loggerhead shrike is a small avian predator that hunts from perches and impales its prey on thorns, barbed wire fences, and other sharp objects (Yosef 1996). It prefers open country within close proximity to brushy areas containing trees or shrubs taller than six feet for nesting (Dinsmore 1983). It breeds in basin-prairie shrublands, sagebrush grasslands, mountain-foothills shrublands, pine-juniper woodlands, and woodland chaparral. Nests are located 1-5 feet above the ground regardless of shrub height. The loggerhead shrike feeds primarily on grasshoppers and other large insects although some small mammals and birds are also taken. Areas of low vegetation or bare ground are preferred foraging habitat (Cerovski et al. 2001).

Two records of loggerhead shrikes are documented within six miles of the project area (WGFD 2002c) and it is likely that loggerhead shrikes utilize portions of the project area during the nesting season.

Brewer's Sparrow. Most Brewer's sparrows breed in the Great Basin area of the western United States and winter in the Sonoran and Chihuahuan deserts of southwestern United States and Mexico (Rotenberry et al. 1999). Breeding habitat is closely associated with landscapes dominated by Wyoming big sagebrush with an average nest - shrub height of 0.5 meters. Nests are located less than 1.2 meters high in live sagebrush or on the ground at the base of a live sagebrush shrub. The Brewer's sparrow is a common cowbird host and parasitized nests are sometimes deserted (Cerovski et al. 2001).

Eight records of Brewer's sparrows are documented within six miles of the project area (WGFD 2002c, WYNDD 2002). It is likely that Brewer's sparrows breed within the sagebrush habitats that exist on the project area.

Sage Sparrow. The sage sparrow prefers semi-open habitats with evenly spaced shrubs 1-2 meters high. Although closely associated with Wyoming big sagebrush, the sage sparrow will utilize sagebrush communities interspersed with other shrub species, such as bitterbrush (*Purshia tridentata*), saltbush (*Atriplex* spp.), shadscale (*Atriplex confertifolia*), rabbitbrush (*Chrysothamnus* spp.), or greasewood (Martin and Carlson 1998). Sage sparrows nest in shrubs up to one meter high and require a large block of unfragmented habitat to breed successfully (Cerovski et al. 2001).

No records of sage sparrows are documented within six miles of the project area (WGFD 2002c, WYNDD 2002). The project area is dominated by Wyoming big sagebrush and it is possible that sage sparrows occur on the project area.

Burrowing Owl. The burrowing owl is a summer resident on the plains over much of Wyoming and usually arrives on its breeding grounds from late March to mid-April (Johnsgard 1986, Haug et al. 1993). The species is associated with dry, open habitat that has short vegetation and contains an abundance of burrows (Thomsen 1971, Wedgwood 1978, Haug et al. 1993). In Wyoming, prairie dog burrows are the most important source of burrowing owl nest sites. Burrowing Owl use of abandoned prairie dog towns is minimal, and active prairie dog towns are their primary habitat (Butts 1973). Destruction of burrowing mammal habitat that the birds depend on, pesticides, predators, and vehicle collisions have all combined to cause a decline in

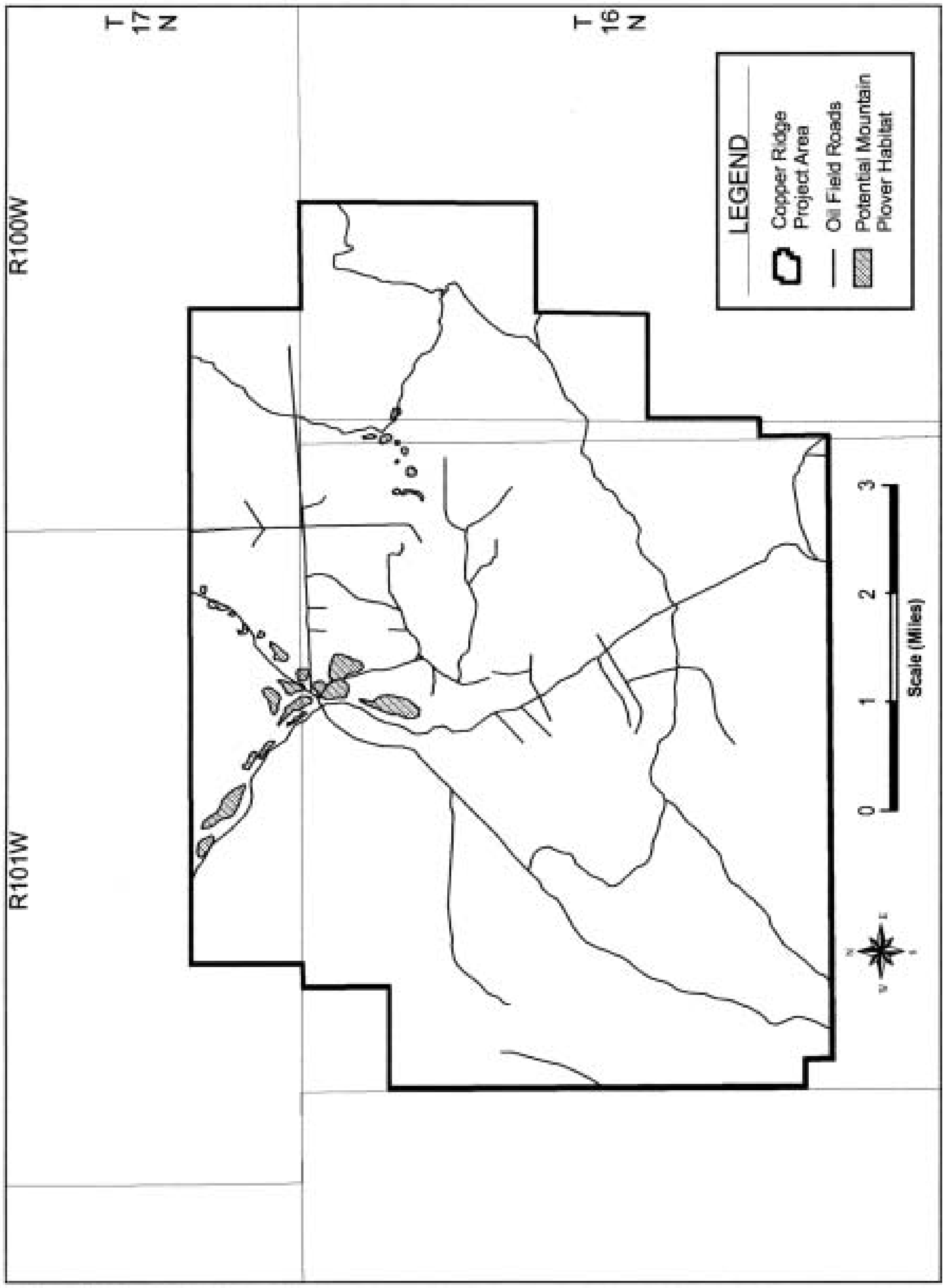


Figure 3-13. Areas Identified as Potential mountain plover Habitat on the CRPA.

burrowing owl numbers (Haug et al. 1993).

No burrowing owl sightings have been documented within six miles of the project area (WGFD 2002c, WYNDD 2002), however the presence of prairie dog colonies may provide adequate nesting habitat for burrowing owl use.

3.8.2.3 Reptiles

No records of midget-faded rattlesnakes are documented within six miles of the project area (WGFD 2002c, WYNDD 2002). Although included in BLM's sensitive species list (USDI-BLM 2002, Table 3-5), the likelihood that the midget-faded rattlesnake occurs on the CRPA is very low.

3.8.2.4 Amphibians

Four sensitive amphibian species may potentially be found on the CRPA (USDI-BLM 2002, Table 3-5). The boreal toad, northern leopard frog, and spotted frog are unlikely to occur on the CRPA; the Great Basin spadefoot toad has a slight potential to occur.

Great Basin Spadefoot Toad. In Wyoming, the Great Basin spadefoot occurs in sagebrush communities mostly west of the Continental Divide (Baxter and Stone 1980). They are dormant in fall and winter and their emergence in spring may be triggered by moisture in the burrow. Spadefoots may extend their dormancy period during drought for long periods of time. Breeding occurs during spring and early summer in permanent and temporary waters, including playas that develop after heavy rains and spring runoff pools. Males usually emerge from burrows after spring rains to breed, although Great Basin spadefoots do breed during periods of no rain. The stimulus for emergence for breeding in the absence of rain is unknown. Adult spadefoots are opportunistic carnivores and emerge from their burrows at night to forage for insects, arachnids, and snails only when the air is humid enough for dew to collect or during light rains (Howard 1996).

The Great Basin spadefoot has not been documented within six miles of the project area (WGFD 2002c, WYNDD 2002). Although limited habitat exists in the area it is possible that Great Basin spadefoots occur on the project area and utilize the intermittent and temporary water sources for breeding during years with adequate moisture.

3.8.2.5 Fish

Five sensitive fish species may potentially be found downstream of the CRPA. These include: leatherside chub, roundtail chub, bluehead sucker, flannelmouth sucker, and Colorado River cutthroat trout. These species are unlikely to occur on the CRPA due to a lack of suitable habitat. However, they do occur downstream of the CRPA and are therefore considered in this document.

3.8.2.6 Plants

Sixteen BLM Wyoming state sensitive plant species are found in the RSFO Area (USDI-BLM 2002). Table 3-10 provides a listing of these species, habitat needs, and their potential to occur within the project area. Of these species, three have the potential to occur in the project area: Cedar Rim thistle (*Cirsium radium*), Beaver Rim phlox (*Phlox pungens*), and tufted twinpod

(*Physaria condensata*).

Cedar Rim Thistle. This thistle can be found on barren, chalky hills, gravelly slopes, and fine-textured, sandy shaley draws between 6,700 and 7,200 ft.

Beaver Rim Phlox. Beaver Rim phlox prefers sparely vegetated slopes on sandstone, siltstone, or limestone substrates at elevations between 6,000 and 7,000 ft.

Tufted Twinpod. Tufted twinpod occurs in sparsely vegetated slopes and ridges between 6,500 and 7,000 ft.

3.8.3 Migratory Birds

The Copper Ridge Project area is mixed sagebrush steppe and pinon-juniper habitat. A wide variety of landscape features also add to the diversity of bird species found within the analysis area. Small rock outcrops associated with low escarpments provide suitable nesting habitat for rock wrens, while pinon jays, western bluebirds, tits and warblers can be found among the junipers.

Found within the sagebrush steppe habitat are sage thrasher, white-crowned sparrow, northern shrike and horned lark. Because the area consists of tall sagebrush communities, mid and low sagebrush, cushion plant communities, grassy meadows and greasewood bottoms, the avifauna is widely diverse. A few man-made perennial waters hold many of these species throughout the dry summer.

As the season changes to winter and temperatures fall, avian species inhabiting the area change. Flocks of snow bunting, horned larks, grey-crowned rosy finch and McCowen's longspur can be found foraging gravel along roadways. Northern harriers also winter here, foraging for cottontail and small rodents.

3.9 VISUAL RESOURCES

The CRPA is located in within the Wyoming Basin physiographic province. The topography of the area is highly variable, ranging from relatively flat areas to rolling hills, carved by numerous drainages. In the distance are desert mountains with steep sideslopes cliffs and canyons. Two prominent features to the southeast, Sand Butte and Pine Butte, can be seen in the distance from certain locations within the CRPA. Additionally, views of ridges, rims and draws are available from different locations within and near the project area. Cultural modifications in and near the CRPA include extensive oil and gas field development (roads, well pads, wellhead facilities and a processing plant), primarily in the north central and northeastern portions of the project area, although two-track roads and scattered drilling locations are can be seen elsewhere in the CRPA.

According to the GRRMP, the region which contains the CRPA has been designated as Visual Resource Management (VRM) Class IV, which allows for major modification of the character of the landscape, with appropriate mitigation measures to reduce visual impacts. However, the northeast portion of the CRPA lies within an area that has been designated as a VRM rehabilitation area, which means that the natural character of the landscape has been disturbed to a point where rehabilitation is needed to bring it up to one of the higher classifications (USDI-

BLM 1996). Visual resource rehabilitation is required because historic oil and gas development in the area has resulted in substantial disturbance, including a number of two-track short-cut roads. It is a BLM VRM objective to reclaim areas of unnecessary disturbance within the existing Brady and Jackknife Spring fields, effectively rehabilitating the area to VRM Class IV (Deakins 2003).

3.10 RECREATION

Recreation resources in and near the CRPA are limited to dispersed recreation activities, primarily hunting (antelope, deer, sage grouse and small game). There are no special recreation management areas, designated recreation use areas, scenic or historic trails or developed recreation facilities in or adjacent the CRPA. The CRPA and immediately adjacent areas are believed to receive limited recreational use, primarily because of the existing oil and gas development and associated operations and maintenance activities (Foster 2003). Sweetwater County and BLM roads within the CRPA provide access to less disturbed areas to the south and southwest of the project area and some recreationists may cross the CRPA on their way to and from these areas.

3.11 CULTURAL AND HISTORIC RESOURCES

Management Objectives

The objectives for the management of the cultural and paleontological resources are to:

- Expand the opportunities for scientific study, and educational and interpretive uses of cultural and paleontological resources;
- protect and preserve important cultural and paleontological resources and/or their historic record for future generations; and
- resolve conflicts between cultural/paleontological resources and other resource uses.

Of particular concern are significant sites of historic or prehistoric human habitation, sites demonstrating unique ethnic affiliation, places having traditional cultural significance to Native Americans, and vertebrate fossil localities (USDI 1997).

3.11.1 Cultural Chronology of Area

Archaeological investigations in the Green River Basin indicate the area has been inhabited by prehistoric people for at least 10,000 years from Paleoindian occupation to the present. The accepted cultural chronology is based on a model for the Wyoming Basin by Metcalf (1987) and revised by Thompson and Pastor (1995). The Wyoming Basin prehistoric chronology is documented in Table 3-11. Not all of the sites discussed below are located in the project area.

Table 3-11. Prehistoric chronology of the Wyoming Basin.

Period	Phase	Age (YBP)
Paleoindian		12,000 - 8500
Early Archaic	Great Divide	8500 - 6500
	Opal	6500 - 4300
Late Archaic	Pine Spring	4300 - 2800
	Deadman Wash	2800-2000/1800
Late Prehistoric	Uinta	2000/1800 - 650
	Firehole	650 - 300/250
Protohistoric		300/250 - 150

from Metcalf (1987), as modified by Thompson and Pastor (1995)
YBP is years before present

Paleoindian Period

The oldest period for which there is solid archaeological evidence is the Paleoindian, beginning ca. twelve thousand years before present (YBP) and ending around 8500 YBP. This is the transition period from the periglacial conditions of the Wisconsin ice advance during the terminal Pleistocene to the warmer and drier climatic conditions of the Holocene. A savanna-like environment with higher precipitation than occurs today was prevalent in southwest Wyoming. Archaeological research has focused on understanding paleoenvironmental conditions operating at the end of the Pleistocene and into the Holocene to provide insights into the articulation between human populations and the environment (Thompson and Pastor 1995). Paleoindian sites are rare in southwest Wyoming. However, isolated surface finds of Paleoindian projectile points are not uncommon and suggest that site preservation or visibility may be factors affecting the number of known sites. The Paleoindian tool assemblage includes lanceolate points, gravers, and end-scrapers.

Archaic Period

Settlement and subsistence practices, in southwest Wyoming, remained largely unchanged from the end of the Paleoindian period through the Archaic and continued until at least the introduction of the horse, or even until Historic Contact. Reduced precipitation and warmer temperatures occurred ca. 8500 YBP. The environmental change at the end of the Paleoindian period led to a pattern of broad-spectrum resource exploitation, which is reflected in the more diverse subsistence and settlement practices of the Archaic period.

The Archaic period is divided into the Early and the Late periods and subdivided in the Great Divide and Opal and the Pine Spring and Deadman Wash phases, respectively. Large side- and corner-notched dart points used for hunting are temporally diagnostic artifacts of the Archaic period. The earliest dated occurrence of side-notched points are Component I at the Maxon Ranch site, located west of the project area, dating between 6400 - 6000 YBP (Harrell and McKern 1986). Large side-notched points from the Great Basin and Colorado Plateau occur as early as 7000 years YBP. The presence of ground stone implements suggests a greater use of plant resources during the Archaic period. Faunal assemblages from Archaic period components document increased use of small animals (Thompson and Pastor 1995).

Slab-lined features and housepits are also prevalent during this period.

Examples of two sites located in the area surrounding the Copper Ridge project area that contain Archaic components include Sites 48SW97 and 48SW5175. Site 48SW97 is a multi-component campsite located northwest of the study area. Component II dated to 2600"110 B. P. and contained evidence of processing and preparation of one or more medium to large-sized animal and limited tool manufacture and tool maintenance (McNees et al.1992). Site 48SW5175 is a multi-component Archaic site dating between 5220 and 3770 B. P. located west/northwest of the project area. The site represents residential occupation evidenced by housepits in Components I and II with tool manufacture and maintenance centered at the hearths. Slab-lined features were documented in Component III (Newberry and Harrison 1986).

Late Prehistoric Period

The Late Prehistoric period is between 2000 - 250 YBP and is subdivided into the Uinta and the Firehole phases. Large-scale seed processing and an increase in the number of features is noted in the Late Prehistoric period, as is the presence of pottery and the introduction of the bow and arrow technology. A characteristic of the Uinta phase is clusters of semi-subterranean structures dating to ca. 1500 YBP.

Two sites in the region represent Uinta phase occupation. Component III at Site 48SW97 (McNees et al. 1992) returned a radiocarbon date of 1460"70 B. P. and is a single occupation exhibiting projectile point manufacture, tool maintenance, and a domestic activity/work area. Seed processing, meat processing, and bone processing of medium and large mammal bone was also noted. Hearth styles included a deep, steep-sided oxidized basin hearth, a shallow basin hearth, and a deep basin hearth. Site 48SW270 (McNees et al. 1992) is located in stabilized sand dunes. The Uinta phase site contained a tri-hearth complex, Rose Spring points, an oxidized cylindrical basin, bone tube manufacture, and seed processing. Two separate but distinct occupations with reuse of features and activity areas were identified.

Two sites located west of the study area date to the transition period between the Uinta phase and the Firehole phase of the Late Prehistoric period. Component IV at Site 48SW97 dates from 940 to 670 B. P. The single component contains multiple occupations. Artifacts include tri-notched projectile pints, side-notched points, fingernail-incised ceramics, and procurement of large mammals at the site. A sandstone cobble incised with an apparent anthropomorphic figure and a fragment of a ceramic tube were also recovered from the component (McNees et al. 1992). Another transition period site is Site 48SW5377 dating to 980"90 B. P. The site is a late summer to early fall, short-term camp located in a dune. Results of the analysis of the floral and faunal remains indicate that floral processing was the more important. Rose Spring points and a clay animal figurine possibly a mountain sheep or pronghorn with holes incised into its body was collected (Harrison 1986).

The Firehole phase is distinguished from the preceding Uinta phase by a dramatic decline in radiocarbon dates possibly related to a decline in population density. Site 48SW5176 (Hoefer et al. 1992) is a Brush shelter site, 15-30 loci with one burned structure, Cottonwood and Desert Side-notched points, large mammal bone fragments, Intermountain Ware ceramics, shell beads, and obsidian debitage (11% of total site) and tools sourced to Malad, ID.

Protohistoric Period

The Protohistoric period begins sometime after 300 years YBP with the first European trade goods to reach the area, and ends with the development of the Rocky Mountain fur trade 150 years ago. The Wyoming Basin was the heart of Shoshone territory during this period, with occasional forays into the area by other groups such as the Crow and Ute (Smith 1974). The most profound influence on native cultures during this time was the introduction of the horse enabling Native Americans to expand their range. All forms of rock art denoting horses, metal implements, and other Euro-American goods are associated with the Protohistoric period. Metal projectile points have been recovered from both surface and subsurface contexts in southwest Wyoming. The Upper Powder Springs Hunting Complex is a multi-component site located south of the project area (Murcray et al. 1993). Protohistoric artifacts recovered from the complex include tinklers and trade beads.

Historic Period

Historic use of the study area is associated with limited ranching/grazing activities. Filing for water rights occurred as early as 1906 on Black Buttes Creek north of the study area. Filing for water rights for mineral development, west of the study area, occurred as early as 1924. No buildings or corrals associated with ranching/shepherding activities are depicted on the 1884, 1908, 1912, or 1913 GLO maps of the study area. Local ranch roads, including the Road to Black Buttes and Rife's Bitter Creek Road, are shown on the 1908, 1912, and 1913 GLO maps. These are local roads connecting the ranching community located to the south of the project area with the Union Pacific Railroad, located to the north. Historic emigration routes across Wyoming, such as the Overland Trail and the Cherokee Trail skirt the project area to the north and to the south but are outside of the project area. Table 3-12 summarizes the historic chronology of the area.

3.11.2 Summary of Known Cultural Resources

The Cultural Records Office in Laramie provided information on the previous work conducted in the Copper Ridge analysis area and documented cultural resources. Records at Western Archaeological Services (WAS) were consulted for previous work in the project area. Consultation with the Archaeological Specialist of the Rock Springs Field Office of the BLM was conducted. There have been 134 projects conducted in the study area resulting in the recordation of 70 sites. Of these projects, there were 79 Class III block and linear surveys including seismograph or geophysical surveys, well surveys, road surveys, pipeline surveys, and compressor station surveys, 1 monitor, 1 test excavation project, 1 historic overview, and 52 Class II sampling surveys. Limited amounts of field work have resulted in the documentation of cultural resources through survey, testing, examination of ethnographic records, and historic record research. No excavations have been conducted in the Copper Ridge Environmental Assessment (EA) study area. No radiocarbon analysis has been conducted on cultural resources in the project area.

The CRPA encompasses approximately 38.9891 square miles or 24,953.01 acres. Federal surface acreage is 11,564.91 acres, 1280 acres of State of Wyoming land, and 12,108.12 acres are private land. Mineral ownership is 46% federal, 5% State of Wyoming, and private owners retain 49% ownership. Approximately 3619 acres (block) or ca. 14.5% of the project area have been inventoried for cultural resources. The site density calculated using the total project area and recorded sites in the project area is one site per 356 acres.

The overall site density within the study area varies with the highest number of sites located along drainages and near the major topographic land forms. Site density along the ridges in the

Table 3-12. Historic Chronology.

Phase	Age A.D.
Protohistoric	1720 - 1800
Early Historic	1800 - 1842
Pre-Territorial	1842 - 1868
Territorial	1868 - 1890
Expansion	1890 - 1920
Depression	1920 - 1939
Modern	1939 - Present

from Massey 1989

juniper trees is high. Many sites are located along Black Buttes Creek and Sand Wash and their ephemeral drainages. Some sites are situated around the natural springs in the study area and some sites are located on prominent points overlooking the drainages. The site density away from these areas is relatively low.

Site types

Seventy sites have been recorded in the project area including 60 prehistoric sites (51 prehistoric camps (1 with ceramics and 1 with milling and plant processing activities), 9 lithic scatters (1 secondary lithic procurement and 1 destroyed site), 7 historic sites (2 local roads, 3 sheep herding/ranching, and 2 debris scatters), and 3 prehistoric/historic sites. Of the total site types, 86% are prehistoric sites, 10% are historic sites, and 4% contain both prehistoric and historic components. Of the recorded cultural resources, 31.5% (n=22) are recommended eligible for nomination to the NRHP, 31.5% (n=22) are recommended not eligible for nomination to the NRHP, 36% (n=25) remain unevaluated to the National Register, and 1% (n=1) has been destroyed.

Prehistoric sites

Prehistoric camps consist of sites that contain evidence of a broad range of activities including subsistence-related activities. They may contain formal features, lithic debris, chipped stone tools, evidence of milling/vegetable processing activities including ground stone, and pottery. Single as well as multiple occupations are represented.

Lithic debris scatters consist of sites containing lithic debitage or stone tools. The sites are described as representing short-term activities. Counted in the lithic scatters is one site documented as a secondary lithic procurement site.

Quarries are sites where lithic raw material was obtained and initially processed. Primary and secondary lithic procurement areas are geologic locations where chert and quartzite cobbles have been redeposited. No quarry sites have yet to be documented in the study area.

Lithic landscapes are secondary lithic procurement deposits recommended not eligible for inclusion on the National Register. The artifacts from the sites cannot be associated with a specific cultural group or tradition nor can they be temporally associated. No lithic landscapes have been documented in the study area.

Human burials, rock alignments, stone circles, cairns, and rock art have been identified as sensitive or sacred to Native Americans. Although human burials or rock art have not been documented in the project area, it is important to be cognizant of the possibility of such resources in the project area. Several such sites have been documented in the areas surrounding the study area. No prehistoric cairns/caches are reported in the project area.

Pottery/ceramics are relatively rare and only one site containing pottery has been identified in the study area. Pottery is usually associated with the Uinta phase of the Late Prehistoric period. Many times only a few fragmentary shards are found on a site's surface.

Consultation with appropriate Native American tribes pertaining to areas of concern for traditional, cultural, and religious purposes will occur in accordance with the American Indian Religious Freedom Act and BLM Manual 8160-1 Handbook. Native American consultation will occur within the context of specific development proposals, but will also be an ongoing process between BLM and affected Indian tribes and traditional cultural leaders (USDI 1997).

Historic sites

The Road to Black Buttes is an expansion era road, which connected the rural population of Vermillion Creek/Coyote Creek area of southern Sweetwater County with the Union Pacific Railroad. Transportation of freight and trailing stock to the railroad were primary functions along the wagon road. The portion of the Road to Black Buttes contained within the study area is upgraded Sweetwater County Road 4-24/4-26. A historic overview of the Road to Black Buttes, Site 48SW12421, determined the road to be not eligible for inclusion on the National Register (Johnson 2001).

Rife's Road to Bitter Creek is an expansion era road located in the south and east portions of the study area recommended not eligible for inclusion on the National Register. Historically, the road was used to connect the Rife Ranch, the Guy Rife Ranch, and other ranches of southwest Wyoming with headquarters at Bitter Creek. The area in Sweetwater County was used as winter range for sheep ranchers. Supplies were taken to the camps and animals were trailed north to the railroad at the town of Bitter Creek. Portions of the road were improved in the early 1900s by Sweetwater County and later more of the road was improved by the companies for mineral development. However, much of the road remains a two-track (Ficenec 1998).

Ranching and stock herding activities are represented by herding camps (n=3) in the study area. Filing for water rights occurred as early as 1906 on Black Buttes Creek north of the study area. Filing for water rights for mineral development, west of the study area, occurred as early as 1924. Local ranch roads present on the GLO maps include the Rife's Road to Bitter Creek and the Road to Black Butte.

Summary

Prehistoric subsistence and settlement patterns of the region reflect a hunter-gatherer lifeway. Research into the subsistence and settlement patterns used during the Archaic period indicates summer occupations in the mountains, winter occupations in the foothills, and spring and fall movements utilizing all available zones (Creasman and Thompson, 1997). Subsistence patterns in the Archaic period and the Late Prehistoric period are similar in that they are based on seasonal movement throughout the basins and foothills in response to the availability of floral and faunal resources (Creasman and Thompson 1988). A wide diet breadth is evident in extensive procurement and processing of small mammals. By 450 YBP (Shimkin 1986), or possibly earlier (Bettinger and Baumhoff 1982), Numic-speaking Shoshonean groups occupied the Wyoming Basin and continued to reside there until Euro-American expansion relegated them to reservations beginning in 1868.

Important cultural resources are found along the major ephemeral drainages and ridge tops in the juniper trees. Sensitive areas include Black Buttes Creek and Sand Wash drainages. Certain topographic settings have higher archaeological sensitivity such as eolian deposits (sand dunes, sand shadows, and sand sheets), alluvial deposits along major drainages, and colluvial deposits along lower slopes of ridges.

Historic use of the project area was restricted by terrain and limited to grazing activities. Historic use of the area to the north and the south of the Copper Ridge EA study area includes westward migration routes including the Overland Trail, the Pine Butte Variant of the Overland Trail, and the north and south branches of the Cherokee Trail. No documented trails are located within the Copper Ridge study area.

3.12 SOCIOECONOMICS

3.12.1 Introduction

Area socioeconomic conditions potentially affected by the Proposed and No Action alternatives include the local economy (primarily employment and earnings in the oil and gas industry and other sectors of the economy), population, housing, emergency response services, and local, state and federal tax revenues.

The area of analysis for potential socioeconomic impacts is Sweetwater County, Wyoming.

3.12.2 Economic Conditions

An area’s economic base is comprised of activities, which bring money into the local economy from other areas of the state, nation and world. Sweetwater County has a diversified natural resource-based economy. Basic sectors include oil and gas production and processing, coal mining, electric power generation, trona mining and the manufacturing of soda ash and related products, fertilizer manufacturing, agriculture, and transportation (primarily the Union Pacific railroad). Also, the portions of the retail and service sectors which serve visitors (travel, tourism and recreation) can be considered basic (PIC 1996).

3.12.2.1 Employment, Unemployment and Labor Force

Sweetwater County total full and part-time employment grew from the 1990 level of 22,856 jobs to a 2000 level of 24,436, growing by about seven percent or 1,580 jobs. There was some volatility during the period, however. In 1994, total employment peaked at 25,177jobs (WDAI 2002a). These employment statistics, compiled by the US Bureau of Economic Analysis, represent full and part-time jobs located in the county. Some Sweetwater County jobs are filled by persons living outside the county.

Local area labor force, employment and unemployment statistics are compiled by the Wyoming Department of Employment and represent county residents who are employed or unemployed. According to these statistics, Sweetwater County resident employment was about one percent higher in 2001 (19,447) than in 1990 (19,231). As with the number of jobs discussed above, resident employment was somewhat higher during the 1994-1995 period. The local labor force (employed residents plus residents looking for work) began and ended the period at about the same level (20,348 and 20,388, respectively). Resident employment increased slightly and the local labor force was virtually flat over the last decade, but the unemployment rate decreased from 5.5 percent in 1990 to 4.6 percent in 2001 (WDE 2003). This decrease in the unemployment rate reflects a smaller number of county residents registered as unemployed in the Department of Employment system. In all likelihood, a portion of unemployed residents left Sweetwater County to seek work elsewhere during this period.

Recently, employment conditions in Sweetwater County have been changing. Oil and gas service firms are adding employees, both from the local labor pool and from outside of the county. At the same time, the trona/soda ash industry is undergoing a reduction in workforce (Robbins 2003).

3.12.2.2 Earnings

Sweetwater County earnings by place of work increased from $633 million in 1990 to $881 million in 2002, a 39 percent increase over the decade (WDAI 2002b). This increase compares to a 56 percent increase in earnings for the State of Wyoming during this period. However, when adjusted for inflation, Sweetwater County earnings increased by about 6 percent during this period.

3.12.2.3 Recent Oil and Gas Activity

Production and approved applications for well drilling permits (APDs) are two measures of oil and gas activity. As shown in Figure 3-14, annual natural gas production in Sweetwater County decreased from 238 million MCF in 1995 to 225 million MCF in 2001. Sweetwater County production accounted for about 14 percent of all natural gas produced in Wyoming during 2001 (WOGCC 1995-2001). Approved APDs reflect both current and potential future oil and gas activity. Increased drilling may result in increased production if drilling efforts are successful and commodity prices increase or stabilize at economic levels. Sweetwater County approved APDs have increased dramatically in recent years (see Figure 3-15 below), 534 APDs were approved in the county during 2001.

In 1995, there were a total of 1,544 producing wells (oil and gas) in Sweetwater County. By 2001, that number had increased to 2,377 a 54 percent increase over the 6 year period (see Figure 3-16). The relatively high levels of natural gas exploration, drilling and production that have occurred in Sweetwater County in recent years have sustained an active natural gas service industry (Robbins 2003). Additionally, natural gas development in the county is served by contractors operating out of Casper, Rawlins, Kemmerer, Evanston and Craig.

3.12.2.4 Other Economic Activities near the Project Area

In addition to oil and gas exploration and production, other economic activities occurring in and near the CRPA include grazing and low-intensity dispersed recreation, (Deakins 2003).

3.12.3 Population Conditions

Population levels in Sweetwater County have been volatile over the past 20 years. Sweetwater County population in 2000 was almost 10 percent lower than its 1980 level of 41,723 (see Figure 3-17). It is estimated that Sweetwater County population continued to fall in 2001, losing an additional 2 percent of population (WDAI 2002c).

Rock Springs, the largest community in the county, lost almost 2 percent of total population between 1990 and 2000, despite showing a 3 percent increase in 1995 (see Table 3-13). Similarly, Green River, the county's second largest city and county seat lost 7 percent of its population between 1990 and 2000, despite a slight increase in the early years of the decade.

Table 3-13. Population Estimates 1990 - 2000: Sweetwater County, Rock Springs and Green River

	1990	1995	2000
Sweetwater County	38,823	40,635	37,613
Rock Springs	19,050	19,687	18,708
Green River	12,711	12,778	11,808

Source: WDAI 2002

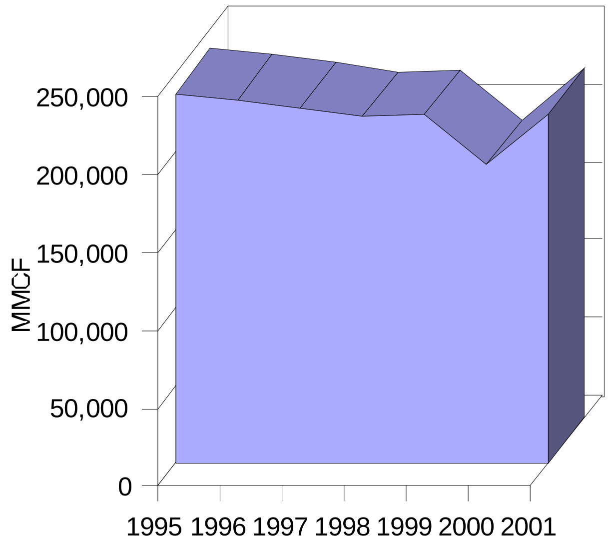
The most recent population forecasts available from the Wyoming Division of Economic analysis projects that population levels in Sweetwater County will decrease 6 percent by 2010, to 35,399 (WDAI 2002d).

3.12.4 Housing

The nature of natural gas drilling and field development activities (relatively short duration tasks performed primarily by contractors) results in demand for temporary housing resources such as motel rooms and mobile home and recreational vehicle (RV) spaces near the project area. However, as Sweetwater County oil and gas service firms respond to increased natural gas development in the county, it is likely that drilling and field development employees hired from outside the county will seek longer-term housing accommodation. Oil and gas production employees are typically interested in longer-term housing resources.

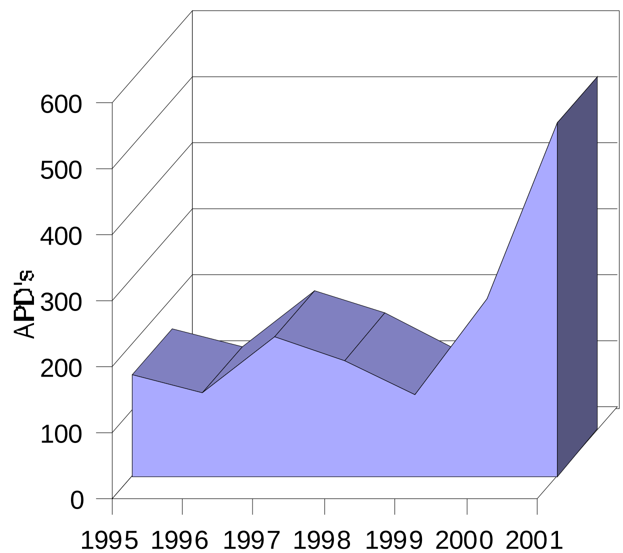
There are a substantial number of temporary housing resources (motels and RV parks) available in Rock Springs including 15 motels with over 1,100 rooms and 30 mobile home parks

Figure 3-14. Natural Gas Production for Sweetwater County 1995 - 2001



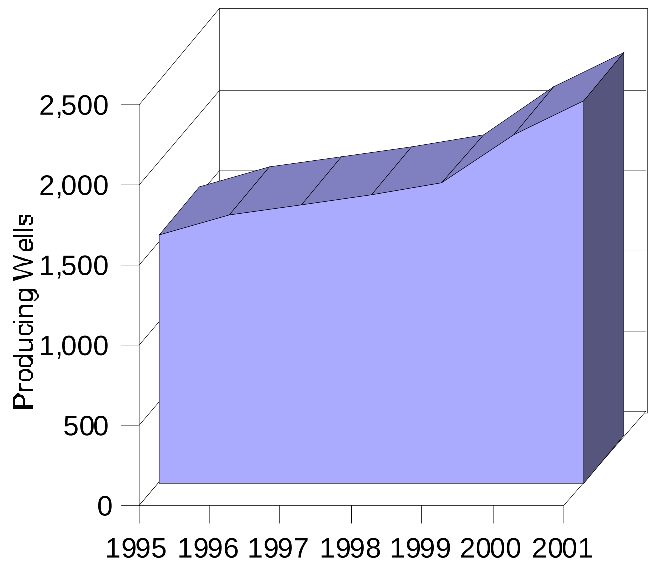
Source: WOGCC 1995-2001

Figure 3-15. Approved Sweetwater County Applications for Permits to Drill (APDs): 1995- 2001.



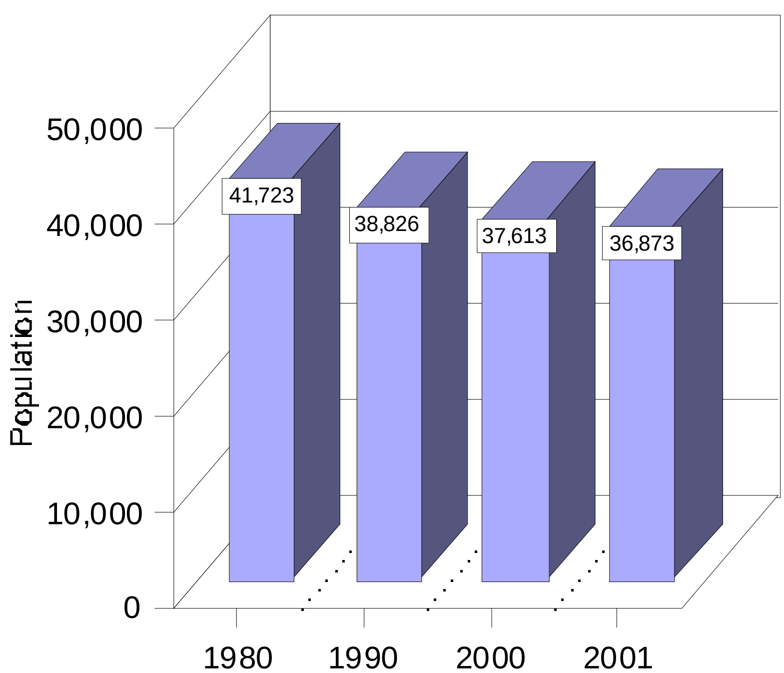
Source: WOGCC 1995-2001

Figure 3-16. Producing Oil and Gas Wells in Sweetwater County 1995 - 2001



Source: WOGCC

Figure 3-17. Sweetwater County Population: 1980, 1990, 2000 and 2001.



Source: WDAI 2002c

with over 1,900 pads (PIC 1997). Recently, the number of houses for sale has decreased as a result of lower interest rates, and housing and apartments are filling up as a result of the increased natural gas development activity in the county (Robbins 2003).

3.12.5 Community Facilities, Law Enforcement and Emergency Management Services

Because population in Sweetwater County, Rock Springs and Green River is substantially below historic high levels of the 1980's, county and municipal infrastructure has, in general, capacity to serve a larger population than currently exists. In fact, Sweetwater School Districts #1 (Rock Springs) and #2 (Green River) have closed several elementary schools because of declining enrollment, which is partly a function of declining population and partly a function of an aging population. One facility that is currently inadequate is the county jail, and the county is in the process of replacing that facility (Robbins 2003).

Law enforcement in the area surrounding the CRPA is provided by the Sweetwater County Sheriff's Department. No routine patrols are provided in the area, rather deputies respond on an as needed basis (Scofield 2003).

Emergency management in Sweetwater County is coordinated by the Sweetwater County Emergency Management Agency (SCEMA), which operates under Federal Emergency Management Agency (FEMA) and Environmental Protection Agency (EPA) guidelines. SCEMA is the agency designated by the Sweetwater County Commissioners to analyze potential hazards, assess emergency response capabilities, plan for and respond to potential events and mitigate the effects of emergencies or disasters. SCEMA coordinates with response agencies, industry, elected officials and volunteer agencies to accomplish its mission of limiting injuries, loss of life and damage to property.

The portion of Sweetwater County that includes the CRPA is served by emergency response organizations (fire suppression, emergency medical and ambulance) located in Rock Springs. Routine injuries are treated at Memorial Hospital of Sweetwater County. Cases requiring specialized treatment are transported to Salt Lake City by air ambulance services dispatched from Salt Lake City or Craig or Grand Junction in Colorado (Valentine 2003).

3.12.6 Local, State and Federal Government Fiscal Conditions

Fiscal conditions most likely to be affected by the Proposed Action and alternatives include the following:

- county, school and special district ad valorem property tax revenues,
- state, county and municipal sales and use tax revenues,
- state severance tax revenues,
- federal mineral royalties.

3.12.6.1 Ad Valorem Property Tax Revenues

Oil and gas companies pay ad valorem property taxes on production and facilities, with certain exemptions. In Sweetwater County, fiscal year (FY) 2002 assessed valuation was over $1.4

billion, 0.2 percent less than the previous year. 2002 property tax revenues were $93.2 million, about 0.7 percent lower than 2001. Natural gas is assessed on the previous year's production. FY 2002 assessed valuation from 2001 natural gas production totaled $577.6 million or about 41 percent of total assessed valuation (WTPA 2002). Current mill levies within the unincorporated portion of Sweetwater County which contains the CRPA total 70.235 mills, including 49.2 mills for schools, a 12 mill county levy, .266 for weed and pest control, a 5 mill community college levy, 2.195 mills for county fire protection and 1.574 mills for Solid Waste District #1.

3.12.6.2 Sales and Use Tax

Wyoming has a statewide four percent sales and use tax. Sweetwater County collects an additional one percent general-purpose local-option sales and use tax and a 0.5 percent specific purpose local-option tax, dedicated to construction of a new county jail. FY 2002 sales and use tax collections in Sweetwater County totaled about $59.56 million.

About 28 percent (less administrative costs) of the statewide four percent sales and use tax collections and all of the general purpose local option collections (also less administrative costs) are distributed to the county and its incorporated municipalities according to a population-based formula.

3.12.6.3 Wyoming Severance Taxes

The State of Wyoming collects a six percent severance tax on oil and natural gas. Severance tax revenues are distributed to the Wyoming Mineral Trust Fund, General Fund, Water Development Fund, Highway Fund, Budget Reserve Account, and to counties and incorporated cities and towns. In FY 2002, severance tax distributions totaled $299 million (CREG 2002a). Of the total, about 43 percent was attributable to severance taxes on natural gas.

3.12.6.4 Federal Mineral Royalties

The federal government collects a 12.5 percent royalty on oil and natural gas extracted from federal lands. Fifty percent of those royalties are returned to the state where the production occurred. In Wyoming, the state's share is distributed to a variety of accounts, including the University, the School Foundation fund, the Highway fund, the Legislative Royalty Impact Account, and cities, towns and counties. In FY 2002, a total of $348.6 million in federal mineral royalty funds were distributed to Wyoming entities (CREG 2002b).

3.12.7 Environmental Justice

Executive Order (EO) 12898, "Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations" was published in the *Federal Register* (59 FR 7629) on February 11, 1994. EO 12898 requires federal agencies to identify and address disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations (defined as those living below the poverty level). There are no persons living within or immediately adjacent to the

CRPA.

3.13 TRANSPORTATION

The regional transportation system serving the CRPA includes an established system of interstate and state highways and county roads. Local traffic on federal land is also served by improved and unimproved BLM and oil and gas field roads.

3.13.1 Access to the Project Site

Access to the project site is provided by I-80, Wyoming State Highway 430 (WYO 430), and Sweetwater County roads 4-26 (Brady Field Road), 4-24 (Patrick Draw Road) and 4-19 (Bitter Creek Road) as shown on Figure 3-18. Table 3-14 displays traffic data, where available, for the highway access routes to the project area.

Federal and State Highways - Current traffic volumes on Wyoming federal and state highways are listed in Table 3-14. The Wyoming Department of Transportation (WYDOT) assigns levels of service to highways in the state system. Levels of service (A through F) are assigned based on qualitative measures (speed, travel time, freedom to maneuver, traffic interruptions, comfort and convenience) that characterize operational conditions within traffic streams and the perceptions of those conditions by motorists. A represents the best travel conditions and F represents the worst. The federal and state highways proving access to the CRPA are currently rated A, and traffic on these highways could increase substantially before level of service standards would be exceeded.

WYO 430 is a two lane-paved highway with narrow shoulders and steep side slopes. Although the highway is in relatively good condition, it is an older highway and the design is not up to current standards. For example, some bridges are narrower than current standards.

There is also concern that the approach to WYO 430 from SCR 4-26 may not be large enough to handle tractor-trailer combinations. This results in safety concerns as trucks must use two-lanes for turning when entering the highway. Additionally, because the approach from SCR 4-26 to WYO 430 is gravel, vehicles can deposit mud and gravel on the highway, resulting in maintenance problems and safety hazards (Montuoro 2003).

Sweetwater County Roads - The Sweetwater County Road and Bridge Department is responsible for maintaining over 1,400 mile of county roads. The three Sweetwater County roads that provide access to the CRPA (SCR 4-26, SCR 4-24 and SCR 4-19) are two-lane roads constructed of native material and graveled when the Road and Bridge Department can budget for and obtain gravel. SCR 4-26 (Brady Field Road) travels about 12 miles east-northeast and then southeastward from its intersection with WYO 430 to its intersection with SCR 4-26 within the CRPA. SCR 4-24 (Patrick Draw Road) travels about 20 miles southward from its intersection with I-80 to its intersection with SCR 4-26 within the CRPA. It proceeds

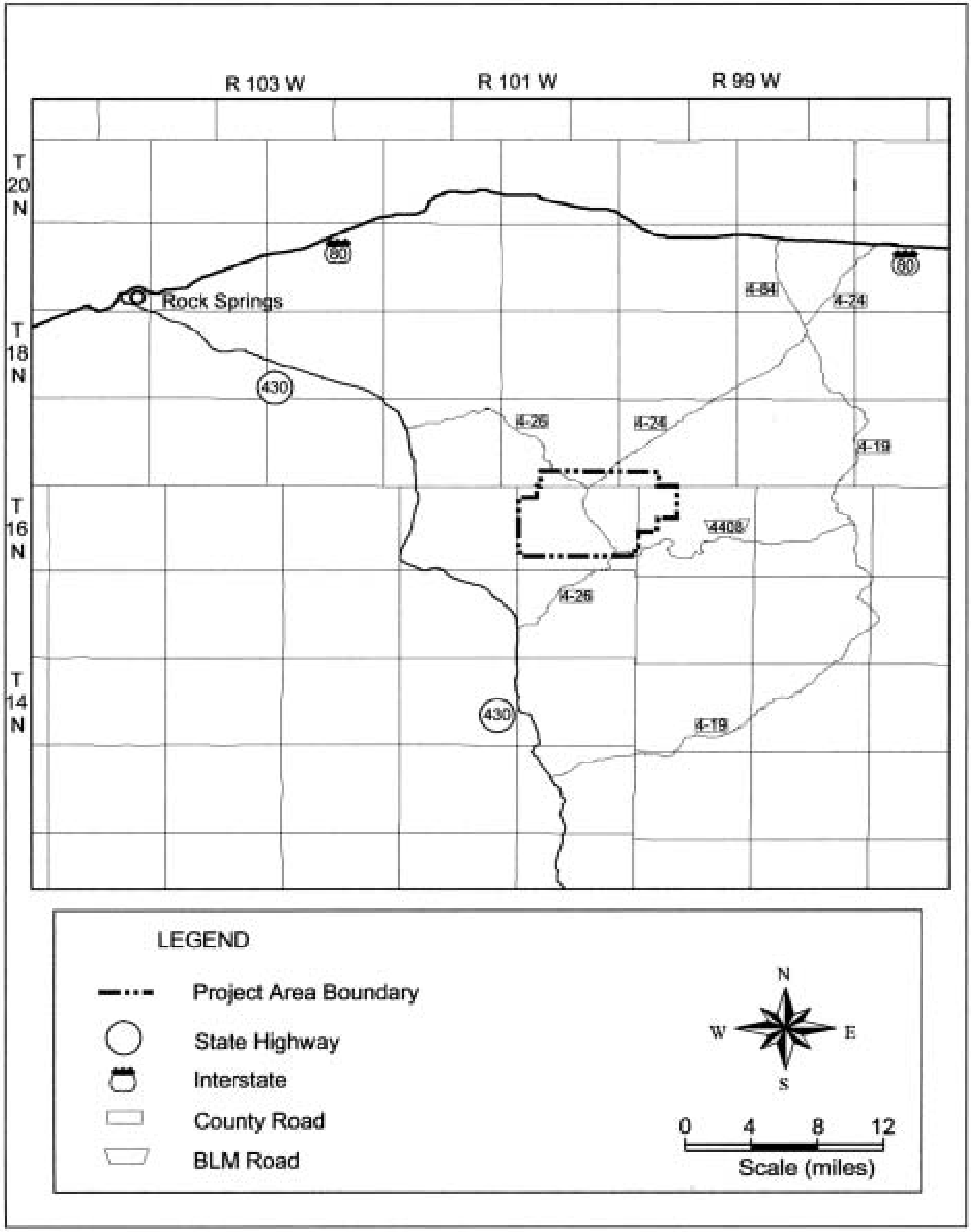


Figure 3-18. Copper Ridge Project Area Access

Table 3-14. Highway Access to the Project Site.

Route	2001 AADT	2000 AADT	Level of Service
I-80 @ Patrick Draw Intersection	11,500 (5,870 trucks)	10,900 (6,400 trucks)	A
I-80 @ Bitter Creek Intersection	11,510 (5,870 trucks)	10,900 (6,300 trucks)	A
WYO 430 @ SCR 26 Intersection	170 (40 trucks)	250 (40 trucks)	A

Source: WYDOT 2001

south for another 5 miles before exiting the CRPA. Approximately 5 miles after exiting the CRPA, SCR 4-24 intersects with WYO 430. SCR 4-19 (Bitter Creek Road) travels about 6 miles south to its intersection with SCR 4-24 and proceeds southward. Travelers approaching from the west would likely exit I-80 onto SCR 19 as a shortcut to SCR 4-24.

These roads serve primarily oil and gas field traffic, and also provide access for grazing operators and recreation users. Some oil and gas operators in the area occasionally contribute gravel and water to the Road and Bridge Department for application on these roads. Maintenance of these roads is a high priority for the county; consequently, two motor graders are stationed in the area. Although the county would prefer to gravel these roads annually, budget limitations and the lack of a gravel source within the area limit the amount of gravel that is applied.

Speeding is a problem in and near the CRPA. In addition to the obvious safety hazards, speeding vehicles accelerate maintenance requirements and remove gravel from the roadbed (Gibbons 2003). Dust is also a problem on these roads.

3.13.2 Access within the Project Area

Existing access within the proposed CRPA is provided by SCR 4-24 and SCR 4-26 (discussed above) and an existing road network developed to service prior and ongoing drilling and production activities in the Brady and Jackknife Spring fields, and ongoing livestock grazing activities in the Rock Springs Grazing Allotment. Additionally, about one mile of BLM road 4408 is located in the southwest corner of the CRPA. BLM Road 4408 provides access eastward from SCR 24 to Pine Butte Basin (Figure 3-15).

3.14 HEALTH AND SAFETY

Existing health and safety concerns in and adjacent to the CRPA include hazards associated with existing oil and gas exploration and operations. Occupational hazards associated with oil and gas operations generally affect workers in the fields and at oil and gas facilities. Two types of workers are employed in oil and gas fields: oil and gas workers, who had a1998 annual accident rate of 4.0 per 100 workers, and special trade contractors, who had a non-fatal accident rate of 8.9 per 100 workers (U.S. Department of Labor, Bureau of Labor Statistics 2000). These rates compare with an overall private industry average for all occupations of 6.2 per 100 workers.

There are also existing risks associated with natural gas pipelines, although these risks are statistically very small. Nationwide, injuries associated with gas transmission pipelines averaged 14 per year from 1990 through 1996, fatalities averaged one per year and incidents such as ruptures averaged 79 per year (U.S. Department of Transportation 1998). Finally, there are risks associated with hazardous materials used or stored at oil and gas facilities. The US BLM, OSHA, USDOT and Wyoming OGCC and OHSA each regulate certain safety aspects of oil and gas operations.

Currently within the CRPA there are risks associated with vehicular travel on improved and unimproved county, BLM and oil and gas field roads; with firearms accidents during hunting season and by casual firearms use such as plinking and target shooting; and with natural events such as flash floods, landslides, earthquakes and range fires, which can also result from human activities.

3.15 NOISE

On-going drilling and production operations and related traffic create most sound disturbances within and in the immediate vicinity of the CRPA. Aircraft overflights (generally at high altitudes) and localized vehicular traffic on county, BLM and two-track roads in the project area also create short-term, localized sound disturbances.